CRM

CENTRE DE RECERCA MATEMÀTICA

Memòria d'Activitats
Report of Activities

2017

CENTRE DE RECERCA MATEMÀTICA

Centres de recerca de Catalunya

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MEMÒRIA D'ACTIVITATS 2017

REPORT OF ACTIVITIES 2017

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Presentació

El Centre de Recerca Matemàtica (CRM) es va crear el 1984 com a part de l'Institut d'Estudis Catalans (IEC), amb la condició d'institut de recerca associat de la Universitat Autònoma de Barcelona. El 2002, CRM es va independitzar i es va convertir en un consorci participat per l'Institut d'Estudis Catalans i la Generalitat a través del Departament d'Economia i Coneixement. El CRM és un dels centres de la xarxa CERCA del Govern català.

La missió del CRM és "desenvolupar la recerca matemàtica a Catalunya, establint sinergies entre els grups de recerca de les universitats catalanes" amb especial èmfasi sobre matemàtiques col·laboratives i aplicades. Actualment, el CRM té grups de recerca actius en Computació i Biologia Matemàtica, Epidemiologia Matemàtica, Neurociència Computacional, Matemàtiques Industrials, Sistemes Complexos i Anàlisi Harmònica. El CRM disposa de la seva pròpia Unitat de Formació de Doctorat, en aquest moment, amb 15 doctorands.

L'estratègia de recerca del CRM té, principalment, dos objectius complementaris:

1. Promoure una recerca matemàtica veritablement interdisciplinària de caràcter col·laboratiu a la interfícies de matemàtiques amb altres disciplines científiques. De fet, l'objectiu del CRM és portar a Catalunya investigadors matemàtics internacionals de talent per millorar la investigació matemàtica de caire aplicat i veritablement interdisciplinària, de caràcter col·laboratiu en les interfícies de les matemàtiques amb altres disciplines científiques i en la promoció del doctorat i la formació postdoctoral en aquestes.

2. Proporcionar suport a la comunitat matemàtica catalana per organitzar activitats la mida o la naturalesa de les quals van més enllà de les capacitats individuals del grup/departament. El CRM també organitza, a través de convocatòries competitives a nivell mundial, els anomenats Programes Intensius de Recerca del CRM (períodes d'investigació intensiva i especialitzada a mig i llarg termini), conferències internacionals, cursos avançats, seminaris i altres reunions científiques. El CRM acull, de manera competitiva, investigadors de primer nivell i investigadors postdoctorals amb diverses fonts de finançament que mantenen col·laboracions actives amb membres de les institucions científiques catalanes per dur a terme estades de recerca a llarg termini al CRM. En aquest sentit, el CRM es pot considerar una infraestructura transversal que està disponible per a la comunitat matemàtica catalana.

El CRM també promou la transferència de coneixement al sector no acadèmic oferint serveis de consultoria a empreses i un seguit d'altres iniciatives. També hi ha activitats de divulgació relacionades amb l'activitat editorial, ja que el centre publica la seva pròpia sèrie a Birkhäuser.

El gener de 2013, el CRM i els departaments de matemàtiques de les universitats de Barcelona van fundar l'Escola de Postgrau de Matemàtiques de Barcelona (BGSMath), amb l'objectiu d'oferir un programa de postgrau en Matemàtiques unitari i atractiu a nivell internacional, atraient estudiants destacats de tot el món, i fomentant el desenvolupament de programes de recerca conjunts que requereixen gran massa crítica. Al desembre de 2014, la BGSMath va ser creada formalment per acord entre el CRM, la Universitat de Barcelona, la Universitat Autònoma de Barcelona i la Universitat Política de Catalunya. Mitjançant aquest acord, el CRM es reconeix com a nòdul administrador de la BGSMath. L'any 2016, la Universitat Pompeu Fabra també s'uneix a la iniciativa BGSMath. Al juny 2015, la BGSMath es constitueix com a Unitat d'Excel·lència Maria de Maeztu durant quatre anys. El doctorat i els programes MdM postdoctorals són la font de finançament dels diversos doctorats i postdoctorats becats del CRM, amb diversos dels seus IPs liderant objectius científics de la unitat de biomatemàtiques i modelització.

El lector trobarà en el present informe una visió general de les activitats organitzades i patrocinades pel CRM durant l'any 2017. Aquest ha estat un any prolífic: el CRM ha organitzat 4 programes de recerca internacionals amb 12 activitats internes, 6 conferències internacionals d'alt nivell, hem tingut més que 8 sèries de seminaris i activitats de divulgació. Totes aquestes activitats s'han beneficiat d'aproximadament 87 visitants. Pel que a la producció de recerca, hem publicat més de 80 articles i els investigadors del CRM han participat en 81 activitats de recerca. A més, el CRM ha publicat diversos volums de les col·leccions Advanced Courses in Mathematics (Birkhauser), Extended Abstracts (Birkhauser), la sèrie de documents del CRM, i diversos preprints.

La informació de les nostres activitats està disponible a la nostra pàgina web http://www.crm.cat

Lluís Alsedà, Director

Presentation

The Centre de Recerca Matemàtica (CRM) was established in 1984 as part of the Institut d'Estudis Catalans (IEC), with the status of associated research institute of the Universitat Autònoma de Barcelona. In 2002, CRM became independent, becoming a partnership of the Institut d'Estudis Catalans and the Catalan Government (Generalitat) through the Departament d'Economia i Coneixement. The CRM is one of the centres in the CERCA network of the Catalan Government.

The CRM's mission is "the development of mathematical research in Catalonia, establishing synergies among the research groups of the Catalan universities" with special emphasis on the collaborative and applied mathematics. Presently, the CRM has active research groups in Computational & Mathematical Biology, Mathematical Epidemiology, Computational Neuroscience, Industrial Mathematics, Complex Systems and Harmonic Analysis. The CRM has its own Doctoral Training Unit, at this moment, with 15 doctoral students.

The CRM research strategy addresses two complementary goals:

1. *Promote truly interdisciplinary mathematical research of collaborative nature in the interfaces of mathematics with other scientific disciplines. Indeed, the goal of the CRM is to attract international talented researchers in mathematics to Catalunya, to improve rather applied and truly interdisciplinary mathematical research of collaborative nature in the interfaces of mathematics with other scientific disciplines, and promoting doctoral and postdoctoral training in those.*

2. *Provide support to the Catalan mathematical community to organize activities whose size or nature go beyond their group/department's individual capabilities. The CRM also organizes, through worldwide competitive calls, the so called CRM Intensive Research Programmes (mid term and long term periods of intensified and specialized research), international conferences, advanced courses, seminars and other scientific meetings. The CRM hosts, on a competitive basis, world-class scientists and postdoctoral researchers with different sources of funding that maintain active collaborations with members of Catalan scientific institutions to conduct long term research stays at the CRM. In this sense, the CRM can be considered a transversal infrastructure that is available to the Catalan mathematical community*

The CRM promotes as well knowledge transfer to the non academic sector providing consulting services to companies and a number of other initiatives. Dissemination activities are also leveraged by an editorial activity, as the institute publishes its own series in Birkhäuser.

In January 2013, the CRM and the mathematics departments of Barcelona universities launched the Barcelona Graduate School of Mathematics (BGSMath), with the objective of offering a unified and internationally appealing postgraduate program in Mathematics, attracting excellent students worldwide and fostering the development of joint research programmes requiring large critical mass. In December 2014, the BGSMath was formally created by agreement between the CRM, the Universitat de Barcelona, the Universitat Autònoma de Barcelona and the Universitat Politècnica de Catalunya. By this agreement, CRM is recognised as the BGSMath managing node. In 2016, the Pompeu Fabra University has also joined the BGSMath initiative. In June 2015, BGSMath is awarded as a María de Maeztu Unit of Excellence for four years. The doctoral and postdoctoral MdM Programmes are the funding source for several PhD and postdoctoral fellows at CRM, with several of its IPs leading scientific objectives of the Unit on biomathematics and modelling.

The reader will find in the present report an overview of the activities organized and sponsored by CRM during 2017. This has been a prolific year: CRM has organized 4 international research programs with 12 internal activities, 6 high-level international conferences, we had more than 8 seminar series and outreach activities. All these activities have profited of approximately 87 visitors. Concerning the research output, we have published more than 80 papers and the CRM researchers have participated in 81 research activities. Also, CRM has published several volumes in the collections Advanced Courses in Mathematics (Birkhauser), Extended Abstracts (Birkhauser), CRM Document Series, and several preprints.

Information of our activities are available at our web page `http://www.crm.cat`

Lluís Alsedà, Director

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Descripció institucional

Institutional description

1.1. Missió i objectius

L'objectiu definit als estatuts del CRM és el foment de la recerca i la formació avançada en l'àmbit de les matemàtiques, mitjançant la col·laboració i les sinergies amb les universitats i les institucions de recerca a Catalunya, amb l'objectiu d'ésser un referent científic internacional en aquest àmbit.

El CRM és un centre amb implantació interuniversitària en el sentit que de la seva activitat se'n beneficia el conjunt de la recerca en matemàtiques del país. La política científica del CRM per a l'assoliment de la seva missió té dos eixos d'actuació recollits en el seu pla estratègic i dins el marc del contracte-programa amb la Generalitat de Catalunya per al període 2014-2019:

- Donar suport als grups d'investigació catalans, organitzant activitats que depassen la capacitat dels mateixos, amb projecció internacional i acollint visitants amb qui treballen conjuntament.
- Des d'un punt de vista més proactiu, dissenyar i executar polítiques estratègiques que incideixin en debilitats de la recerca matemàtica a Catalunya entesa globalment, incentivant el desenvolupament d'àrees estratègiques i creant-ne grups propis.

1.1. Mission and Statement

As stablished in its statutes, the CRM's aim is to foster research and advanced training in mathematics, by collaborating with the universities and research institutions in Catalonia, in order to become an international reference in this field.

The CRM is a transversal centre in the sense that its activities benefit the whole community of mathematical researchers of our country. The scientific policy of the CRM towards fulfilling its mission is structured around two main core concepts, quoted in the strategic plan within the contract-program with the Generalitat de Catalunya for the period 2014-2019:

- *To give support to research groups, by organising activities whose size or nature go beyond the capabilities of the teams, achieving broad visibility and hosting visitors for joint work.*
- *To design and execute strategies aimed at addressing the weaknesses of the mathematical research activity in Catalonia as a whole, encouraging emergent areas and creating its own research groups in these areas.*

1.2. Estructura jurídica

El CRM va ser creat l'any 1984 per l'Institut d'Estudis Catalans (IEC) com a centre de recerca propi. El mateix any, l'IEC signà un conveni de col·laboració amb la Universitat Autònoma de Barcelona (UAB), en virtut del qual el Centre quedà ubicat físicament en uns espais d'aquesta universitat. L'any 1993 s'adequaren uns espais propis per al CRM a la Facultat de Ciències de la UAB amb finançament de la CIRIT. Per aquest motiu, es reformulà el conveni entre l'IEC i la UAB i se sol·licità l'adscripció del CRM a la UAB com a institut universitari.

L'acord del Govern de la Generalitat de 9 de juliol de 2002 (DOGC núm. 3693, de 6 d'agost de 2002) aprovà la constitució del Consorci Centre de Recerca Matemàtica, integrat per la Generalitat de Catalunya i l'IEC. El Consorci és una entitat pública amb personalitat jurídica pròpia. El desembre de 2013, la Universitat Autònoma de Barcelona es va incorporar al Consorci.

El CRM està regit pel Consell de Direcció i pel director, i compta amb un Consell Científic Assessor.

El CRM està integrat dins la Institució CERCA de centres de recerca participats majoritàriament per la Generalitat de Catalunya i forma part de l'Associació Catalana d'Entitats de Recerca (ACER). També forma part d'ERCOM, un comitè de la Societat Matemàtica Europea, i de la xarxa EPDI (European Post-Doctoral Institute).

1.3. Consell de Direcció

El Consell de Direcció, òrgan superior de decisió i d'administració del CRM, està format per:

- El president, que és el conseller d'Economia i Coneixement, o persona en qui delegui.
- El vicepresident, que és el president de l'IEC, o persona en qui delegui.
- Tres vocals en representació de la Generalitat de Catalunya.

1.2. Legal Status

The CRM was founded in 1984 as a research center within the Institut d'Estudis Catalans (IEC), the Catalan Academy. In the same year, an agreement was signed with the Universitat Autònoma de Barcelona (UAB), by virtue of which the CRM became established in the UAB Campus. In 1993, the CRM opened its own premises at the UAB's Science Faculty, thanks to the financial support from CIRIT. On that occasion, the CRM became associated with the UAB as one of its research institutes.

The Government of Catalonia approved on July 9^{th}, 2002 (DOGC No. 3693, August 6^{th}, 2002) the creation of the CRM Consortium, formed by the Generalitat de Catalunya and the IEC. The CRM Consortium is a public body with its own legal status. In December 2013 the Universitat Autònoma de Barcelona joined the Consortium.

The CRM is guided by its Governing Board and the Director, and has a Scientific Advisory Board.

The CRM is one of the centres in the CERCA Institution of research centres sponsored by the Generalitat de Catalunya, and of the Associació Catalana d'Entitats de Recerca (ACER). The CRM is a member of both ERCOM, a committee of the European Mathematical Society (EMS), and the European Post-Doctoral Institute (EPDI).

1.3. Governing Board

The Governing Board, the highest level of decision and management of CRM, consist of:

- *The president, who is the Minister of Economy and Knowledge, or his delegate.*
- *The vice president, who is the president of the IEC, or his delegate.*
- *Three representatives from the Generalitat of Catalunya.*

- Dos vocals en representació de l'IEC.
- Un vocal en representació de la UAB.
- El director del CRM, que hi participa amb veu però sense vot.

El Consell de Direcció es va reunir el dia 27 de setembre de 2017. En aquesta reunió, la Generalitat de Catalunya va estar representada per Francesc Subirada com a director general de recerca.

L'IEC hi va estar representat Joandoménec Ros, que va presidir el Consell, Josep Enric Llebot en substitució de Joaquim Agulló i per Joan Girbau. Francisco Javier Lafuente, vicerector de Projectes Estratègics i de Planificació de la UAB, va assistir a la sessió en representació del rector de la UAB. Van assistir també el director del CRM, Lluís Alsedà, i la gerent, Àngels Huertos. Com a representant del CERCA va assistir el senyor Lluís Rovira. Va actuar com a secretari Josep Maria Alcoberro.

- *Two representatives from the IEC.*
- *One representative from the UAB.*
- *The Director of CRM, who participates with a voice but not a vote.*

The Governing Board met on September 27st, 2017. In that meeting, the Generalitat de Catalunya was represented by Francesc Subirada, in his capacity of Director General de Recerca, who assumed the position of Chairman of the Board.

The IEC was represented by Joandomènec Ros, by Josep Enric Llebot replacing Joaquim Agulló and by Joan Girbau. Francisco Javier Lafuente, the vice-rector of Strategic Projects and Planning of the UAB, assisted to the meeting on behalf of the rector of the UAB. The CRM director, Lluís Alsedà, and the general manager, Àngels Huertos, also assisted to the meeting. CERCA was represented by Lluís Rovira. Josep Maria Alcoberro acted as Secretary.

Generalitat de Catalunya

Institvt d'Estvdis Catalans

UAB Universitat Autònoma de Barcelona

1.4. Consell Científic Assessor

El Consell Científic Assessor (CCA) està integrat per personalitats de prestigi científic en l'àmbit d'actuació del Centre, nomenats pel Consell de Direcció a proposta del director.

El CCA va celebrar la seva reunió anual presencial el 16 de juny de 2017. Al llarg de l'any es van fer diverses reunions no presencials.

La composició de l'actual Consell Científic Assessor, aprovada en reunió del Consell de Direcció del 27 de setembre de 2017, és:

1.4 Scientific Advisory Board

The Scientific Advisory Board (SAB) consists of prestigious personalities within the scientific scope of the Centre, appointed by the Governing Board, after proposal by the Director.

The SAB held its annual meeting in person on Juny 16th, 2017. Throughout the year, on-line meetings were held.

The Governing Board approved on September 27th, 2017, the new composition of the Scientific Advisory Board:

Stephen O'Brien, University of Limerick
Helen Byrne, Oxford University
Albert Cohen, Université Pierre et Marie Curie 4

Peter Imkeller, Humboldt-Universität zu Berlin
Mogens H. Jensen, University of Copenhaguen
Gábor Lugosi, Universitat Pompeu Fabra, Barcelona
Robert MacKay, University of Warwick
Eva Miranda, Universitat Politècnica de Catalunya
Jaroslav Nešetřil, Charles University, Prague
Peregrina Quintela, Universidad de Santiago de Compostela

1.5. El pla estratègic del CRM 2014–2019

El primer contracte-programa del CRM amb la Generalitat de Catalunya es va signar el 18 de juny de 2003. Es va mantenir vigent fins a 2006 i es va prorrogar durant l'any 2007. El 14 de febrer de 2009 es va signar un segon contracte-programa que cobreix el període de 2008 a 2013, emanat del primer pla estratègic del centre. Aquest contracte-programa es va prorrogar durant el 2014, mentre s'elaborava el nou pla estratègic.

El pla estratègic del CRM per al període 2014-2019, aprovat pel Consell de Direcció a la reunió de l'11 de juliol de 2014, conté un apartat introductori sobre "Missió i visió del CRM", seguit d'una secció "El CRM al final del pla estratègic 2008-2013" en la qual es fa un retrat de la situació actual del centre. Seguidament s'aborda pròpiament el nou pla, el qual té per objectiu servir de full de ruta del centre en sintonia amb la seva missió estatutària. El nou pla es proposa desenvolupar determinades polítiques orientades a diferents àmbits i assolir uns objectius concrets, agrupats com segueix.

1.5.1. Recerca

El CRM com a pol atractor d'investigadors a Catalunya:

- Objectiu 1: atraure al CRM dos investigadors ICREA consolidats addicionals en els propers sis anys. El CRM farà una prospecció cada any i presentarà les corresponents expressions d'interès.

1.5. The CRM strategic plan 2014–2019

The first contract-program between the CRM with the Catalan Government was signed on June 18^{th}, 2003. It remained in force until 2006 and was extended over 2007. On February 14^{th}, 2009, a new contract-program, stemmed from the first CRM's strategic plan, was signed for the period 2008–2013, and extended over the year 2014. Meanwhile, the new strategic plan was designed.

The CRM strategic plan for the period 2014–2019, approved by the Board of Governors on July 11^{th}, 2014, contains an introductory section on "Mission and vision of CRM", followed by a section on "The CRM at the end of the strategic plan 2008–2013" which is a portrait of the current state of the center. Next, the document addresses the new plan, which serves as a roadmap for the center, in line with its statutory mission. The new plan proposes the development of policies oriented to different areas and to achieve specific goals, grouped as follows.

1.5.1. Research

The CRM as an attraction pole for researchers in Catalonia:

- *Goal 1: attract to the CRM two additional consolidated ICREA researchers in the next six years. The CRM will make a market search every year and will present the corresponding expressions of interest.*

- Objectiu 2: atraure al CRM una mitjana de 1,5 investigadors júnior per any en els propers sis anys a través de beques *Marie Skłodowska-Curie* i contractes *Ramón y Cajal*.

El CRM i la recerca aplicada i col·laborativa en matemàtiques:

- Objectiu 3: aconseguir, al final del pla 2014-2019, una unitat de recerca consolidada en Matemàtica Aplicada Col·laborativa, consistent en tretze investigadors (IP's).

- Objectiu 4. crear una unitat mixta CRM-CRG en *Exploratory Data Analysis*.

La creació de sinergies entre els grups:

- Objectiu 5: millorar la cooperació entre els grups de recerca amb una acurada planificació a mitjà i llarg termini en la preparació de propostes a convocatòries competitives.

- Objectiu 6: promoure la codirecció de tesis de doctorat dins del CRM.

Les xarxes temàtiques i els investigadors col·laboradors del CRM:

- Objectiu 7: augmentar el nombre de col·laboradors del CRM d'altres institucions, en particular els que participen en les xarxes temàtiques del CRM.

- Objectiu 8: posar en marxa altres xarxes temàtiques en un futur proper; per exemple, en Biologia de Sistemes, o Epidemiologia Matemàtica.

El paper del CRM en la formació d'investigadors:

- Objectiu 9: arribar a una mitjana de dos estudiants de secundària per any que facin el seu treball de recerca al CRM.

- *Goal 2: attract to the CRM 1,5 junior researchers per year on average in the next six years through Marie Skłodowska-Curie fellowships and Ramón y Cajal contracts.*

The CRM and the collaborative applied research in mathematics:

- *Goal 3: achieve, by the end of this 2014-2019 plan, a consolidated research unit in Collaborative Applied Mathematics, consisting of thirteen researchers (IP's).*

- *Goal 4. create a joint CRM-CRG unit on Exploratory Data Analysis.*

Creating sinergies among groups:

- *Goal 5: improve the cooperation among research groups by means of a thorough mid- and long-term planning in order to prepare proposals to apply to competitive calls.*

- *Goal 6: promote the co-supervision of PHD theses within the CRM.*

Thematic networks and the scientific collaborators of the CRM:

- *Goal 7: increase the number of CRM scientific collaborators coming from other institutions, in particular those participating in the CRM thematic networks.*

- *Goal 8: launch other thematic networks in the near future; for instance, in Systems Biology or Mathematical Epidemiology.*

The role of CRM in research training:

- *Goal 9: achieve an average of two college students per year to develop their research project at the CRM.*

- Objectiu 10: enfortir les activitats de difusió dirigides als joves (*Saló de l'Ensenyament*, *Fira de la Ciència*, entrevistes gravades, etc.) per comunicar els valors de la investigació matemàtica a la societat.

- Objectiu 11: designar els investigadors del CRM com a col·laboradors científics a les universitats. Els actuals acords amb universitats ho permeten. A més, el projecte BGSMath hi tindria un efecte molt positiu.

- Objectiu 12: millorar i potenciar el programa d'estades d'investigació al CRM d'estudiants de grau i màster, amb el propòsit d'arribar a una mitjana de 4 estades per any.

- Objectiu 13: crear i consolidar la Unitat de Formació Doctoral del CRM (UFD-CRM).

- Objectiu 14: aconseguir una taxa mitjana de dos tesis doctorals per any durant el pla 2014–2019.

- Objectiu 15: obtenir recursos per a places postdoctorals en els projectes competitius atrets pels investigadors del CRM.

- Objectiu 16: obtenir recursos del sector privat per a la formació doctoral i postdoctoral en el CRM.

1.5.2. Reforçament del sistema

El CRM i la BGSMath:

- Objectiu 17: completar el redisseny institucional del CRM impulsant la BGSMath.

El CRM com a centre ERCOM organitzador d'activitats:

- Objectiu 18: el CRM ha de trobar finançament estable per als seus programes de recerca temàtica fora del sector públic.

- *Goal 10: reinforce the diffusion activities addressed to young students (Saló de l'Ensenyament, Fira de la Ciència, recorded interviews, etc.) to spread the impact of mathematical research on society.*

- *Goal 11: appoint the CRM researchers as scientific collaborators of the local universities, as the current agreements with universities allow. In addition, the BGSMath project would have a very positive effect in this respect.*

- *Goal 12: improve and potentiate research internships of undergraduate and masters' students at CRM, up to 4 stays per year on average.*

- *Goal 13: create and consolidate the CRM Doctoral Training Unit (UFD-CRM).*

- *Goal 14: achieve two PhD thesis per year on average along the 2014–2019 plan.*

- *Goal 15: obtain funds for postdoctoral position through the competitive projects attracted by CRM researchers.*

- *Goal 16: obtain funds from the private sector for doctoral and postdoctoral training at CRM.*

1.5.2. System reinforcement

The CRM and the BGSMath:

- *Goal 17: complete the institutional redesign of the CRM by promoting the BGSMath.*

The CRM as an ERCOM centre organiser of events:

- *Goal 18: find stable non-public funding for its thematic intensive research programmes.*

- Objectiu 19: el CRM ha d'obtenir un rendiment econòmic de l'organització d'esdeveniments científics en el centre; per exemple, un percentatge fix dels ingressos procedents dels drets d'inscripció.

- Objectiu 20: requerir als coordinadors dels programes de recerca i als visitants a llarg termini d'usar també una afiliació temporal al CRM quan signen documents originats durant la seva estada al centre.

El CRM com a centre promotor de la mobilitat dels investigadors:

- Objectiu 21: obtenir un finançament estable per als programes de visitants $DevMath$ i $Lluís\ Santaló$.

1.5.3. Captació de recursos i transferència

Projectes de recerca:

- Objectiu 22: augmentar la participació del CRM en projectes de recerca finançats per la UE.

- Objectiu 23: aconseguir almenys un projecte de l'ERC durant els propers sis anys.

Transferència de coneixement i serveis a les empreses:

- Objectiu 24: aconseguir en transferència de coneixement una mitjana de dos contractes per any. El laboratori experimental hi podria tenir un paper important.

- Objectiu 25: posar en marxa una $start\text{-}up$ en el camp de la Matemàtica Financera.

Explotació de les instal·lacions:

- Objectiu 26: aprofitar les instal·lacions del CRM per a obtenir ingressos addicionals.

- *Goal 19: obtain an economic yield from scientific events organised in the centre; for instance, a fixed percentage of the incomes from registration fees.*

- *Goal 20: require the coordinators of intensive research programmes and long-term visitors a temporary affiliation to the CRM when signing documents originated from their stay at the centre.*

The CRM as a centre promoting researchers' mobility:

- *Goal 21: obtain stable funding for the $DevMath$ and $Lluís\ Santaló$ visiting programmes.*

1.5.3. Fundraising and transference

Research projects:

- *Goal 22: increase the participation of the CRM in research projects funded by the EU.*

- *Goal 23: achieve, at least, one ERC contract in the next six years.*

Knowledge transfer to industry and services offered to private companies

- *Goal 24: obtain two contracts on knowledge transfer per year on average. The CRM experimental lab could play an important role in this regard.*

- *Goal 25: launch a $start\text{-}up$ in the field of Financial Mathematics.*

Exploitation of the premises:

- *Goal 26: make the most of the CRM premises to get additional income.*

1.5.4. Publicacions i imatge

Activitat editorial:

- Objectiu 27: consolidar com una subcol·lecció dels *CRM Documents* els informes anuals dels programes de recerca temàtics i fer una nova sèrie amb els *extended abstracts* dels congressos i *workshops* celebrats al CRM.

- Objectiu 28: arribar a una taxa de publicació mitjana de dos números a l'any de la sèrie de *Advanced Courses CRM Barcelona*, editada per Birkhäuser, i reduir a sis mesos el retard entre el curs i l'edició.

Divulgació científica i imatge institucional:

- Objectiu 29: organitzar dues vegades l'any una jornada temàtica amb altres centres CERCA en les àrees de matemàtiques col·laboratives cultivades en el CRM.

1.5.5. Processos, administració i instal·lacions

- Objectiu 30: elaboració i implementació d'un pla d'igualtat del centre que comprengui tots els àmbits d'actuació del centre i en consideri tots els aspectes (diversitat, gènere, etc.).

- Objectiu 31: posar en marxa i executar la *HR Strategy for Researchers* (HRS4R).

- Objectiu 32: posar en marxa un servidor de càlcul intensiu.

- Objectiu 33: dissenyar i posar en marxa una intranet, que permeti millorar especialment la gestió econòmica dels projectes de recerca, la comptabilitat i la logística.

1.6. Col·laboració amb altres institucions

El CRM participa en iniciatives de diversa índole junt amb altres institucions acadèmiques.

1.5.4. Publications and image

Editorial activity:

- *Goal 27: consolidate as a subcollection of the CRM Documents the annual reports of the intensive research programmes and promote a new series around the extended abstracts of the conferences and workshops held at the CRM.*

- *Goal 28: achieve an average publication rate of two issues per year of the series Advanced Courses CRM Barcelona, edited by Birkhäuser, and reduce to six months the period between the courses and the edition.*

Scientific dissemination and institutional image:

- *Goal 29: organise, twice a year, a thematic day with other CERCA centres around the topics on collaborative mathematics cultivated in the CRM.*

1.5.5. Procedures, management and premises

- *Goal 30: ellaboration and implementation of an equality plan for the centre including all the action areas and considering all aspects (diversity, gendre, etc.).*

- *Goal 31: implement the HR Strategy for Researchers (HRS4R).*

- *Goal 32: set-up an intensive computing server.*

- *Goal 33: design and launch an intranet allowing to improve, specifically, the economic management of research projects, the accounting and the logistics.*

1.6. Institutional collaboration

The CRM participates in initiatives of various kinds with other academic institutions.

1.6.1. BGSMath

Barcelona té una reconeguda excel·lència, al més alt nivell, en recerca en matemàtiques. En els darrers anys, s'han incorporat, de manera significativa, en aquest àmbit nombrosos estudiants estrangers, a través dels programes de màster i de doctorat de les universitats catalanes. En aquest escenari, el 2013 es va crear la *Barcelona Graduate School of Mathematics* (BGSMath) amb la intenció d'aportar una formació en recerca doctoral coordinada, d'alta qualitat i amb visibilitat internacional. La BGSMath també té com a objectius millorar l'ocupació de titulats en matemàtiques a la indústria i en l'àmbit no acadèmic en general, i esdevenir una plataforma per a tots els agents actius en recerca matemàtica orientada al desenvolupament de projectes col·laboratius.

Les institucions promotores de la BGSMath són:

- Facultat de Matemàtiques de la Universitat de Barcelona,
- Departament de Matemàtiques de la Universitat Autònoma de Barcelona,
- Facultat de Matemàtiques i Estadística de la Universitat Politècnica de Catalunya,
- Universitat Pompeu Fabra,
- Centre de Recerca Matemàtica, i
- L'Institut de Matemàtica de la Universitat de Barcelona també hi participa com a entitat de suport.

La BGSMath va estar guardonada l'any 2015 amb la distinció "María de Maeztu" pel Ministeri d'Economia i Competitivitat del Govern Espanyol com a part del seu Programa d'Excel·lència". Aquesta distinció va adreçada a centres de recerca espanyols destacats en totes les àrees de la ciència o les humanitats. Són beques adreçades a estades

1.6.1. BGSMath

Barcelona has an internationally recognized excellence in mathematics research at the highest level. In the latest years, the number of foreign graduate students enrolled in the master's and doctoral programs in Mathematics offered by Catalan universities has increased significantly. In this scenario, the Barcelona Graduate School of Mathematics (BGSMath) was created in 2013 with the aim of providing coordinated and high quality research PhD training with international visibility. Another mission of the BGSMath is the enhancement of employment of mathematicians in industry and in non-academic environment in general, and becoming a platform for all active agents in mathematical research towards the development of collaborative projects.

The promoting institutions of the BGSMath are the:

- *The Mathematics Faculty of the Universitat de Barcelona,*
- *The Mathematics Department of the Universitat Autònoma de Barcelona,*
- *The Faculty of Mathematics and Stadistics of the Universitat Politècnica de Catalunya,*
- Universitat Pompeu Fabra,
- *Centre de Recerca Matemàtica, i*
- *The Mathematics Institute of the Universitat de Barcelona also participates as a supporting entitiy.*

On 2015 BGSMath was awarded a "Maria de Maeztu" grant by the Spanish Ministry of Economy and Competitiveness under its "Excellence Program". The award is aimed at Spanish research centers that are leaders in all areas of science and the humanities. Grants provide funding for international PhD

de doctorands i postdoctorals internacionals a Barcelona.

Els becaris finançats per la BGSMath que estan col·laborant amb els grups de recerca de les universitats catalanes i el CRM són els següents:

students and postdocs to complete stays in Barcelona.

The fellows financed by the BGSMath and in collaboration with the research groups of the catalan universities and the CRM are the following ones:

Nom	Cognom	Data d'inici	IP/Grup	Organisme
Enric	Costa	01/10/2014	Tomás Alarcón	CRM
Carlos	Sáez	01/10/2015	Carles Casacuberta	UB
Carmelo	Puliatti	07/01/2016	Xavier Tolsa	UAB
Joan	Gimeno	01/10/2016	Àngel Jorba	UB
Helmut	Schmidt	01/06/2016	Alex Roxin	CRM
Matteo	Cozzi	21/06/2016	Xavier Cabré	UPC
Tomás	Sanz	01/09/2016	Xavier Cabré	UPC
Francesc	Fité	01/09/2016	Víctor Rotger	UPC
Federico	Cantero	01/09/2016	Carles Casacuberta	UB
Claudia	Fanelli	01/10/2016	Tim Myers	CRM
Gladston	Duarte	01/12/2016	Àngel Jorba	UB
Mallika	Roy	01/02/2017	Enric Ventura	UPC
Juan Carlos	Felipe Navarro	01/05/2017	Xavier Cabré	UPC
Maximilian	Wötzel	15/05/2017	Oriol Serra	UPC
Marina	Garrote	01/09/2017	Marta Casanellas	UPC
Gonzalo	Fiz	01/09/2017	Oriol Serra	UPC
Antti Ilmari	Perälä	01/09/2017	Jordi Pau	UB
Alvaro	Leitao	01/09/2017	Montserrat Guillén	UB
Aapo P.	Kauranen	01/09/2017	Xavier Tolsa	UAB
Jordi	Vila	01/09/2017	Antonio Huerta	UPC
Damian	Dabrowski	01/10/2017	Xavier Tolsa	UAB
Nicolas	Cantier	10/10/2017	Francesc Perera	UPC
Andres	Rojas	01/11/2017	Ignasi Mundet	UB
Waleed A.	Mirza	01/11/2017	Marino Arroyo	UPC
Joan	Bosa	01/11/2017	Pere Ara	UAB
Gyla	Csato	01/11/2017	Xavier Cabré	UPC

A part de l'activitat de formació de predocs i postocs, la BGSMath organitza programes mensuals de recerca.

http://www.bgsmath.cat/

1.6.2. ERCOM

ERCOM és l'acrònim del comitè European Research Centres on Mathematics de la Societat Matemàtica Europea (EMS), format pels directors científics de diversos centres europeus de recerca en matemàtiques. Els centres representats a ERCOM són aquells el nombre de visitants dels quals supera essencialment el nombre d'investigadors permanents o de llarga durada i que cobreixen un espectre ampli de les matemàtiques. El CRM és membre d'ERCOM des de la seva fundació l'any 1997.

El president d'ERCOM és nomenat per un període de quatre anys pel comitè executiu de l'EMS amb la possibilitat de nomenar-lo per un període de 2 anys més.

Des de la seva fundació, ERCOM ha estat presidit per: Ole Barndorff-Nielsen (MaPhySto) 1997–2002, Manuel Castellet (CRM) 2002–2005, Jan Karel Lenstra (CWI) 2006–2009, Gert-Martin Greuel (MFO) 2010–2013 i Ari Laptev (Institut Mittag-Keffler) 2014–.

La reunió anual d'ERCOM de 2017 tingué lloc els dies 28 i 29 d'abril, a Linz (Àustria).

1.6.2. ERCOM

ERCOM is the acronym of the European Research Centres on Mathematics committee of the European Mathematical Society (EMS), composed by the scientific directors of European research centres in mathematics. Only centres for which the number of visiting staff substantially exceeds the number of permanent and long-term staff, and which cover mathematical sciences broadly, are eligible for representation in ERCOM. The CRM has been a member of ERCOM since its foundation in 1997.

The president of ERCOM is appointed for a period of four years by the EMS Executive Committee with the possibility of re-appointment for another two-year period.

Since its foundation, ERCOM has been chaired by Ole Barndorff-Nielsen (MaPhySto) 1997–2002, Manuel Castellet (CRM) 2002–2005, Jan Karel Lenstra (CWI) 2006–2009, Gert-Martin Greuel (MFO) 2010–2013, and Ari Laptev (Institut Mittag-Keffler) 2014–.

The annual meeting of ERCOM in 2017 was held on April 28^{th} and 29^{th}, in Linz (Austria).

European Mathematical Society

http://www.ercom.org

1.6.3. ICREA

La Institució Catalana de Recerca i Estudis Avançats (ICREA) és una fundació impulsada per la Generalitat de Catalunya que, per mitjà d'un procés de selecció basat en el talent científic, contracta investigadors/es d'arreu del món per desenvolupar la seva tasca en universitats i centres de recerca de Catalunya. El CRM participa activament en totes les convocatòries de places d'ICREA presentant-hi candidatures d'investigadors en matemàtiques de reconegut prestigi. El centre compta de fa temps amb la presència de l'investigador ICREA Sergey Tikhonov i de l'investigador Tomás Alarcón que va obtenir una plaça ICREA senior a la convocatòria 2015.

1.6.3. ICREA

The Catalan Institution for Research and Advanced Studies (ICREA) is a foundation supported by the Catalan Government whose aim is to recruit top scientists for the Catalan R&D system. The CRM participates actively in all the ICREA calls by presenting renowned mathematical researchers as candidates for ICREA positions. ICREA researcher Sergey Tikhonov has been working at the CRM for some time and Tomas Alarcón, who obtained an ICREA senior position in the 2015 call.

*iCrea
INSTITUCIÓ CATALANA DE RECERCA I ESTUDIS AVANÇATS

http://www.icrea.cat/

1.7. Patrocinis

En la conjuntura econòmico-financera en què es mou actualment el CRM, alguns dels projectes endegats els darrers anys corren el perill de quedar-se en via morta. Afortunadament, els esforços del centre per captar l'interès de patrocinadors sensibles a la recerca en matemàtiques ha tingut alguns fruits al llarg de l'any 2017. El CRM està molt agraït a les institucions que es detallen a continuació perquè amb la seva contribució es podrà mantenir i incrementar la qualitat d'algunes de les activitats consolidades del centre.

1.7. Sponsorships

With the economic and financial situation in which the CRM is currently immersed, some of the projects undertaken in recent years would be in danger of continuity. Fortunately, the efforts of the center to attract the interest of sponsors sensitive to research in mathematics has had some success along 2017. The CRM is deeply grateful to the institutions listed below since their contribution can maintain and increase the quality of some of the activities consolidated in the center.

1.7.1. Obra Social "la Caixa"

L'Obra Social "la Caixa" és una institució compromesa amb la societat a través de projectes de suport al benestar, als drets humans, a la pau, a la justícia i a la dignitat de les persones. Aquesta fundació treballa conjuntament amb institucions de

1.7.1. "la Caixa" Foundation

"la Caixa" Foundation is an institution committed to society through Welfare Projects, human rights, peace, justice and people's dignity. The foundation also works together with research institutions to generate new scientific knowledge by opening

recerca per tal de generar coneixements científics obrint nous horitzons de recerca. El principal objectiu de l'acció de l'Obra Social "la Caixa" és la de finançar la ciència aportant més seguretat a aquestes institucions a l'hora de planificar la seva recerca i facilitant sinergies entre els diferents centres. A finals de 2013, l'Obra Social "la Caixa", en el marc d'un acord amb el Govern de la Generalitat de Catalunya, va aprovar el finançament d'un programa de formació en Recerca Matemàtica Col·laborativa presentat pel CRM. Vegeu

up research horizons. The main aim of the action of "la Caixa" Foundation in sponsoring science is giving research institutions more security when planning their research and facilitating the generation of synergies among different centres. At the end of 2013, "la Caixa" Foundation, in the frame of the agreement with the Catalan Government, approved funding of the training program on Collaborative Mathematics presented by the CRM. See

www.crm.cat/en/Research/Training/CollabMathResearch/Pages/Description.aspx

L'objectiu del programa és promoure la recerca matemàtica col·laborativa i interdisciplinària. En el marc d'aquest programa, s'entén per matemàtica col·laborativa "la recerca matemàtica situada en alguna interfície orientada al desenvolupament, anàlisi i simulació de models contextualitzats, amb interès més enllà de les matemàtiques, contrastada per la interacció amb experimentalistes".

The aim of the program is to encourage interdisciplinary and collaborative mathematical research. In the framework of this program, collaborative research is meant "mathematical research located in an interface which purpose is the development, analysis and simulation of contextualized models, with interest beyond mathematics, contrasted by interacting with experimentalists".

El finançament d'aquest programa per part de la Fundació "la Caixa" està permetent al CRM d'oferir un nombre important de contractes doctorals i postdoctorals al llarg de cinc anys a partir de gener de 2014. Cada membre del programa té assignat un projecte de formació en un tema específic escollit entre un investigador del CRM que actua de supervisor i un cosupervisor d'una altra disciplina. Durant el 2017 es van concedir les següents beques o contractes (investigadors, temes, supervisor al CRM, supervisors externs):

The funding of this program by "la Caixa" allows the CRM to offer a number of doctoral and postdoctoral contracts over a period of five years starting January 2014. They consist of 3-year long contracts linked to a training project on a specific topic defined jointly by a researcher in mathematics as director and a co-director from another discipline. The following fellowships were awarded during 2017 (researcher, topic, CRM supervisor, external supervisors):

Contractes postdoctorals / *Postdoctoral contracts*:

- Josep Sardanyés, *Multiescale modeling of tumour growth and tumour - induced angiogenesis*.

Obra Social "la Caixa"

http://obrasocial·lacaixa.es/laCaixaFoundation/home_en.html

1.7.2. Clay Mathematics Institute

El *Clay Mathematics Institute* (CMI) és una fundació privada dedicada al foment i disseminació del coneixement matemàtic. Un dels programes del CMI és l'anomenat "*Enhancement and Partnership Proposals*", creat amb la intenció d'enriquir activitats ja planificades, principalment a través del finançament de participants a nivell internacional. Durant el 2017, l'ajut del CMI ha permès finançar dos tipus d'accions: la millora de les condicions econòmiques d'1 investigador sènior per participar en un programa de recerca.

1.7.2. Clay Mathematics Institute

The Clay Mathematics Institute is a privately funded operating foundation dedicated to increasing and disseminating mathematical knowledge. One of the programs of the CMI is the "Enhancement and Partnership Proposals", aiming at enhancing activities that are already planned, particularly by funding international participation. During the year 2017, the CMI support has been allocated in two directions: to enhance the economical conditions of one senior researcher to participate on a research programme.

http://www.claymath.org/

1.7.3. Simons Foundation

La *Simons Foundation* és una fundació privada, la missió de la qual és ampliar les fronteres de la recerca en matemàtica i en ciències bàsiques. A finals de 2013, la *Simons Foundation* va aprovar una proposta del CRM per potenciar els actuals Programes Temàtics de Recerca finançant visites d'entre 2 i 6 mesos a investigadors sèniors. Durant el curs 2014–2015, el CRM va acollir els primers investigadors dins del *Simons Visiting Program* i ha continuat col·laborant durant els cursos 2015–2016 i 2016–2017.

1.7.3. Simons Foundation

The Simons Foundation is a private foundation whose mission is to advance the frontiers of research in mathematics and the basic sciences. During Fall 2013, a CRM proposal aimed at enhancing the existing Thematic Research Programs by offering financial support to senior researchers for visits from 2 to 6 months long was approved. In 2014–2015, the CRM hosted the first researchers under the Simons Visiting Program, and this collaboration has continued in the 2015–2016 and 2016–2017 academic years.

SIMONS FOUNDATION

https://www.simonsfoundation.org/

1.8. Estructura i administració

1.8.1. Equip de direcció

El director del CRM és nomenat pel Consell de Direcció, a proposta del president, per a un període de quatre anys. L'actual director és Lluís Alsedà, que va ser nomenat a la reunió del Consell de Direcció del CRM de l'1 de desembre de 2015 per al període de 2016 a 2019.

El director, l'adjunt de direcció, càrrec representat per l'investigador principal Tomás Alarcón, la gerent i un representant del personal de recerca formen la Comissió Executiva del Centre, que es reuneix periòdicament per tractar afers de tràmit o urgents. El representant dels investigadors és Álvaro Corral.

Manuel Castellet, que va ser director del CRM des de la seva creació l'any 1984, va ser nomenat director honorari pel Consell de Direcció l'any 2007.

1.8.2. Gerència

Des d'octubre del 2014 ocupa el càrrec de gerent:

1.8.3. Equip d'administració

L'equip d'administració del CRM durant el 2017 ha estat format per les persones següents:

1.9. Structure and administration

1.8.1. Team of Directors

The Governing Board elects a Director, proposed by the Chairman, to serve for a period of four years. The current Director is Lluís Alsedà, who was elected for the period from 2016 to 2019 in the meeting of the Governing Board on December 1st, 2015

The director, the assistant director, represented by the principal investigator Tomás Alarcón, the manager and one representative of the researchers form the Executive Commission of the CRM, which meets regularly to discuss routine or urgent affairs. The representative of the researchers is Álvaro Corral.

Manuel Castellet, who had been director of the CRM since its creation in 1984, was nominated Honorary Director by the Governing Board in 2007.

1.8.2. General Management

Since October 2014, the CRM's general manager is

Maria Àngels Huertos mahuertos@crm.cat telèfon 93 586 8424

1.8.3. Management team

The following people made up the management team in 2017:

Ana García-Donas	agarcia@crm.cat	Tel: 93 581 4727
Núria Hernández	nhernandez@crm.cat	Tel: 93 586 8192
Raquel Hernández	rhernandez@crm.cat	Tel: 93 581 2953
Jordi Mullor	jmullor@crm.cat	Tel: 93 586 8496
Guillem Pérez	gperez@crm.cat	Tel: 93 586 8423

Consol Roca	croca@crm.cat	Tel: 93 581 4353
Vanessa Ramírez	vramirez@crm.cat	Tel: 93 581 4353
David Romero	dromero@crm.cat	Tel: 93 586 2201
Elena Samblás	esamblas@crm.cat	Tel: 93 581 4353
Alba Tomàs	atomas@crm.cat	Tel: 93 581 4086
Mari Paz Valero	mpvalero@crm.cat	Tel: 93 586 2201
Pau Varela	pvarela@crm.cat	Tel: 93 581 1081

1.9. Equipament

Els espais que actualment ocupa el CRM estan situats en una ala de l'edifici de la Facultat de Ciències de la UAB, amb una superfície total de 2.125 m^2, després de la darrera ampliació finalitzada l'octubre de 2010, amb el finançament de la Generalitat i del fons FEDER. Permeten la ubicació de l'administració, la direcció, un màxim de 60 investigadors, tres sales de reunions, tres aules amb capacitat per a 40 persones i un auditori amb capacitat per a 100 persones.

Per a l'allotjament dels investigadors visitants, el CRM utilitza l'oferta d'apartaments de la Vila Universitària de Bellaterra.

Durant l'any 2017, l'equipament informàtic del CRM constava d'una xarxa LAN Ethernet d'aproximadament unes vuitanta estacions de treball basades en sistemes Microsoft i Linux, i estructurades sota un domini Windows. Entre d'altres serveis, la xarxa constava d'un servidor de correu electrònic, un servidor d'impressió (que gestionava els treballs de cinc impressores), un servidor de fitxers i un *Firewall/Router* que la connectava a la infraestructura de la UAB mitjançant un enllaç d'1 Gb. Es va dotar, dins d'aquesta xarxa, de sistemes per a permetre el treball en remot utilitzant FTP, accés al correu web, accés via SSH a servidors dedicats al càlcul i una securització a través de VPN per accedir a la resta de serveis del centre. Disposava també de connexió a internet sense cables, de set canons de projecció i sistemes de gravació per a les aules i sales de reunions, recursos per a establir videoconferència, sistemes digitals

1.9. Equipment

The CRM facilities are located in a wing of the UAB Faculty of Sciences with a total floor space of 2,125 m^2, after completion in October 2010 of the enlargement of CRM premises, made possible through Generalitat and FEDER funding. The facilities include management offices, the Director's desk, up to 60 researcher places, three meeting rooms, three lecture rooms with capacity for 40 people and an auditorium with capacity for 100 people.

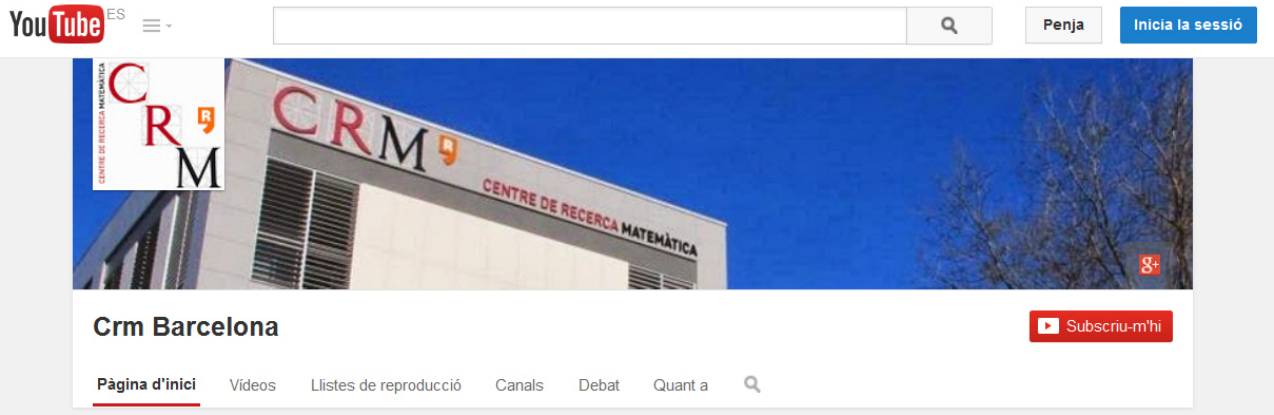
To host visiting researchers, the CRM uses the facilities provided by Vila Universitària at Bellaterra.

During 2017, the CRM computer equipment was based on a LAN Ethernet net of, approximately, eighty workstations based both on Microsoft and Linux operating systems and structured under a Windows domain. Among other services, the net included an e-mail server, a printer server (managing the tasks of five printers), a file server and a Firewall/Router *that linked it to the UAB infrastructure by means of a 1 Gb connection. The network was endowed with systems that allow the remote access via FTP, webmail access, SSH access to computing servers and a secure system through VPN to have access to the rest of center services. Facilities also included wifi internet connection, seven projectors and recording systems for all the meeting rooms, resources to videoconferencing, digital control systems for the meeting rooms, a tactile CRM presentation panel and the infrastructure for*

de control d'aules, un panell tàctil de presentació del CRM i una infrastructura de retransmissió de gravacions, tant en directe com en diferit (*streaming*). A més a més, el CRM compta amb el canal d'emissió on podreu trobar vídeos de conferències celebrades al centre:

live broadcasting and streaming. Morevoer, the CRM has opened a broadcast channel where you can find videos of lectures held in the center:

https://www.youtube.com/user/CRMatematica



1.10. Serveis externs

El CRM té contractats els serveis de l'empresa externa "Gestió laboral: 3F Consultors".

1.10. External services

The firm "Gestió laboral: 3F Consultors" has service contracts with the CRM.

2

Recerca i transferència de coneixement al CRM

Research and Technology at CRM

2.1. Grups de recerca

Tal i com s'ha esmentat a la secció 1.1, la política científica del CRM es concreta mitjançant dos eixos d'actuació, el segon dels quals contempla la creació de grups de recerca propis en àrees poc desenvolupades a Catalunya. Els següents grups de recerca del CRM actius durant el 2017 han estat:

2.1. Research Groups

As mentioned in Section 1.1, the scientific policy of the CRM has two main axes, the second one aiming at building its own research groups in underdeveloped areas in Catalonia. The active CRM research groups continued during 2017 have been:

- Anàlisi Harmònica i Teoria de l'Aproximació / *Harmonic Analysis and Approximation Theory*
- Biologia matemàtica i computacional / *Computational & Mathematical Biology*
- Epidemiologia Matemàtica / *Mathematical Epidemiology*
- Matemàtica Financera i Control de Riscos / *Financial Mathematics and Risk Control*
- Matemàtica Industrial / *Industrial Mathematics*
- Neurociència Computacional / *Computational Neuroscience*
- Sistemes Complexos / *Complex Systems*

A continuació s'exposen les línies de recerca de cada grup i les principals activitats dutes a termes durant el 2017.

Next, we focus on the research lines of each group and the main activities they have carried on during 2017.

Anàlisi Harmònica i Teoria de l'Aproximació
Harmonic Analysis and Approximation Theory

Àmbit de recerca

L'anàlisi harmònica estudia la representació de funcions o senyals com a superposició d'ones elementals. Avui, és un dels camps amb més aplicacions en matemàtiques, entre les quals hi ha el processament del senyal, la transmissió d'imatges, diversos camps en enginyeria, electrònica, física, probabilitat i molts altres camps de les matemàtiques.

La teoria de l'aproximació considera el problema d'aproximar de la forma més senzilla i acurada possible senyals complicats per altres més senzills i més manipulables. El significat de "senzill", "acurada", i "manipulable" depèn de l'aplicació que es consideri. La teoria d'aproximació és un àrea establerta de les matemàtiques en fase de creixement per la varietat de les seves aplicacions, no solament en matemàtiques (anàlisi numèrica, anàlisi en ondetes) sinó també en ciències de la computació, tractament del senyal, biomedicina, geomàtica, etc. Els avenços recents de naturalesa teòrica en aproximació no lineal han permès incrementar la capacitat de manipular i extreure informació de grans conjunts de dades.

Research Field

Harmonic analysis studies the representation of functions or signals as the superposition of basic waves. It is now one of the most applicable fields of modern mathematics. Among its many applications are signal processing/image transmission, various electrical and computer engineering applications, physics, probability theory and many fields of pure and applied mathematics.

Approximation theory considers the problems of best approximating general and possibly complicated functions by simpler and more easily calculated ones. Concepts "best", "simpler" and "easily calculated" depend on the applications. Although approximation theory is a well-established area of mathematics, it is currently experiencing a significant rise due to its wide applications both in mathematics (e.g., numerical, wavelet analysis) and in computer science, signal processing, biomedical optics and geographic information systems. Recent developments in nonlinear approximation theory are aimed at carrying out fundamental mathematical (compress, denoise,...) and algorithmic study to increase our ability to process large data sets.

Projectes vigents
Current Projects

- MTM2014-59174-P. *Methods of constructive approximation and Fourier analysis*, 2015–2017. PI: S. Tikhonov.

Membres del grup
Research Team

- Sergey Tikhonov (team leader)
- Thaís Jordão (post-doctoral researcher)
- Néstor Costa (PhD student)
- Alberto Debernardi (PhD student)
- Ainur Jumabayeva (PhD student)
- Askhat Mukanov (PhD student)
- Aizhan Ydyrys (PhD student)

Activitats relacionades
Related Activities

- Barcelona Analysis Seminar (every Monday, CRM or UB).
- Approximation Theory Seminar (every Monday or Tuesday; from September 2011).

Col·laboradors
Collaborators

• Andrey Bondarenko	Norwegian University of Science and Technology
• Feng Dai	University of Alberta
• Laura De Carli	Florida InternationalUniversity
• Michael Dyachenko	Moscow State University
• Erlan Nursultanov	EurasianUniversity
• Vladimir Temlyakov	University of South Carolina
• Walter Trebels	Technische Universität Darmstadt

Group Activity in 2017

During 2017 the members of the group studied the following topics: convergence of Fourier series, embedding theorems for function spaces, weighted norm inequalities for integral transforms, polynomial inequalities, estimates for moduli of smoothness.

In particular, Thaís Jordão investigated the Riemann Lebesgue type results on the sphere. Nestor Costa studied optimal decoding and related problems of harmonic analysis. Alberto Debernardi continued working on his PhD dissertation focusing on convergence of Fourier transforms of general monotone functions. Ainur Jumabaeva studied the (L_p, L_q) inequalities for best approximation and moduli of smoothness of the generalized Liouville derivatives. Aizhan Ydyrys obtained several results on asymptotical behavior of double trigonometric series with convex and monotone coefficients. Askhat Mukanov investigated different types of convergence of trigonometric series. S. Tikhonov has been working on embedding theorems for Besov spaces with limiting smoothness and weighted norm inequalities for Fourier-type transforms

Biologia matemàtica i computacional
Computational & Mathematical Biology

Àmbit de recerca

La majoria dels fenòmens estudiats per les Ciències Naturals, des de Ciència de Materials a Astrofísica, són processos d'escales múltiples, és a dir, fenòmens que impliquen l'acoblament de processos regits per escales espacials i temporals característiques molt diferents, de manera que

Research Field

Most phenomena studied by the Natural Sciences, from Material Sciences to Astrophysics, are multi-scale processes, i.e., they involve the coupling of multiple different processes characterised by widely-ranging time and length scales, with the macroscopic behaviour emerging from the

el comportament global emergeix d'aquesta interacció. Mentre que en el camp de les Ciències Físiques s'ha fet un progrés considerable en el tractament d'aquest tipus de fenòmen, els resultats per a sistemes biològics són més modestos. Aquesta circumstància es deu a què la unitat fonamental en sistemes vius (la cèl·lula) és molt més complexa que les corresponents unitats en sistemes inerts. Per tant, es necessiten tant models com mètodes nous per analitzar els processos d'escales múltiples en Biologia. Aquest és el camp de recerca del grup de Biologia Computacional i Matemàtica al CRM: la formulació de nous models que siguin rellevants tant per a biòlegs experimentals com per a investigadors clínics, i el desenvolupament de les eines computacionals i analítiques necessàries per al seu estudi. Ens centrem en problemes de rellevància clínica, en particular els relacionats amb càncer.

complex interactions between them. Whilst considerable progress has been done in dealing with such problems in the Physical Sciences, the success achieved so far in the Biological Sciences is rather more limited. This is partly due to the fact that the individual components of biological systems (e.g., cells) are much more complex than their counterparts in physical systems and, therefore, new methods and models are needed to analyse multi-scale processes in Biology. Such is the remit of the Computational & Mathematical Biology group at CRM: To propose new models relevant to experimental biologists and clinicians and develop the analytical and computational tools necessary for their analysis. We pay special attention to problems with clinical relevance, in particular those related to cancer.

L'activitat del nostre grup s'articula al voltant de les línies de recerca següents:

- Modelatge multiescala del creixement del tumor i l'angiogènesi.
- Mètodes híbrids per als models multiescala.
- Modelació estocàstica de la reprogramació de cèl·lules somàtiques.
- Robustesa i capacitat d'evolució i la seva relació amb la resistència als medicaments.
- Models estocàstics en dinàmica de poblacions.
- Biofísica teòrica: biofísica de membranes i microfluídica.

The research activity of our group is developed along the following lines:

- *Multiscale modelling of tumour growth and angiogenesis.*
- *Hybrid methods for multiscale models.*
- *Stochastic modelling of somatic cell reprogramming.*
- *Robustness and evolvability and their relation to drug resistance.*
- *Stochastic models in population dynamics.*
- *Theoretical biophysics: membrane biophysics and microfluidics.*

Projectes vigents
Current Projects

- MTM2015-71509-C2-1-R, *Evolutionary and stochastic modelling and analisys of multi-scale dynamics in Bio-medicine, 2016–2018. PI Tomás Alarcón and Andrei Korobeinikov.*

Membres del grup
Research Team

- Tomás Alarcón (ICREA Research Professor, team leader)
- Elisa Beltrán-Sáez (PhD student, FPU grant)
- Enric Costa-Miracle (PhD student, BGSMath FPI grant)
- Roberto de la Cruz (PhD Student, FI grant)
- Núria Folguera-Blasco (PhD Student, "la Caixa"-CRM)

• Victoria Ponce	(PhD Student, Heidelberg University)
• Josep Sardanyés	(Postdoc researcher, "la Caixa"-CRM)
• Daria Stepanova	(PhD Student)

Activitats relacionades
Related Activities

- Computational & Mathematical Biology Seminar

Col·laboradors
Collaborators

• Simone Ballocca	Universitat de Barcelona
• Mauricio Barahona	Imperial College London
• Rafael Barrio	(UNAM, México)
• Helen M. Byrne	University of Nottingham
• Pilar Guerrero	University College London
• Aurora Hernández-Machado	Universitat de Barcelona
• Philip K. Maini	Centre for Mathematical Biology, Oxford
• Javier Ménendez	ICO - IDIBGI
• Anna Meseguer	VHIR
• Markus R. Owen	Centre for Mathematical Medicine, Nottingham
• Karen M. Page	University College London
• Rubén Pérez-Currasco	Univ College London
• Fabian Spill	MIT & Boston University

Group Activity in 2017

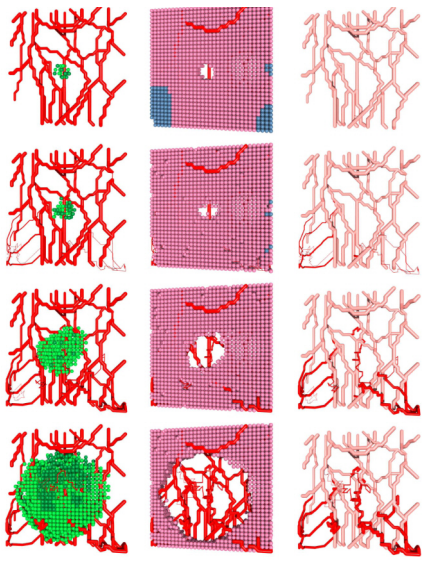
During 2017, the Computational & Mathematical Biology group has continued to develop its research activity around four basic axes: Stochastic multiscale modelling of tumour growth, hybrid methods for multiscale models, stochastic modelling of somatic cell reprogramming, and mathematical and experimental microfluidics. We have further started and/or consolidated collaborations with both the mathematical and experimental communities. As a result, we have ongoing collaborations with researchers from the Department of Applied Mathematics and Analysis, School of Mathematics, University of Barcelona, the School of Physics, University of Barcelona, Catalan Institute Oncology-IDIBGI, Girona, the Centre for Computer Vision, Bellaterra, and the Vall d'Hebron Research Institute (VHIR).

Concerning training, during 2017, six PhD projects are ongoing: Elisa Beltrán-Sáez, who is working on robustness of cellular signaling systems and its relation to drug resistance, Enric Costa-Miracle, who is doing his

PhD in mathematical modelling in microfluidics, Núria Folguera–Blasco, who is doing her PhD on models of reprogramming of somatic cells, Victoria Ponce, and Daria Stpanova.

Roberto de la Cruz defensed on September 8 his Ph.D. Dissertation entitled "Stochastic multi-scale modelling of tumour growth".

Finally, as research output, the group has published 7 papers in peer-reviewed journals during 2017. All of these were published in ISI journals of top quality.



Epidemiologia matemàtica

Mathematical Epidemiology

Àmbit de recerca

Els models matemàtics de les malalties infeccioses dels éssers humans, els animals domèstics i silvestres i les plantes constitueixen una àrea de recerca molt rellevant i en ràpida expansió. L'objectiu del recentment creat grup de recerca en Epidemiologia Matemàtica és l'estudi matemàtica de l'aparició i propagació de malalties infeccioses. El grup investiga en diferents direccions, com ara l'aparició de nous agents patògens, la seva evolució, la dinàmica de les malalties infeccioses en una població, així com la dinàmica de microparàsits dins d'un hoste. També treballem en l'elaboració d'una descripció matemàtica de la resposta immune, per analitzar-ne fallades com la que es dóna en la infecció per VIH. Estem interessats, a més,

Research Field

The mathematical modelling of infectious diseases of the humans, domestic and wild animals and plants is a rapidly expanding and a highly practically relevant area of research, and the aim of the newly established Mathematical Epidemiology Research Group is to study the emergence and spread of infectious diseases from a mathematical point of view. The group is working towards a number of directions of research such as the emergence of new pathogens, evolution of pathogens, the dynamics of infectious diseases in a population, as well as the dynamics of microparasites within a host. It is also dealing with mathematical description of immune response, as well as with its failure, as in the case of HIV infection. We are

en el control d'infeccions, tant a nivell d'un sol hoste com a nivell de població i, com a tasca de particular importància, ens proposem col.laborar amb epidemiòlegs i biòlegs en el desenvolupament d'estratègies racionals per al control de malalties infeccioses.

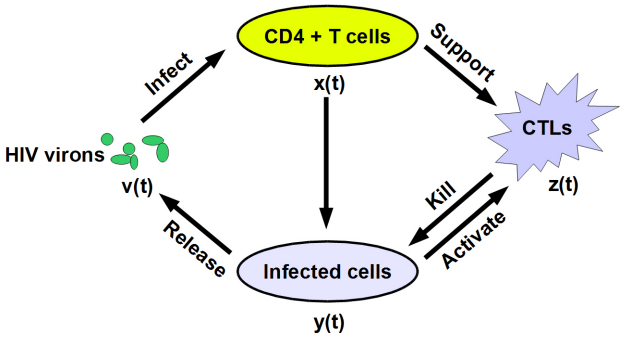
also interested in methods to control of infections, at both a single host and a population levels, and consider assisting the epidemiologists and biologists in the development of rational strategies for control of infectious diseases as a task of particular importance.

Des del grup d'Epidemiologia Matemàtica treballem en estret contacte amb científics experimentals i amb el grup de recerca en Biologia Computacional i Matemàtica del CRM. En la nostra recerca emprem models matemàtics i tècniques de la teoria de sistemes dinàmics per a descriure i estudiar la dinàmica de les malalties infeccioses. Els nostres interessos particulars se centren en la invasió de les infeccions emergents, en l'estabilitat i persistència d'un agent patogen, així com l'estabilitat de la resposta immune. Estem també interessats en l'evolució viral i microbiana, que és probablement el factor més important responsable de l'aparició de noves infeccions i per al desenvolupament de soques resistents als medicaments, i la prevenció d'un desenvolupament de medicaments i vacunes eficaces. Una de les direccions que actualment estem explorant activament és l'aplicació de les eines i mètodes de la teoria de control òptim per al control de malalties infeccioses.

The Mathematical Epidemiology group, working in close contact with experimental scientists and the Computational & Mathematical Biology Research Group, employs mathematical modelling and the mathematical technique of the Dynamical Systems Theory to describe and study the dynamic of infectious diseases. Our particular interests are in the invasion of emerging infections, in the stability and persistence of a pathogen, as well as the stability of immune response. We also interested in viral and microbial evolution, which is probably the most important single factor responsible for emergence of new infections and for development of drug resistant strains, and preventing a development of effective drugs and vaccines. One of the directions, which we are currently actively exploring, is application of the tools and methods of the Optimal Control Theory to the control of infectious diseases.

A part d'aquestes investigacions, recentment el grup també va començar a investigar el càncer. La nostra intenció és estudiar el càncer aplicant les mateixes tècniques (en particular, la modelització matemàtica, la teoria de sistema dinàmic i la teoria òptima del control) en aquesta direcció. Estem particularment interessats en problemes com la interacció entre el sistema immunològic i el càncer, la immunoedició i la immunoteràpia del càncer, el desenvolupament de la resistència immune pel càncer i l'optimització de les teràpies anticancerígenes. Hem establert contactes estrets amb els biòlegs de l'Institut d'Oncologia de Vall d'Hebron (VHIO) i l'Institut Català d'Oncologia (ICO) i l'Institut de Recerca Biomèdica de Bellvitge (IDIBELL) i esperem que finalment desenvolupem aquesta connexió en una col·laboració duradora i productiva.

Apart from these research direction, recently the Group also started research of cancer. Our intension is to study cancer applying the same techniques (in particular mathematical modelling, the dynamical system theory and the optimal control theory) in this direction. We are particularly interested in problems such as immune system and cancer interaction, cancer immunoediting and immunotherapy, the development of immune resistance by cancer and optimizing anticancer therapies. We established close contacts with biologists in the Vall d'Hebron Institute of Oncology (VHIO) and the Catalan Institute of Oncology (ICO) and the Bellvitge Institute for Biomedical Research (IDIBELL) and we hope to eventually develop these connection in lasting and productive collaboration.



Projectes vigents
Current Projects

- MTM2015-71509-C2-1-R, *Evolutionary and stochastic modelling and analisys of multi-scale dynamics in Bio-medicine*, 2016–2018. PI Andrei Korobeinikov and Tomás Alarcón.

Membres del grup
Research Team

- Andrei Korobeinikov (team leader)
- Anel Nurtay (PhD student)
- Stefano Pedarra (MSc student)
- Vladimir Sobolev (medium-term visitor researcher)
- Elena Shchepakina (medium term visitor researcher)

Activitats relacionades
Related Activities

- Computational & Mathematical Biology Seminar

Col·laboradors
Collaborators

• Santiago F. Elena	Instituto de Biología Molecular y Celular de Plantas
• Lourdes Esteva	Universidad Nacional Autónoma de México
• Ellina Grigorieva	Texas Woman's University
• Tomas Kelly	University College Cork
• Evgenii Khailov	the Moscow State University
• Michael O'Callaghan	University College Cork
• Alexander Pimenov	Weierstrass Inst. for Applied Analysis and Stochastics
• Dmitry Rachinskiy	the University of Texas at Dallas
• Leonid Shaikhet	Donetsk State University of Management, Donetsk
• Konstantin Starkov	Instituto Politécnico Nacional-CITEDI
• Cruz Vargas de León	Universidad Nacional Autónoma de México
• Graeme Wake	Massey University

Group Activity in 2017

During 2017, research activities of the group was mostly focused towards following directions:

1. Stability, persistence and global property of models in mathematical epidemiology, and in mathematical biology in general. This direction is a continuation of the earlier research of Prof. Korobeinikov However, recently this direction was extended, as modelling in cancer was also initiated by the Group.

2. Viral and microbial evolution. The goal of this project is mathematical study of pathogen evolution, including plant pathogens. Project is in collaboration with Santiago Elena (Evolutionary Systems Virology Group, Instituto de Biología Molecular y Celular de Plantas, Valencia), Josep Sardanyés (Group of Mathematical and Computational Biology, CRM), and with participation of Vladimir Sobolev and Elena Shchepakina (the Samara State Airspace University, Russia) and Graeme Wake (Massey University, New Zealand).

3. Optimal control of infectious diseases, at a population and a single host levels (including antiviral and cancer therapy). The goal is to employ the methods and tools of the optimal control theory to assist in the developing of the optimal (in a certain sense) antiviral therapy and rational strategies for control of infectious diseases. In collaboration with Prof. Ellina Grigorieva of Texas Woman's University, and Prof. Evgenii Khailov of the Moscow State University. Recently this research direction was also extended to incorporate research in optimal anti-cancer therapies.

4. Immune response, its failure, and development of AIDS. In collaboration with Prof. Yasuhiro Takeuchi of Shizuoka University, Japan, and Prof. Leonid Shaikhet of Tel Aviv University, Israel.

The group was visited by Prof. Sobolev and Prof. Shchepakina, who stay at the CRM for six weeks each.

Matemàtica Financera i Control de Riscos
Financial Mathematics and Risk Control

Àmbit de recerca

Les Finances Computacionals es troben en la intersecció entre el numèric i l'estocàstic. Un aspecte important de la recerca en aquest camp és millorar el rendiment dels mètodes de valoració i medició del risc.

De particular interès per al nostre grup és el càlcul eficient de les mesures de risc àmpliament

Research Field

Computational Finance lies at the intersection of numerical analysis and stochastic calculus. An important aspect of research in this field is to further increase the performance of pricing and risk measurement methods.

Of particular interest to our group is the efficient computation of the risk measures widely used

utilitzades en risc de crèdit i de mercat, com ara el Valor en Risc (VaR) i la *Expected Shortfall* (deute esperat); l'estimació acurada de les contribucions individuals de risc també és un tema rellevant. Desenvolupem mètodes numèrics capaços de calcular aquestes mesures en un temps de CPU curt, el que permet la reavaluació de carteres molt grans freqüentment i evitar d'aquesta manera simulacions de Monte Carlo que consumeixen massa temps. També estem interessats en la valoració dels derivats de crèdit, com ara CDOs (obligacions de deute garantides), que s'utilitzen normalment per transferir el risc associat a una determinada cartera subjacent. Fins al moment, la maquinària per dur a terme aquest treball es basa principalment en ondícules de Haar.

in credit and market risk such as the Value-at-Risk (VaR) and the Expected Shortfall. The accurate estimation of the individual risk contributions is an important issue as well. We develop numerical methods capable to calculate these measures in a short CPU time, allowing to rebalance very large portfolios frequently and avoiding this way the time-consuming Monte Carlo simulations. We are also interested in the valuation of credit derivatives such as Collateralized Debt Obligations, which are typically used to transfer the risk associated to a certain underlying portfolio. So far, the machinery to carry out this work is mainly based on Haar wavelets.

Projectes vigents
Current Projects

- CRM Research Group in Collaborative Mathematics, AGAUR. 2014–2016 (extended to April 2017). PI: Álvaro Corral
- Ministerio de Economía y Competitividad (MINECO). *Stochastic Finance* 2014–2016. P.I: José Manuel Corcuera Valverde, Universitat de Barcelona.

Membres del grup
Research Team

• Luis Ortiz	(team leader)
• Gemma Colldeforns	(PhD student, "la Caixa" and AGAUR)
• Ricard Alemany	(scientific collaborator)

Col·laboradors
Collaborators

• Cornelis W. Oosterlee	Centrum voor Wiskunde en Informatica and Delft University
• Elisa Alòs	Universitat Pompeu Fabra

Degut a canvis en el Pla Estratègic del CRM, que consistirán en la creació d'un grup de recerca en Big-Data, s'ha extingit el grup de recerca en Matemàtica Financera.

Due to changes in the Strategic Plan of the CRM, that will consist in the creation or a research group in Big-Data, the Financial Mathematics research group has been extinguished.

Matemàtica Industrial

Àmbit de recerca

La matemàtica industrial es pot definir com l'aplicació de les matemàtiques als problemes del món real. El camp sembla estar guanyant popularitat a tot el món. A Europa, el European Consortium for Mathematics in Industry ha estat promovent l'assignatura des de fa més de 25 anys, recentment en conjunt amb la EU-Math-In i fins a 2019 per la EU COST Network MI-Net.

Actualment, el grup de Matemàtiques Industrials del CRM està contribuint, en termes de recerca, principalment en l'aplicació de les matemàtiques a la nanotecnologia. Les activitats més tradicionals de IM es tenen en compte a través de la participació del grup en grups d'estudi.

Els temes de recerca principals tractats pels membres del grup durant el 2017 inclouen:

- Transferència de calor a nanoescala. Aquest treball està realitzat en col·laboració amb el departament de física de la UAB. L'objectiu principal és desenvolupar i analitzar models matemàtics per al flux de calor en situacions on la llei de Fourier es descompon. Els resultats s'han comparat molt favorablement amb experiments sobre nanocables de silici.

- Captació d'energia mitjançant nanofluids en una cèl·lula solar d'absorció directa. Això segueix el treball de Cregan & Myers de 2015. Actualment estem buscant diferents dissenys i configuracions de flux per millorar l'eficiència.

- Creixement de nanocristalls de la solució. Aquest projecte va sorgir a partir d'un problema presentat al 2016 European Study Group with Industry, que es va celebrar al CRM l'any 2016. És una col·laboració amb l'Institut Català de Nanociència i Nanotecnologia.

Industrial Mathematics

Research Field

Industrial mathematics can be defined as the application of mathematics to real-world problems. The field appears to be gaining in popularity throughout the world. In Europe the European Consortium for Mathematics in Industry has been promoting the subject for over 25 years, they have now been joined by EU-Math-In and until 2019 the EU COST Network MI-Net.

The Industrial Mathematics group at the CRM is currently contributing, in terms of research, primarily in the application of mathematics to nanotechnology. More traditional IM activities are not forgotten through the group's involvement in Study Groups.

The primary research topics dealt with by group members during 2017 included:

- *Heat transfer at the nanoscale. This work is in collaboration with the physics department at UAB. The main goal is to develop and analyse mathematical models for heat flow in situations where Fourier's law breaks down. Results have compared very favourably with experiments on silicon nanowires.*

- *Energy capture using nanofluids in a Direct Absorption Solar Cell. This follows the work of Cregan & Myers in 2015. We are currently looking into different designs and flow configurations to improve efficiency.*

- *Nanocrystal growth from solution. This project grew from a problem presented at the 2016 European Study Group with Industry, held at the CRM in 2016. It is a collaboration with the Catalan Institute for Nanoscience and Nanotechnology.*

□ Efecte Kirkendall. Com a primer intent d'analitzar la producció de nanocristalls buits, es va desenvolupar un model de difusió binària (entre dos metalls). El treball inicial ha avançat bé, en el futur esperem incloure nano-efectes.

□ *Kirkendall effect. As a first attempt to analyse the production of hollow nanocrystals we developed a model for binary diffusion (between two metals). Initial work has progressed well, in the future we hope to include nano-effects.*

□ Imatge de nanopartícules amb llum visible. Es tracta d'una col·laboració amb un centre de recerca francès, CEMES. L'objectiu és desenvolupar un model matemàtic per ajudar a analitzar les franges d'interferència produïdes per una nanopartícula en una ona de llum.

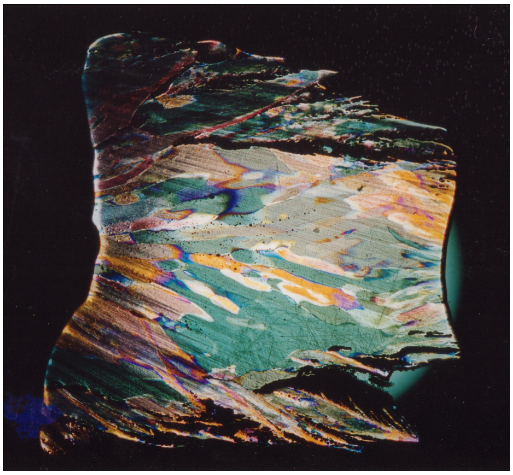
□ *Imaging of nanoparticles with visible light. This is a collaboration with a French research centre, CEMES. The goal is to develop a mathematical model to help analyse the interference fringes produced by a nanoparticle on a light wave.*

En reunions de matemàtiques industrials a Sud-àfrica i Irlanda, els membres del grup han treballat en la combustió espontània; el fluid prop de les parets d'una caldera de sucre i amortiment del soroll.

In industrial mathematics meetings in South Africa and Ireland group members worked on spontaneous combustion; flow near the walls of a sugar boiler and noise damping.

El grup ha acollit com a investigadors visitants el Dr Adewumni Fareo de Sud-àfrica, el Dr Iain Moyles d'Irlanda i el Prof. Brian Wetton de Canadà per treballar en projectes que involucren l'evaporació en canonades de refrigeració i la fuga tèrmica en bateries.

The group hosted visitors Dr Adewumni Fareo from South Africa, Dr Iain Moyles from Ireland and Prof. Brian Wetton from Canada to work on projects involving evaporation in cooling pipes and thermal runaway in batteries.



Projectes vigents
Current Projects

- MTM2014-56218-C2-1-P. Dinámica de fluidos complejos y fronteras *móviles*. 2015–2017. P.I.: Tim Myers; Team Members: Vincent Cregan, Helena Ribera; Sub-Project 2: Susana Serna, Antonio Marquina.
- MARIE SKLODOWSKA-CURIE ACTIONS Individual Fellowship: Nanoheat, 140K to fund Post-doc Matt Hennessy.

• Mathematical modelling of Nanoscale and Energy Technologies, New Foundations grant, Ireland. P.I.: Iain Moyles (University of Limerick). Team members Matt Hennessy, Brian Wetton, Tim Myers.

Membres del grup
Research Team

- Tim Myers (team leader)
- Vincent Cregan ("la Caixa" post-doc 04/2014-03/2017)
- Matt Hennesy (Marie Curie Post-Doc, 09/2016-08/2018)
- Helena Ribera ("la Caixa" PhD, since 09/2014-03/2018)
- Marc Calvo ("la Caixa" PhD, since 09/2015, previously Masters student in IM group)
- Claudia Fanelli (BGSM PhD, since 09/2016)
- Gary O'Keeffe (PhD student, University of Limerick, TM joint supervisor)
- Curial Gallart (Final Year graduate, UAB)
- Dani Salgado (Final year graduate, UAB)

Activitats relacionades
Related Activities

• TM is currently the Short Term Scientific Mission Manager and a member of the Management Committee for the EU COST Action TD1409 Maths for Industry Network, MI-Net. He is the co-ordinator of the European Study Groups with Industry and the Spanish Representative on the council for the European Consortium for Mathematics in Industry. He was a member of the scientific committee for the conferences Recent Advances in Moving Boundary Problems in Mechanics, International Union of Theoretical and Applied Mechanics, held in New Zealand, Feb. 2018 and the Knowledge Exchange Community Meeting – Industrial Maths in Action, held in Edinburgh in September, 2017.

He is on the editorial board of Mathematics in Industry Case Studies and the RSME-Springer book series and also a Panel Member for the evaluation of this year's Portuguese ministry funding for mathematics projects.

Matt Hennessy and TM both presented projects for the undergraduate course on Mathematical Modelling at UPC (although since TM was also visiting France for most of this period Helena replaced him on the course). Marc Calvo teaches undergraduate mathematics at the EAE Business school.

Col·laboradors
Collaborators

• Sarah Mitchell	University of Limerick
• Brian Wetton	University of British Columbia
• Gideon Fareo	University of the Witwatersrand
• Francesc Font	Universitat Politècnica de Catalunya
• Xavier Alvares	Universitat Autònoma de Barcelona
• Wolfgang Bacsa	Centre d'Elaboration de Matériaux et d'Etudes Structurales
• Iain Moyles	University of Limerick

Group Activity in 2017

The group's research into nanotechnology has now led to various solid collaborations and fascinating research topics. Marc Calvo and Matt Hennessy are both working with a group in the physics department at UAB on heat flow at the nanoscale. This allows the coupling of exciting new mathematical models to experimental data.

Claudia Fanelli is working on the problem of nanocrystal growth, in collaboration with the Inorganic Nanoparticles Group of ICN2. The work seems to be leading to a corrected basic model for the initial growth of particles. Helena Ribera's PhD is almost finished, her final research led to models for binary diffusion and a novel solution approach, using cellular automata. She is currently involved in the work on imaging nanoparticles with visible light at CEMES in France. Gary O'Keeffe will also submit in 2018, his work has led to new design considerations for a specific type of solar cell which uses nanofluids.

Matt Hennessy and TM were both invited experts at a Study Group in Cape Town, where TM also gave a public lecture on mathematics in nanotechnology. TM was also invited to the European Study Group in Ireland. Helena and Claudia both attended a mathematical modelling week at the ICMS in Edinburgh.

The group has also been active in outreach, participating in the talk series Bojos per les Matematiques (Mad for Maths) which involves giving a four hour presentation to talented final year school children. A shorter presentation was given to students at a local school, Colegio Europa, in Sant Cugat.

Marc Calvo teaching maths at EAE Business School.

Group members published 8 journal articles in 2017, with another two accepted (and already appeared in January 2018)

Neurociència Computacional

Àmbit de recerca

La neurociència computacional és un subcamp de la neurociència en el qual el models computacionals s'usen per a entendre millor com funciona el sistema nerviós. Es tracta d'un camp molt vast, que disposa de molts tipus diferents de model, des dels estadístics o probabilístics, fins a les equacions diferencials. Com que la major part del treball experimental en neurociència requereix algun grau de modelatge, encara que només sigui a nivell d'anàlisi de dades, no hi ha una divisió clara entre la neurociència experimental i la computacional. Això implica que una col.laboració estreta entre teòrics i experimentalistes és molt important, i fa que la tasca computacional estigui molt condicionada per les dades experimentals.

En el Grup de Neurociència Computacional del CRM, ens centrem principalment en la dinàmica de microcircuits corticals, és a dir, conjunts de centenars o milers de neurones de l'escorça cerebral. En particular, s'estudia la paper de la connectivitat recurrent en la conformació de l'activitat espontània en models de microcircuits corticals. Aquest tema de recerca molt oportú en aquests moments perquè les dades de connectivitat cortical han anat en augment en l'última dècada, i s'han produït millores notables en mesures d'activitat simultània d'un gran nombre de neurones. Un objectiu futur seria identificar quins aspectes de la connectivitat de la xarxa són més importants per al processament cortical en els models, i llavors dirigir els experiments a buscar patrons similars en el cervell. Estudiem models de formació i consolidació de la memòria per tal d'explorar els límits computacionals dels sistemes de memòria biològics i orientar sobre els mecanismes fisiològics involucrats en la memòria del cervell animal.

Desenvolupem també models computacionals de circuits computacionals per tal d'aclarir els mecanismes dinàmics subjacents a la conducta animal durant tasques cognitives elementals tal

Computational Neuroscience

Research Field

Computational neuroscience is a sub-field of neuroscience proper in which computational models are used to learn something about how the nervous system works. It is a broad field, encompassing many different types of models, from statistical or probabilistic models, to differential equations. As most experimental work in neuroscience already requires some degree of modeling, if only at the level of data analysis, there is no clear divide between experimental and computational neuroscience. This means that close collaboration between theorists and experimentalists is important. At the very least, modeling work must be constrained by experimental data.

In the Computational Neuroscience group at the CRM, we focus mainly on the dynamics of cortical microcircuits, that is ensembles of hundreds or thousands of neurons in the cerebral cortex. In particular, we study the role of the recurrent connectivity in shaping spontaneous activity in models of cortical microcircuits. This is a timely topic because data on cortical connectivity has been increasing over the past decade, as well as improved measurements of the simultaneous activity of large numbers of neurons. A future goal would be to identify which aspects of network connectivity are most important for cortical processing in models, and then direct experimentalists to look for similar patterns in the brain. We study models of memory formation and memory consolidation in order to explore the computational limits of biological memory systems and shed light on the physiological mechanisms involved in memory in the animal brain.

We also work on developing computational models of cortical circuits to shed light on the neural network dynamics underlying an animal's behavior during elementary cognitive tasks such as working

com la memòria de treball o les preses de decisions perceptuals. Complementem els projectes de modelització amb l'anàlisi de dades neuronals d'alta dimensió obtingudes per col.laboradors del nostre grup (e.g. registres simultanis de poblacions grans de neurones o dades de neuroimatge funcional amb humans), fent servir mètodes estadístics d'ùltima generació i mètodes d'aprenentatge automàtic.

memoryh and perceptual decision making. Modelling efforts are complemented by analysis of typically high-dimensional neural data obtained by collaborators (e.g. simultaneous recordings from large populations of neurons or human neuroimaging data) involving state-of-the-art statistical and machine learning tools.

El grup de Neurociència Computacional es va iniciar el maig de 2012. Durant l'any 2017 l'equip ha estat format per tres estudiants doctorants: Marina Vegué, Bernat Rovira i Genís Prat i un posdoc, el Helmut Schmidt.

The Computational Neuroscience Group was started in May 2012. In 2017 the group was made up of three doctoral students: Marina Vegué, Bernat Rovira and Genís Prat, and one postdoctoral researcher, Helmut Schmidt.

Aquest any es va incorporar un nou investigador Ramón i Cajal al Grup en qualitat de co-IP, el Klaus Wimmer. El seu camp de treballa és la recerca en dinàmica de xarxes neuronals sustentant funcions cognitives bàsiques com ara la memòria operativa i la presa de decisions de percepció. Compagina l'estudi de models de xarxes neuronals amb l'anàlisi de dades experimentals (obtingudes d'enregistraments neuronals en primats ensinistrats i neuroimatges humanes obtingudes en laboratoris de col·laboradors experimentals). En particular, treballarà en estendre les models computacionals de circuits locals actuals de processos de presa de decisió cap a una xarxa de circuits interactius que permetran estudiar la contribució de diverses àrees del cervell al còrtex parietal i prefrontal per elaboració de decisions i manteniment de memòria.

In May this year, Klaus Wimmer joined the group as a Ramón y Cajal researcher and co-PI. His focus is on investigating the neural network dynamics underlying elementary cognitive functions such as working memory and perceptual decision making. He complements the study of neural network models with analysis of experimental data (obtained from neural recordings in behaving primates and from human neuroimaging in the laboratories of experimental collaborators). In particular, he will work on extending current local-circuit computational models of decision making processes towards a network of interacting circuits that will allow to study the contribution of different brain areas in the parietal and prefrontal cortex to decision build-up and memory maintenance.

Projectes vigents
Current Projects

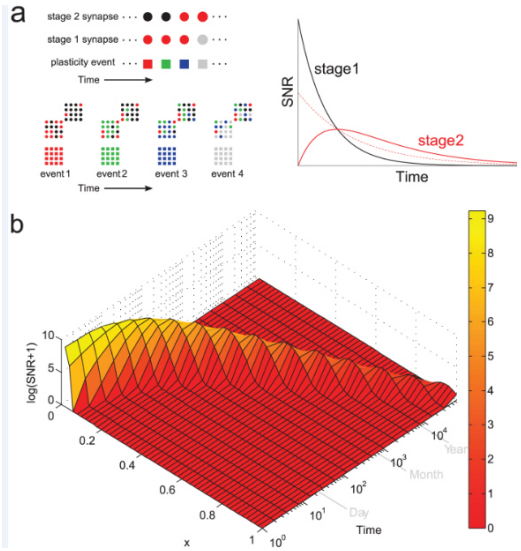
- MINECO, BFU2017-86026-R, *Neural network dynamics of distributed decision circuits*, CRM, 1/1/2018–31/12/2020 PI: Alex Roxin, Klaus Wimmer.

Membres del grup
Research Team

- Alex Roxin (team leader)
- Klaus Wimmer (team leader)
- Marina Vegué (PhD student)
- Bernat Rovira (PhD student)
- Genís Prat (PhD Student)
- Helmut Schmidt (BGSMath Postdoctoral researcher)

Col·laboradors
Collaborators

- Albert Compte IDIBAPS
- Jaime de la Rocha IDIBAPS
- Duane Nykamp University of Minnesota
- Ernest Montbrió UPF
- Tobias Donner UKE Hamburg
- Tatiana Pasternak University of Rochester



Group Activity in 2017

In 2017 we continued work on cortical connectivity (thesis work of Marina Vegué) (Vegué et al. J. Neurosci. 2017), perceptual decision making (thesis work of Genís Prat) and recall dynamics in attractor neural networks (thesis work of Bernat Rovira). We also developed mean-field theory for networks of spiking neurons in collaboration with Ernest Montbrió, Duane Nykamp and Albert Compte, leveraging this theory to study the role of oscillations in memory storage and recall with postdoctoral researcher Helmut Schmidt. Finally, we worked on testing whether experimental data supports one of two conflicting computational models of the neural basis of working memory in prefrontal cortex (stable vs. dynamic coding models).

Sistemes Complexos

Complex Systems

Àmbit de recerca

Podem considerar com a sistemes complexos aquells formats per un nombre molt gran de components que interactuen intensament. Molts

Research Field

We can consider complex systems to be the ones formed by a large number of heavily interacting elements. As a result, many of mankind's greatest

dels reptes actuals de la humanitat estan en comprendre el comportament de sistemes complexos, com ara el clima, l'economia, la societat, el cervell humà, la biologia del desenvolupament, etc. En oposició a aquest concepte, l'àtom d'hidrògen, el sistema solar o un gas ideal serien sistemes simples, malgrat que per descriure'ls necessitem conceptes profunds de la física i matemàtiques sofisticades. Tanmateix, si tot allò que és complex és un sistema complex, què aporta de nou el nou paradigma de la complexitat? Tots aquests sistemes d'àmbits tan diversos poden ser tractats des d'una única perspectiva? Una de les idees clau en els estudis de complexitat és que les estructures apareixen en aquest tipus de sistemes a tots els nivells, incloent nivells molt llunyans dels propis de la interacció entre els components i, a més, mostren regularitats estadístiques sorprenents.

challenges come from trying to unravel the behaviour of these systems, such as the climate, the economy, the society, the brain, biological development, etc. Contrary to this, the hydrogen atom, the solar system or an ideal gas would be simple systems, despite the fact that in order to study them we need to use in-depth physics concepts and sophisticated mathematics. However, if everything that is complex is a complex system, what does the new science of complexity bring to the table? Can such wide-ranging systems be tackled with a single perspective? One of the key ideas in complexity studies is that structures appear in these types of systems at all levels, including levels far in excess from those achieved by the interaction between components; in addition to this, the structures also show surprising statistical regularities.

En el grup de Sistemes Complexos del CRM ens concentrem en dues línies de recerca: la primera, desastres naturals i fenòmens meteorològics, resultat de l'activitat complexa de la Terra; i la segona, l'estructura de la informació en la comunicació entre humans, originada per l'activitat complexa de les zones cerebrals que les controlen i de les relacions socials entre els comunicadors. A la línia de desastres naturals investiguem els patrons d'ocurrència de terratrèmols, incendis forestals, huracans, pluja, etc., amb la idea que les seves propietats estadístiques amaguen claus per a la seva comprensió, modelització i previsió. Pel que fa a la comunicació humana, ens fixem tant en el llenguatge humà com en la música. Novament, estudiem patrons d'ocurrència, aquest cop dels símbols que componen els textos o les peces musicals, per tal d'entendre millor com funcionen aquestes característiques tan exclusives del gènere humà i, per què no?, esbrinar si les màquines les podrien reproduir.

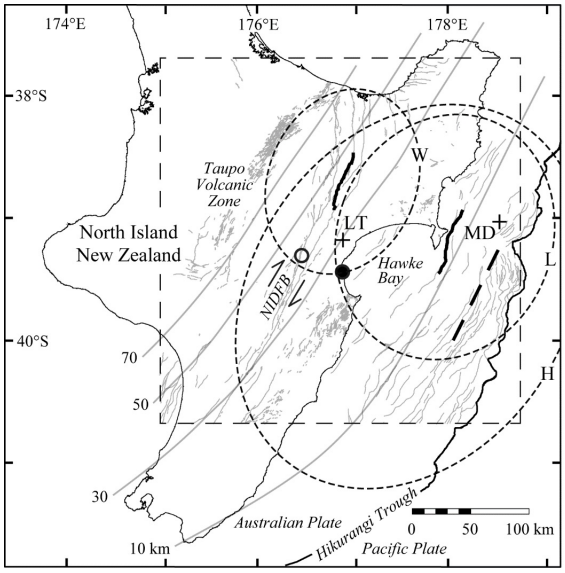
At the CRM Complex Systems Group, we focus on two major lines of research: one, natural disasters and meteorological phenomena, resulting from the complex activity of the Earth's system, and the other, the structure of information in human communication, produced by the areas of the brain responsible for this and the relationship between the communicating agents. Regarding natural hazards, we study the occurrence patterns of earthquakes, forest fires, hurricanes, rainfall, etc., with the idea that the statistical properties of these phenomena contain key information for their understanding, modelling and forecasting. In relation to human communication, we concentrate both in natural language and in music. Again, we study occurrence patterns, this time of the symbols that constitute the texts or the musical compositions, in order to better understand how these unique characteristics of humans work, and also, why not?, to guess whether machines could reproduce them.

Projectes vigents
Current Projects

- 2014SGR1307 AGAUR. *CRM research group in Collaborative*, Mathematics 2014–2017. PI: Álvaro Corral. Number of researchers: 18

• FIS2015-71851-P. *Sistemas invariantes de escala: herramientas, evidencia empírica, modelos y limitaciones*, Ministerio de Economía y Competitividad, 2016–2018. PI: Álvaro Corral. Number of researchers: 2.

• MAT2015-69777-REDT. *Avalanchas en Biofisica, Geofisica, Materiales y Plasmas*, ABIGMAP, MINECO, 2016–2017. PI: Eduard Vives Santa-Eulalia.



Membres del grup
Research Team

- Álvaro Corral (team leader)
- Isabel Serra (Postdoctoral res., "la Caixa"-CRM, since 09/2014)
- Víctor Navas (PhD student, "la Caixa"-CRM, since 01/2016)

Activitats relacionades
Related Activities

• Workshop on Avalanche Processes in Condensed Matter Physics and Beyond, Centre de Recerca Matematica, January 2017.

• VI Jornada complexitat.cat, IN3-UOC, Castelldefels, Barcelona, May 2017.

Col·laboradors
Collaborators

• Elsa Arcaute	University College London
• Ramon Ferrer-i-Cancho	Universitat Politecnica de Catalunya
• Francesc Font-Clos	ISI Foundation, Torino
• Rosalba Garcia-Millan	Imperial College London
• Abigail Jimenez	Ulster University
• Eugenio Lopez Periago	Universidad de Vigo

• Cristina Masoller	Universitat Politecnica de Catalunya
• Nicholas R. Moloney	London Mathematical Laboratory
• Joan Serrà	Telefonica I+D
• Eduard Vives	Universitat de Barcelona

Group Activity in 2017

During 2017 we have witnessed the incorporation to the group of Antoine Allard as la Caixa postdoctoral researcher. Predoctoral researcher Victor Navas has obtained the prestigious FPI grant from the MINECO. We have had the long-term visit of our colleague Abigail Jimenez. The main research of the group has focused on scaling laws, in concrete finite-size scaling, applied to the theory of branching processes, difussion phenomena, and quantitative linguistics. We have also performed analysis of fracture experiments and seismological data. Some papers about these research have been published in important journals. The group has continued also some consulting projects that started in previous years. Some guests that have contributed to the CRM CAMP Seminars are Bernat Corominas-Murtra and Abigail Jimenez.

2.2. Personal investigador / Research Staff

En correspondència amb els dos eixos d'actuació del CRM, en el Centre hi conviuen dos tipus de personal investigador: els investigadors vinculats contractualment al CRM, que llistem en aquesta secció, i els investigadors visitants (secció 2.5).

Accordingly with the two activity axes of CRM, two types of researchers can be found: the ones employed by CRM, quoted in this section, and visiting researchers (Section 2.5).

2.2.1. Investigadors Sènior

2.2.1. Senior Researchers

Tomás Alarcón

During 2017, my research has focused on four main subjects, all related to issues arising in cancer and cancer therapeutics: coarse-graning and hybrid methods for stochastic multi-scale models of tumour growth, mathematical modelling of epigenetic plasticity and cell fate plasticity in aging and cancer, robustness of information transmission through cell surface receptors systems, and mathematical modelling of scratch assays as experimental models of cell motility and population dynamics. Besides my work on cancer modelling, I have continued my collaboration with Prof. Aurora Hernandez-Machado, Dep. of Condensed Matter Physics, Universitat de Barcelona, on theoretical and experimental microfluidics.

This work is being carried out with experimental and theoretical collaborations, both locally and abroad. Current active theoretical collaborators include Helen Byrne and Philip Maini (Oxford), Pilar Guerrero, Karen Page, and Ruben Perez-Carrasco (University College London), Mauricio Barahona (Imperial College London),

Thomas Carraro (University of Heidelberg), Miguel O. Bernabeu (Institute of Medical Informatics, Edinburgh), Rafael Barrio (UNAM), Juan Calvo (Universidad de Granada). Furthermore, I have consolidated a network of collaborations with experimental biologists and experts in image analysis, which is essential to carry out the interdisciplinary research carried out in my group. Current collaborations include: Javier Menendez (Metabolism & Cancer Group, Catalan Institute of Oncology, Girona), Anna Messeguer (Renal Physiology, Vall d'Hebron Institute of Research, Barcelona), Simone Balloco (Centre for Computer Vision, Barcelona), Santiago Elena (Institute for Molecular and Cell Biology of Plants, CSIC, Valencia), and Hernando del Portillo (Institue for Global Health, Barcelona).

In 2017, I have been a co-organiser, jointly with Philip Maini (Oxford), Fred Nijhout (Duke), and Pablo Padilla, (UNAM) of the MBI Emphasis Semester on *Growth and Morphogenesis*, held at the Mathematical Biology Institute, Columbus, Ohio, USA, Spring Term, 2017. Within this emphasis programme I also organised, in collaboration with Helen Byrne, Oxford, and James Glazier, Indiana, the Workshop on *Hybrid multi-scale modelling and validation* held at the Mathematical Biology Institute on 27–31 March, 2017.

□ Publications

Articles

- H. Perfahl, B.D. Hughes, T. Alarcón, P.K. Maini, M.C. Lloyd, M. Reuss, H.M. Byrne, *3D Hybrid modelling of vascular network formation*, J. Theor. Biol. **414**, 254-268 (2017).
- C. Trejo-Soto, E. Costa-Miracle, I. Rodriguez-Villarreal, J. Cid, M. Castro, T. Alarcón, A. Hernandez-Machado, *Front microrheology of the non-Newtonian behaviour of blood: Scaling theory of erythrocite aggregation by aging*, Soft Matter **13**, 3042-3047 (2017).
- J.A. Menéndez, T. Alarcón, *Senescence-inflammatory regulation of reparative cellular reprogramming: a threshold model of epigenetic plasticity in aging and cancer*, Frontiers in Cell and Developmental Biology **5**, 49 (2017).
- R. de la Cruz, P. Guerrero, J. Calvo, T. Alarcón, *Coarse-graining and hybrid methods for efficient simulation of stochastic multi-scale models of tumour growth*, J. Comp. Phys. **350**, 974-991 (2017).

Preprints

- J. Sardanyés and T. Alarcón, *Noise-induced bistability in the fate of cancer phenotypic quasispecies: a bit-strings approach*. To appear in Scientific Reports (2017).
- R. de la Cruz, R. Pérez-Carrasco, P. Guerrero, T. Alarcón, K.M. Page, *Epigenetic regulation of cell fate reprogramming in aging and disease: A predictive computational model*. To appear in Phys. Rev. Lett. (2017).
- N. Folguera-Blasco, E. Cuyàs, J.A. Menéndez, T. Alarcón. To appear in PLoS Comp. Biol.(2017).

Research projects

- *Multiscale modelling and analysis in systems biology and biomedicine (Coordinated project CRM-UPC)*, Centre de Recerca Matematica 01-01-2015–31-12-2018, PI: Tomás Alarcón & Andrei Korobeinikov
- *Grup de Recerca en Matemàtica Col·laborativa del CRM*, Generalitat de Catalunya, 2014SGR-01307, AGAUR 20142016 (extended to April 2017), PI: Álvaro Corral

Activity in research training

- Elisa Beltrán-Sáez. Funded by a FPU scholarship. Subject: *Evolutionary dynamics of systems with degeneracy*, since October 2014 – Present.
- Enric Costa-Miracle. Funded by a FPI scholarship associated to the Maria de Maeztu–BGSMath Unit. Subject: *Mathematical modelling in microfluidics*. November 2014 – Present. Co-supervised by Aurora Hernández-Machado (School of Physics, Universitat de Barcelona).
- Roberto de la Cruz. Funded by a scholarship of the Generalitat de Catalunya (FI-AGAUR). Subject: *Stochastic multi-scale modelling of tumour growth*. January 2013 – Present. Co-supervised by Pilar Guerrero (Dep. Mathematics, University College London, UK).
- Núria Folguera-Blasco, PhD student (CRM), co-supervised by Javier A. Menendez (ICO-IDIBGI).
- Victoria Ponce, PhD student (based at the University of Heidelberg), co-supervised by Thomas Carraro (University of Heidelberg) and Helen M. Byrne and Philip K. Maini (Mathematical Institute, University of Oxford).
- Daria Stepanova, PhD student (CRM), co-supervised by Helen M. Byrne and Philip K. Maini (Mathematical Institute, University of Oxford).
- Master's thesis: Hybrid and adaptive methods for simulation of stodhastic reaction-diffusion systems, September 2017.

Teaching activity

- Applied Stochastic Methods, MSc in Modelling for Sciences and Engineering, Universitat Autònoma de Barcelona, December 2017-January 2018.

Scientific activities

Organisation

- Co-organiser (jointly with Helen Byrne, Oxford, and James Glazier, Indiana) of the Workshop on *Hybrid Multi-scale modelling and validation*, MBI Emphasis Semester on *Growth and Morphogenesis*, held at the Mathematical Biology Institute, Columbus, Ohio, USA, 27–31 March, 2017.

• Co-organiser (jointly with Philip Maini, Oxford, Fred Nijhout, Duke, and Pablo Padilla, UNAM) of the MBI Emphasis Semester on *Growth and Morphogenesis*, held at the Mathematical Biology Institute, Columbus, Ohio, USA, Spring Term, 2017.

Invited lectures in conferences

• T. Alarcón. *Mathematics for oncology: multi-scale modelling of tumour growth*. Plenary talk, Joint Meeting the Swedish, Catalan, and Spanish Mathematical Societies, Umea, Sweden, June 2017.

• T. Alarcón. *Stochastic modelling of gene regulatory networks under epigenetic regulation: oncometabolic nuclear reprogramming of cancer stemness*. Invited talk, 9th International Conference Engineering of Chemical Complexity, Vilanova i la Geltru, Barcelona, Spain, June 2017.

• T. Alarcón. *Mathematics for oncology: multi-scale modelling of tumour growth*. Plenary talk, Conference on Differential Equations and Applications/Conference on Applied Mathematics (CEDYA/CAM) 2017, Cartagena, Spain, June 2017.

• T. Alarcón. *Mathematics for oncology: multi-scale modelling of tumour growth*. Invited talk, Workshop on Dynamical Systems in Biology 2017, Basque Centre for Applied Mathematics (BCAM), Bilbao, Spain, July 2017.

Courses delivered

• Applied stochastic processes: Simulation and model reduction techniques, Advanced course. A Coruña, October 2017.

Seminars

• T. Alarcón. *Mathematics for oncology: multi-scale modelling of tumour growth* Seminar at the Department of Media Technologies, La Salle School of Engineering, Universitat Ramón Llull, Barcelona, Spain, April 2017.

• T. Alarcón. *Plasticity and heterogeneity of epigenetic states: the roles of oncometabolic transformation and aging*. Seminar at the Aragón Institute for Studies in Engineering (IA3E), Zaragoza, Spain, May 2017.

Research stays

• MBI Emphasis semester on Growth and Morphogenesis, Mathematical Biology Institute, Columbus, Ohio, USA, March 2017.

□ Technology transfer

• I. Rodriguez-Villarreal, T. Alarcon, J. Colomer, A. Hernandez-Machado, P. Miribel. *Method and apparatus for measuring viscosity of Newtonian and Non-Newtonian fluids*. Number 15/574,021, national phase US priority of the PCT/EP2016/060835. Reference 16-0005736, regional phase of the PCT/EP2016/060835.

□ Other activities

- Deputy director, Centre de Recerca Matematica, March 2016 – Present.
- Member of the Scientific Committee of the Catalan Mathematical Society. March 2015–Present.
- Member of the Scientific Committee of the Barcelona Graduate School of Mathematics (BGSMath). September 2014–Present.

Álvaro Corral

During 2017, the research activity of A. Corral has been dispersed across several research lines, including scaling laws, in concrete finite-size scaling applied to the theory of branching processes, diffussion phenomena, and quantitative linguistics. Also, analysis of fracture experiments and seismological data have been performed. An important effort has been dedicated to the preparation of a proposal of a Marie-S.-Curie ITN project about prediction of climatic extremes.

A. Corral has also continued his work in the Scientific Committee of the GEFENOL Summer School. He has had the great honor and responsability of being elected president of the so-called complexitat.cat network (Associació Catalana per a l'Estudi dels Sistemes Complexos).

□ Publications

Articles

- D. Soto, M. Paradelo, A. Corral, and J.E.L. Periago, *Pressure jumps during drainage in macroporous soils*. Vadose Zone Journal 16 (2017), doi:10.2136/vzj2017.04.0088.
- A. Corral and F. Font-Clos, *Dependence of exponents on text length versus finite-size scaling for word-frequency distributions*. Physical Review E 96 (2017), 022318.
- I. Serra and A. Corral, *Deviation from power law of the global seismic moment distribution*. Scientific Reports 7 (2017), 40045.

Preprints

- V. Navas-Portella, I. Serra, A. Corral, and E. Vives, *Increasing power-law range in avalanche amplitude and energy distributions*. `arxiv1711.06007`, (2017).

□ Research projects

- *Sistemas invariantes de escala: herramientas, evidencia empírica, modelos y limitaciones*, Ministerio de Economía y Competitividad, FIS2015-71851-P. From 2016 to 2018. PI: Álvaro Corral
- *Grup de Recerca en Matemàtica Col·laborativa del CRM*, Generalitat de Catalunya, 2014SGR-01307, AGAUR 20142016 (extended to April 2017), PI: Álvaro Corral

• *Avalanchas en Biofisica, Geofisica, Materiales y Plasmas, ABIGMAP*, MAT2015-69777-REDT (Redes de Excelencia) DGICT, MINECO 2016 to 2017, 3PI: Eduard Vives Santa-Eulalia.

□ Activity in research training

Supervision of research students

Bachelor theses supervised

- Irina Espejo (Mathematics, July 2017)
- Alfredo Hernandez (Physics, July 2017)
- Eider Ibiricu (Mathematics, July 2017)

□ Diffusion activity

• A. Corral, A. Roxin, and T. Alarcon, *La ciencia dels sistemes complexos al Centre de Recerca Matematica*. Notícies de la Societat Catalana de Matematiques 41 (2017), 50–57.

• A. Corral, *Complex Systems at CRM: Natural Hazards, Language, Music...* Talk for Danish high-school students visiting CRM, April 2017.

□ Teaching activity

• Contribution to the course Applied Stochastic Processes, Master in Modeling in Science and Engineering, UAB.

• Contribution to the course Tendencies Actuals de les Matematiques, Degree in Mathematics, UAB.

• Contribution to the course Introduction to Applied Mathematics, Degree in Mathematics, UPC.

□ Scientific activities

Organisation

• Co-organizer of the Workshop on Avalanche Processes in Condensed Matter Physics and Beyond, Centre de Recerca Matematica, January 2017.

• Collaboration in the organization of the VI Jornada complexitat.cat, IN3-UOC, Castelldefels, Barcelona, May 2017.

Invited lectures in conferences

• A. Corral and I. Espejo-Morales, *From Boltzmann to Zipf through Jaynes*. Invited lecture in the Workshop on Statistics of Languages, Warsaw, Poland, July 2017.

• A. Corral, F. Font-Clos, R. Garcia-Millan, and N. R. Moloney, *Finite-size scaling in random walks, branching processes, and word frequencies*. Invited lecture in the Workshop Avalanches and Large Events, Barcelona, October 2017.

Communications in conferences

• A. Corral and F. Font-Clos, *Finite-size scaling law for word-frequency distributions*. Contributed lecture in the Conference Crossroads in Complex Systems, Mallorca, June 2017.

• V. Navas-Portella, A. Corral, and E. Vives, *Avalanches and force drops in deformation-driven compression of porous glasses*. Poster presentation in the Workshop on Avalanche Processes in Condensed Matter Physics and Beyond, Barcelona, January 2017.

• V. Navas-Portella, A. Corral, and E. Vives, *Avalanches and force drops in deformation-driven compression of porous glasses*. Poster presentation in the 1st BGSMath Data Science Workshop, Barcelona, February 2017.

• V. Navas-Portella, A. Corral, and E. Vives, *Avalanches and force drops in deformation-driven compression of porous glasses*. Poster presentation in the Jornada de Doctorat CRM a CosmoCaixa Barcelona, October 2017.

• *Effect of Earthquake Coulomb Stresses on the Gutenberg-Richter law*. V. Navas-Portella, A. Jimenez, and A. Corral, poster presentation at the American Geophysical Union Fall Meeting, New Orleans, USA, December 2017.

Andrei Korobeinikov

During 2017, I continued research in mathematical modelling of biological evolution, with a particular emphasis to viral evolution and cancer evolution. I have to note that pathogen evolution is probably the most significant single factor responsible for the emergence of novel pathogens and for a rise of drug resistance. Moreover, collapse of immune system and the development of AIDS is also, probably, a result of within-host viral evolution. Working in general area of evolutionary biology, I also studied mechanisms of adaptation, such as memory, to biological system dynamics.

Another major direction of my research in 2017 was application of the optimal control theory by biological processes. In particularly, I work on the optimal controls for antiretroviral therapy (HIV treatment) and the optimal controls for the spread of an infection in a population. In collaboration with Prof. E. Grigorieva and Prof. E. Khilov, we also started a project on optimal anti-cancer therapy.

□ Publications

Articles

• S. Pagliarini, A. Korobeinikov, *A mathematical model of marine bacteriophage evolution*. Royal Society Open Science 2018 (accepted, to appear)

- A. Pimenov, T.C. Kelly, A. Korobeinikov, M.J.A. O'Callaghan, D. Rachinskii, *Memory and adaptive behavior and in population dynamics: Anti-predator behavior as a case study*. Journal of Mathematical Biology 74 (2017), 1533–1559. http://rdcu.be/wrdB, http://link.springer.com/article/10.1007/s00285-016-1065-6, doi:10.1007/s00285-016-1065-6. Q2–Mathematical & Computational Biology

- S. Pagliarini, A. Korobeinikov, *Order reduction for a model of marine bacteriophage evolution*. Journal of Physics Conference Series 811 (2017), 012010. http://iopscience.iop.org/1742-6596/811/1/012010. doi:10.1088/1742-6596/811/1/012010

- D. Masip, A. Korobeinikov, *A continuous phenotype space model of cancer evolution*. Journal of Physics Conference Series 811 (2017), 012005. http://iopscience.iop.org/1742-6596/811/1/012005. doi:10.1088/1742-6596/811/1/012005

- A. Korobeinikov, K.E. Starkov, P.A. Valle, *Modeling cancer evolution*. Journal of Physics Conference Series 811 (2017), 012004. http://iopscience.iop.org/1742-6596/811/1/012004. doi:10.1088/1742-6596/811/1/012004

Books or book chapters

- A. Korobeinikov (Editor), *Proceedings of MURPHYS-HSFS-2016 Workshop*. Trends in Mathematics: Research Perspectives CRM Barcelona Book, series, Summer 2016, vol. 10, Springer-Birkhäuser, Basel, in print; to appear 2017

Scientific reports

Conference proceedings

- S. Pagliarini, A. Korobeinikov, *Order reduction for a model of bacteriophage evolution*, in Proc. of MURPHYS-HSFS-2016, Trends in Mathematics: Research Perspectives CRM Barcelona, Summer 2016, vol. 10, Springer-Birkhäuser, Basel 2017 (to appear)

- A. Korobeinikov, S. Pagliarini, *A model of marine bacteriophage evolution*, in Proc. of MURPHYS-HSFS-2016, Trends in Mathematics: Research Perspectives CRM Barcelona, Summer 2016, vol. 10, Springer-Birkhäuser, Basel 2017 (to appear)

- P.A. Valle, K.E. Starkov, A. Korobeinikov, *A mathematical model of cancer evolutionary escape*, in Proc. of MURPHYS-HSFS-2016, Trends in Mathematics: Research Perspectives CRM Barcelona, Summer 2016, vol. 10,Springer-Birkhäuser, Basel 2017 (to appear)

□ Research projects

- Evolutionary and stochastic modelling and analisys of multi-scale dynamics in Bio-medicine. Ministerio de Economía y Competitividad, MTM2015-71509-C2-1-R. CRM 2016–2018 PI: Andrei Korobeinikov and Tomás Alarcón

- Análisis de sistemas con dinámica compleja en las áreas de medicina, matemática y física utilizando los métodos de localización de conjuntos compactos invariantes. CONACYT, Mexico, grant N 219614. Centro de Investigación y Desarrollo de Tecnología Digital, Mexico 2015–2017. PI: Konstantin Starkov

- Grup de recerca en matematica col.laborativa del CRM. Agency for Administration of University and Research (AGAUR) of the Generalitat de Catalunya, 2014SGR1307. CRM 2014–30-04-2017. PI: Alvaro Corral

- Recerca Matemàtica Col·laborativa la Caixa Foundation. CRM 2014–2019, Lluís Alsedà, EUR 967,000

- Programa de Incentivación para la Incorporación e Intensificación de la Actividad Investigadora. Ministerio de Economía y Competitividad, I3. CRM 2017 PI: Andrei Korobeinikov

□ Activity in research training

Undergraduate project supervision

- David Masip Bonet (final year BSc honour project, CRM/UAB): *Cancer evolutionary escape*, June 2017.

- Sara Gomez Reverter (final year BSc project, CRM/UAB): *Modelling cancer evolution*, June 2017.

- Ana Cristina Buira (final year BSc project, CRM/UAB): *Modelling cancer evolution*, June 2017.

- Mr Brian Martín Icochea López (final year BSc honour project, CRM/UAB): *HIV evolutionary escape*.

- Mr Ramon Tous Fernandez (final year BSc honour project, CRM/UAB): *ssRNA plant virus evolution*.

- Ms Anna Maria Riera Escandell (final year BSc honour project, CRM/UAB): *Modelling cancer evolution*.

- David Moreno Martos (final year BSc honour project, CRM/UAB): *HIV evolution*.

PhD supervision

- Aleksei Archibasov (PhD student, CRM & Samara University): *Model order reduction in mathematical models of viral evolution*.

- Anel Nurtay (PhD student CRM & Universitat Autònoma de Barcelona): *Modelling of biological evolution: development of specialization in biological species*.

MSc supervision

- Mr Stefano Pedarra (MSc student, CRM/University of Padova): *A project in cancer evolution*.

□ Teaching activity

Lectures and short courses

- *Stochastic treatment of water resources*. Free description including studies, institution and dates.

□ Scientific activities

Organisation

- Member of the scientific committee of the *8th International Conference on Bioscience and Bioinformatics*, Cambridge, UK, February 24–26, 2017
- Member of the scientific committee of the *2017 International Conference on Biology and Biomedical Engineering*, Athens, Greece, April 9–11 2017

□ Other activities

- Member of Editorial board, Mathematical Biosciences and Engineering
- Member of Editorial board, Journal of Nonlinear Systems and Applications (JNSA)
- Member of Editorial board, Nonlinear Modeling and Control (NMC)
- Member of Editorial board, International Journal of Biology and Biomedical Engineering (IJBBE)
- Member of Editorial board, International Journal of Mathematics and Computers in Simulation (IJMCS)
- Member of Editorial board, International Journal of Pure Mathematics (IJPM)
- Member of Editorial board, Infectious Diseases: Research and Treatment
- Member of Editorial board, Journal of Mathematics and Statistics
- Member of Editorial board, Abstract and Applied Analysis
- Member of Editorial board, Research and Communications in Biological Sciences
- Member of Editorial board, Nonlinear Modeling and Control
- Editor of Proceedings of MURPHYS-HSFS-2016 Workshop, Trends in Mathematics: Research Perspectives CRM Barcelona, Springer-Birkhäuser, Basel
- Co-editor of Journal of Physics: Conference Series 811, 2017: 8th Workshop on Multi-Rate Processes and Hysteresis and the HSFS Workshop
- Member of Barcelona Graduate school of Mathematics (BGSM).

Tim Myers

My activities are currently split into three main sections: Research, Teaching and Supervision, and External Activities (which is obviously a very loose term).

My research is primarily focussed on the nanoscale, specifically on nanoscale heat flow and phase change, nano crystal growth, nanofluids in Direct Absorption Solar Cells and imaging nanoparticles using visible light. The crystal growth work is in collaboration with the Catalan Institute of Nanoscience and Nanotechnology. The heat flow with the Physics department at UAB. The imaging work is an exciting new project being carried out with experimentalists at the Centre d'Elaboration de Materiaux et d'Etudes Structurales, a CNRS centre in Toulouse.

At an industrial mathematics meeting in South Africa I worked on spontaneous combustion in sugar cane stockpiles, finding a novel (and easily implementable) solution to prevent fires from occurring. In Ireland I worked on improving the absorption of sound waves for a local company.

Teaching and Supervision: The group currently has 3 PhD students at CRM and 1 in Ireland. Helena Ribera will defend her thesis in March 2018. Gary O'Keeffe intends to submit in early 2018. I continue to teach at the Universitat Politècnica de Catalunya, taking part in the course Models Matematics de la Tecnologia. I supervised undergraduate students in their final year projects, both from UAB and UPC.

External activities: For the period May 2016 - April 2019 I am the Short Term Scientific Manager and member of the core Management Committee for the EU COST Action TD1409, Mathematics for Industry Network. I am the Spanish representative on the council of the European Consortium for Mathematics in Industry and also the co-ordinator for all European Study Groups with Industry. I am on the editorial board of Mathematics in Industry Case Studies and the RSME Springer book series. As well as carrying out the usual reviews for various journals I was a member for the mathematics panel for the Fundação para a Ciência e a Tecnologia –the Portuguese public funding agency for R&D– and also carried out reviews for Scientists Intending to visit King Abdul Aziz University.

I have been active in outreach through the Bojos per les matemàtiques! (Mad for Maths) program as well as talking about practical applications of mathematics to high school students at Colegio Europa in Sant Cugat.

Publications

Articles

- M. Calvo-Schwarzwälder, M.G. Hennessy, P. Torres, T.G. Myers, F.X. Alvarez, *A slip-based model for the size-dependent effective thermal conductivity of nanowires*. International Communications in Heat and Mass Transfer 91 (2018), 57–63.
- G.J. O'Keeffe, S.L. Mitchell, T.G. Myers, V. Cregan, *Modelling the efficiency of a nanofluid-based direct absorption parabolic trough solar collector*. Solar Energy 159 (2018), 44-54.
- T.G. Myers, V.R. Ripoll, A.S. de Tejada Cuenca, S.L. Mitchell, M.J. McGuinness, *Modelling the cardiovascular system for assessing the blood pressure curve*. Mathematics-in-industry case studies 8 (2017), no. 1, 2.

- T.G. Myers, H. Ribera, V. Cregan, *Does mathematics contribute to the nanofluid debate?* International Journal of Heat and Mass Transfer 111 (2017), 279–288.
- T.G. Myers, S.L. Mitchell, P. Slatter, *An asymptotic analysis of the laminar-turbulent transition of yield stress fluids in pipes*. Journal of Physics: Conference Series 811 (2017), no. 1, 012007.

Scientific reports

Conference proceedings

- T.G. Myers, S.L. Mitchell, *Safe Storage of Sugar Cane Bagasse*. Proceedings of the 2017 Mathematics in Industry Study Group, African Institute of the Mathematical Sciences, Cape Town, South Africa.

□ Research projects

- *Dinámica de fluidos complejos y fronteras móviles*, MTM2014-56218-C2-1-P. From 2015 to 2017. Principal investigator: Tim G. Myers. Team Members: Vincent Cregan, Helena Ribera, Sub-Project 2: Susana Serna, Antonio Marquina.
- *Lensless imaging with ultrahigh optical resolution*, October 9^{th} to December 8^{th}, 2017, Centre National de la Recherche Scientifique, France.

□ Activity in research training

Supervision of research students

Undergraduate project supervision

- Curial Gallart, UAB, *Sintesi i estructura de materials cristal.linds i amorfs*, December 2016 to May 2017.
- Daniel Salgado, UAB, *Mathematical modelling of nanocrystal growth in solution*, December 2016 to May 2017.

PhD supervision

- Helena Ribera, PhD project: *Mathematical modelling of nanoparticle evolution*, September 2014 – March 2018.
- Marc Calvo, *Heat transfer and phase change at the nanoscale*, October 2015 – .
- Gary O'Keeffe, PhD project: *Mathematical modelling of nanofluid direct absorption solar cells*, September 2014 – . (University of Limerick, joint with S.L. Mitchell).
- Claudia Fanelli, PHD project: *Diffusion processes and nanoparticle growth*, October 2016 – .

Postdoc supervision

- Vincent Cregan, "la Caixa" Post-doc, *Nanoparticle evolution*, September 2014 – February 2017.

• Matt Hennessy, Marie Curie Post-doc, *Nanoscale heat flow*, September 2016 – September 2018.

□ Diffusion activity

• *Mathematics at the nanoscale*. Public lecture at African Institute for the Mathematical Sciences, January 2017.

• *Matemàtica Industrial*. Talk to gifted high school students, in series Bojos per les matemàtiques! March 2017.

• *How useful is mathematics?* Talk to high-school students, Colegio Europa, May 2017.

• Organiser of "An introduction to seminar series", Departament de Matemàtica Aplicada, Universitat Politècnica de Catalunya, where experts in a field give an introductory lecture to a general audience

□ Teaching activity

• Adjunct Professor at Universitat Politècnica de Catalunya. I teach for the Facultat de Matemàtiques i Estadística, Departament de Matemàtica Aplicada on the undergraduate course Models Matemàtics de la Tecnologia.

□ Scientific activities

Participation

• Mini-symposium organiser (with A. Lacey) for Industrial Mathematics session, joint EMS-Catalan Maths Society meeting, Edinburgh, September 2017.

• Member of Scientific Committee for Recent Advances in Moving Boundary Problems in Mechanics, International Union of Theoretical and Applied Mechanics, New Zealand, February 2018.

• Member of Scientific Committee, Knowledge Exchange Community Meeting – Industrial Maths in Action, September, 2017, The International Centre for Mathematical Sciences, Edinburgh.

Invited lectures in conferences

• T.G. Myers, Invited international expert, Mathematics in Industry Study Group, African Institute for the Mathematical Sciences, Cape Town, South Africa, January 2017.

Communications in conferences

• T.G. Myers, *Mathematical modeling of nanoparticle growth and melting*. Nanotech, Paris, June 2017.

• T.G. Myers, *Phase change at the nanoscale*, joint EMS-Catalan Maths Society meeting, Edinburgh, September 2017.

Research stays

• Centre d'Elaboration de Materiaux et d'Etudes Structurales, Toulouse, France, October to December 2017 (3 weeks).

□ Other activities

• Member of Editorial Board, Book Series RSME Springer Briefs, `http://www.springer.com/series/13759`.

• Member of Editorial Board, Mathematics in Industry Case Studies.

• Evaluator for King Abdul Aziz University, HiCi Distinguished Professor Visiting Programme.

• Panel member and evaluator for Mathematics research grants for Fundação para a Ciência e a Tecnologia, Portugal.

• Referee for Applied Mathematics and Computing, Int. Comm. Heat and Mass Trans., Int. J. Mechanical Sciences, Engineering Computations.

• In charge of "Featured Node" for European Consortium for Mathematics in Industry blog, June.

Alex Roxin

Over the past year our group has continued work on network connectivity, dynamics and plasticity. Specifically, in the framework of her doctoral thesis, PhD student Marina Vegué has completed her study of cortical microcircuitry. She developed a novel statistical model which can account for the non-"random" network structure in data from simultaneous in-vitro recordings of cortical cells. This work was recently published in the Journal of Neuroscience. PhD student Genis Prat has been working on network models for two-choice forced-alternative decision making tasks. Making use of a reduced normal-form equation for the pitchfork bifurcation in the original network model, Genis has developed an algorithm for estimating the parameters of the normal-form equation when only the stimulus strength and decision outcome are known on a trial-by-trial basis. This coming year he plans on applying this method on psychophysical data collected during simultaneous MEG recordings in the laboratory of Tobias Donner. PhD student Bernat Rovira works on the dynamics of memory storage and recall in attractor neural networks. This past year he has studied the role of short-term synaptic depression on recall dynamics and has discovered that it allows for the recall of otherwise hidden memories, fixed points of the system which are stable but which have very small bassins of attraction. He developed this work further during a recent three month stay in the laboratory of Sandro Romani at Janelia Research campus in the US.

In addition, we have continued our work on the development of mean-field models for networks of spiking neurons, in collaboration with Ernest Montbrió at the Universitat Pompeu Fabra. Specifically, we have studied particular network states, in particular oscillatory states, which involve a significant degree of spike synchronization. Such states cannot be captured by traditional, heuristic mean-field models, called firing rate or Wilson-Wowan models, which by definition posit asynchronous activity. On the other hand, our exact mean-field model for networks of quadratic integrate-and-fire neurons correctly take spike synchrony into account. This work has resulted in two publications.

We have presented our work at numerous scientific conferences, including the Computational Neuroscience Meeting in Antwerp and the Society for Neuroscience Meeting in Washington, D.C. Finally, our group has continued to be the main organizer for events of the Barcelona Computational, Cognitive and Systems Neuroscience community, incldluing the annual BARCCSYN meeting held in June, and the yearly BARCCSYN retreat in November.

□ Publications

Articles

- J. M. Esnaola-Acebes, A. Roxin, D. Avitabile, and E. Montbrió, *Synchrony-induced modes of oscillations of a neural field*. Phys. Rev. E 96 (2017), 052407. `https://journals.aps.org/pre/abstract/10.1103/PhysRevE.96.052407`. Q1-Condensed Matter Physics
- D. Jercog, A. Roxin, P. Bartho, A. Luczak, A. Compte, and J. de la Rocha, *Up-down cortical dynamics reflect state transitions in a bistable balanced network*. eLife 6 (2017), e22425. `https://elifesciences.org/articles/22425`. Q1-Neuroscience
- M. Vegué, R. Perin, and A. Roxin,, *On the structure of cortical microcircuits inferred from small sample sizes*. J. Neurosci. 37 (2017), 8498–8510. `http://www.jneurosci.org/content/37/35/8498`. Q1-Neuroscience
- D. Nykamp, A. Compte, and A. Roxin, *Mean-field equations for neuronal networks with arbitrary degree distributions*. Phys. Rev. E 95 (2017), 042323. `https://journals.aps.org/pre/abstract/10.1103/PhysRevE.95.042323`. Q1-Condensed Matter Physics

□ Diffusion activity

- Talk at the Cosmocaixa, Barcelona on *Les Matemàtiques de la Memòria*, November 21, 2017. `http://agenda.obrasocial.lacaixa.es/ca/-/edu-las-matematicas-de-la-memoria?centros=caixaforum-lleida`,

□ Teaching activity

Lectures and short courses

- *Mean-field models for networks of spiking neurons.* Summer School on Mathematical Neuroscience, June 26-30, Bornholm, Denmark. `http://www.math.ku.dk/~susanne/web/index.html`.

□ Scientific activities

Organisation

- Member of the organizing committee of the *Intensive Research Program on the Mathematics of Memory*, CRM, January-March 2017.
- Member of the organizing committee of *Barcelona Computational, Cognitive and Systems Neuroscience Meeting*, Institut d'Estudis Catalans, June 2017.

Invited lectures in conferences

- A. Roxin. *Microscopic and macroscopic states in networks of recurrently coupled spiking neurons* Invited talk at the Computational Neuroscience Meeting. Antwerp, Belgium, July 2017.
- A. Roxin. *The collective dynamics of heterogenous oscillators: the relationship between phase synchrony and neuronal firing rates* Invited talk at the Conference on Computational Neuroscience and Optics. Sophia Antipolis, France, May 2017.

Seminars

- A. Roxin. *A model of plasticity-dependent network activity in rodent hippocampus during exploration of novel environments* Seminar at the Center for Neural Theory, ENS, Paris, May 2017.

Sergey Tikhonov

During 2017, my research activities include the following topics. I started investigating, with Feng Dai, Andriy Prymak, and Vladimir Temlyakov, Marcinkiewicz inequalities and Remez polynomial inequalities. The case of the hyperbolic cross polynomials was of special interest to us.

Together with Amiran Gogatishvili, Mirek Opic, and Walter Trebels we have been investigating sharp Ulyanov-type inequalities between different function spaces. Moreover, jointly with Yury Kolomoitsev, I have finished the project on sharp (L_p, L_q) inequalities for smoothness characteristics in the case of $0 < p < q$.

Besides, together with Mikhail Dyachenko and Erlan Nursultanov we proved new Hardy–Littlewood and Pitt's inequalities for Hausdorff operators and studied smoothness and asymptotic properties of functions with general monotone Fourier coefficients. Moreover, together with Laura De Carli, Dmitriy Gorbachev, and Erlan Nursultanov, I continue the investigation of properties of the Fourier integrals in the weighted Lebesgue and Lorentz spaces.

Jointly with Dmitry Gorbachev and Valery Ivanov, I have studied several directions in Dunkl harmonic analysis.

Besides, I have served as a supervisor for five PhD students: Nestor Costa, Alberto Debernardi, Ainur Jumambaeva, Aizhan Ydyrys, and Askhat Mukanov. Nestor Costa studied optimal decoding and related problems of harmonic analysis. Alberto Debernardi continued working on his PhD

dissertation focusing on convergence of Fourier transforms of general monotone functions. Ainur Jumabaeva studied the (L_p, L_q) inequalities for best approximation and moduli of smoothness of the generalized Liouville derivatives. Aizhan Ydyrys obtained several results on asymptotical behavior of double trigonometric series with convex and monotone coefficients. Askhat Mukanov investigated different types of convergence of trigonometric series.

I have served as an editor of the following journals: Analysis Mathematica, Demonstratio Mathematica, Journal of Mathematical Analysis and Applications, Abstract and Applied Analysis, Bulletin of Mathematical Analysis and Applications, and The Scientific World Journal.

I was the main organizer of the Follow up Workshop on Approximation Theory and Function Spaces in the Centre de Recerca Matemàtica.

□ Publications

Articles

- A. Bondarenko, S. Tikhonov, *Bernstein inequalities with nondoubling weights*. J. Eur. Math. Soc. 19 (2017), no. 1, 67–106
- L. De Carli, D. Gorbachev, S. Tikhonov. *Pitt inequalities and restriction theorems for the Fourier transform*. Rev. Mat. Iberoam.33 (2017), no.1, 789–808
- M. Ganzburg, S. Tikhonov, *On sharp constants in Bernstein-Nikols'kii inequalities*. Constructive Approximation 45 (2017), no. 1, 449–466.
- V. Temlyakov, S. Tikhonov, *Remez-type and Nikol'skii-type inequalities: general relations and the hyperbolic cross polynomials*. Constructive Approximation 46 (2017), no. 1, 593–615.

□ Research projects

- *MTM2014-59174-P "Methods of constructive approximation and Fourier analysis"*, Ministerio de Ciencia e Innovación. From 2015 to 2017. Principal investigator: S. Tikhonov.

□ Activity in research training

PhD supervision

- Aizhan Ydyrys, PhD student (CRM).
- Nestor Costa, PhD student (CRM).
- Alberto Debernardi, PhD student (CRM).
- Askhat Mukanov, PhD student (CRM).
- Ainur Jumabayeva, PhD student (CRM).

□ Scientific activities

Organisation

- Main organizer of the *Follow up Workshop on Approximation Theory and Function Spaces*, CRM, Barcelona, June 2017.

Invited lectures in conferences

- S. Tikhonov, Workshop on Fourier Analysis and Related Fields, Pécs, Hungary. August 2017.
- S. Tikhonov, International Conference in Approximation Theory, Georgia Southern University, USA. May 2017.
- S. Tikhonov, Modern Methods, Problems and Applications of Operator Theory and Harmonic Analysis, Rostov-on-Don, Russia. April 2017.

Communications in conferences

- S. Tikhonov, New perspectives in the theory of function spaces and their applications, Bedlewo, Poland,September 2017.
- S. Tikhonov, AMS Sectional Meeting, Hunter College, City University of New York, New York, NY, May 2017.

Seminars

- PIMS/AMI Seminar, University of Alberta, Edmonton, Canada, November 2017.
- Approximation Theory Seminar, University of Alberta, Edmonton, Canada, November 2017.
- General Seminar, USC, Interdisciplinary Mathematics Institute, SC, USA, May 2017.
- Analysis Seminar, Aristotle University of Thessaloniki, Thessaloniki, Greece, April 2017.
- Approximation Theory Seminar, Steklov Mathematical Institute, Moscow, Russia, April 2017.
- Analysis Seminar, University of Coimbra, Portugal, April 2017.

Research stays

- September, 2017: Invited Researcher at IHES, Bures-sur-Yvette, France (4 weeks).
- October, 2017: Invited Researcher atLaboratoire Jacques-Louis Lions, Université Pierre et Marie Curie, France (4 weeks).
- November-December 2017: Visiting Research Scholar at Invited Researcher, University of Alberta, Canada (2 weeks).
- December 2017: Research in teams, BIRS, Canada (1 week).

□ Other activities

- Member of Editorial board, Journal of Mathematical Analysis and Applications.
- Member of Editorial board, Analysis Mathematica.

- Member of Editorial board, Demonstratio Mathematica.
- Member of Editorial board, Jaen Journal on Approximation.
- Member of Editorial board, Abstract and Applied Analysis.
- Member of Editorial board, Bulletin of Mathematical Analysis and Applications.
- Member of Editorial board, The Scientific World Journal.
- Guest editor of the special issue "Function Spaces and Approximation Theory", Analysis Math. 43 (2017), no. 2.
- Member of the Ph.D. Committee for Martin Krepela. Charles University, Czech Republic. Thesis: Integral and supremal operators on weighted function spaces.
- Member of International Society for Analysis, its Applications, and Computation.

Klaus Wimmer

I have joined the CRM as a Ramón i Cajal researcher and Co-PI of the Computational Neuroscience group in the end of May 2017. The main focus of my work is on investigating the neural network dynamics underlying cognitive functions. The neural basis of the computations that underlie cognitive function has been studied extensively with decision making and working memory tasks in humans and monkeys. In my work, I develop computational models of neuronal circuits (neural network models) to pin down the physiological mechanisms underlying an animals behavior during these elementary cognitive tasks. I complement the study of the dynamics of these circuits with quantitative analysis of psychophysical and electrophysiological data obtained by collaborators. Data analysis of the often high-dimensional data (e.g., fMRI data or hundreds of simultaneously recorded neurons) involves methods from machine learning and statistical methods, for example dimensionality reduction techniques. An important activity this year has also been to apply for competitive funding that will allow to build and consolidate a research team. This resulted in a successful application for a MINECO Retos project. In particular, I have carried out work in the following research projects:

I have been working on testing the neural basis of working memory in prefrontal cortex. Neurophysiological experiments in primates have found that during the delay period of working memory tasks, some neurons in the prefrontal cortex carry information about the stimulus as sustained activity, therefore supporting a stable code. However, many neurons show strong temporal dynamics, which has given rise to the dynamic coding model for working memory. Using single neuron and population decoding I evaluate whether the experimental data favours one of the two models. First results of this work have been presented at the Society for Neuroscience Meeting 2017 in Washington, D.C. and will also be presented at the Computational and Systems Neuroscience (Cosyne) Conference 2018 in Denver, Colorado.

I have been collaborating with Alex Roxin and PhD student Genis Prat on mathematical models for two-alternative forced-choice perceptual decision

making tasks. On the one hand, this project aims at investigating how the magnitude of noise impacts decision build-up in a canonical attractor model of perceptual decision making. One the other hand, Genis has developed an algorithm for estimating the parameters of the model based on a trial-by-trial information about choices and presented stimulus. This algorithm will now be applied to human psychophysical data.

Finally, I have continued my previous efforts in the group of Gustavo Deco (UPF) to use simple noise-diffusion models to model large-scale brain activity. The model is a multivariate Ornstein-Uhlenbeck process, where the spatio-temporal network activity depends on the intrinsic noise at each node and the input received from recurrent connections across the network. The goal was to use this framework to determine task-specific changes in large-scale interaction of distant brain regions during an object recognition task (fMRI data from Max Riesenhuber, Georgetown University). A journal publication is currently in preparation.

□ Research projects

- *Neural network dynamics of distributed decision circuits*, MINECO, BFU2017-86026-R.From 1/1/2018 to 31/12/2020. PI.: A. Roxin, co-PI.: K. Wimmer.

□ Activity in research training

- A. Faustine Ginoux, Summer internship (CRM).

  Project: Using whole-brain modeling to reveal changes in effective connectivity, Nov 2017.

□ Teaching activity

Lectures and short courses

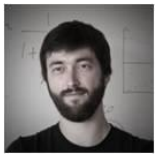
- *Neural network dynamics underlying cognitive function*. Lecture in Research & Innovation, Master's Degree in Modelling for Science and Engineering, UAB; Nov 21, 2017

□ Scientific activities

Organisation

- Member of the organising committee of *PIRE Workshop / Summer School 2017 - Hierarchical Multisensory Integration: Theory and Experiments*, Pals (Girona), June 17 - June 20, 2017.
- Member of the organising committee of the *Cosyne Workshop Circuit Dynamics in working memory*, Breckenridge, Colorado, March 2018.

Antoine Allard



I joined the CRM in June for what ended up being a short eight-month stay. Nevertheless, the scientific freedom that my postdoctoral position granted allowed me to finish and initiate various projects.

The first one was initiated in January 2017 during a two-month stay at the Santa Fe Institute and aimed at estimating the risk that posed the Zika virus as a sexually transmitted infection. This project was in collaboration with another physicist and two mathematical epidemiologists and led to two publications [Allard2017a, Allard2017b]. I have also been able to finish a project in collaboration with M. Á. Serrano from the Universitat de Barcelona in which we studied the relationship between the spatial organization of the brain and the topology of its connectome (the network consisting in the neuronal connections between various regions of the cortex). The results of this project have been uploaded on arXiv and are currently under consideration at Nat. Commun. [Allard2018]. Finally, the results of the research project of the Master's student at Université Laval (Québec) I am co-supervising has been recently accepted for publication in Phys. Rev. E [Murphy2018]. The project designed a framework of growing complex networks embedded in a metric space that allows to generate complex networks whose structure mimics the one of real complex networks of various origins.

During a short stay at the Institute for Disease Modeling in Seattle in October, I started a new project with my collaborator Laurent Hébert-Dufresne in which we identified a key structural feature of real complex networks that allows to extract their *effective* structure, which in turn naturally lends itself to analytical calculations whose predictions regarding the outcome of several dynamical processes is quite accurate. Finally, I started a project with Alvaro Corral (CRM) and Joan Serra (Telefónica R&D) which aims at studying human mobility using location data provided by mobile phones.

□ Publications

Articles

- [Allard2017b] A. Allard, B.M. Althouse, L. Hébert-Dufresne, S.V. Scarpino, *The risk of sustained sexual transmission of Zika is underestimated*. PLoS Pathog. 13 (2017), e1006633. `http://dx.doi.org/10.1371/journal.ppat.1006633`.
- [Allard2017a] A. Allard, B.M. Althouse, S. V. Scarpino, L. Hébert-Dufresne, *Asymmetric percolation drives a double transition in sexual contact networks*. Proc. Natl. Acad. Sci. USA 114) (2017), 8969–8973. `http://dx.doi.org/10.1073/pnas.1703073114`.

Preprints

- [Murphy2018] C. Murphy, A. Allard, E. Laurence, G. St-Onge, L.J. Dubé, *Geometric evolution of complex networks with degree correlations*. To appear in Phys. Rev. E (2018). `http://arxiv.org/abs/1710.01600`.

• [Allard2018] A. Allard, M. Á. Serrano, *Navigable maps of structural brain networks across species*. Additional info: `arXiv:1801.06079`, submitted to Nat. Commun. (2018). `https://arxiv.org/abs/1801.06079`.

□ Scientific activities

Organisation

• Member of the organising committee of *Contagion & Networks satellite symposium (ContNet2017)* of the International School and Conference on Network Science (NetSci 2017), Indianapolis, June 2017.

• Member of the scientific committee of the *6th International Conference on Complex Networks and their Applications (Complex Networks 2017)*, Lyon, November 2017.

Communications in conferences

• *The effective navigable geometry of the brain*. Oral communication: Mapping Complexity: Foundations and Applications of Network Geometry workshop (MACFANG-17), Barcelona, November 2017.

• *The effective navigable geometry of the brain*. Oral communication: International School and Conference on Network Science (NetSci2017), Indianapolis IN, June 2017.

Research stays

• Visiting Research Scholar at Institute for Disease Modeling, Seattle. October 2017 (2.5 weeks).

Vincent Cregan

From March 2016 to March 2017, my research has focused on two key areas, namely nanoscience and phase change phenomena. Firstly, I have been developing models to describe physical processes and applications from nanoscience and nanotechnology. Specifically, I have looked at three distinct problems.

1) Particle Growth from Solution: Nanoparticle growth via solution is one of the most popular methods for nanoparticle synthesis. My aim was to devise models that explain the interactions between the nanoparticles and their surroundings during growth via solution.

I have continued my long-standing collaboration with Prof. Victor Puntes and the Inorganic Nanoparticles Group in the Catalan Institute of Nanoscience and Nanotechnology. My goal is to formulate a model that explains the evolution of a system of nanoparticles via size focussing and defocussing. Initially, I considered a diffusion model for the growth of a single particle. This was then extended to an ensemble of nanoparticles. Thus, far I shown good qualitative agreement between my simulations and data for cadmium selenide nanoparticles. This research will be submitted shorty to Nano Letters.

2) Heat Transfer in Nannofluids: Recent experimental evidence has shown that nanofluids do not provide the greatly enhanced heat transfer predicted in the past. Despite seemingly conclusive proof there is still a great deal of theoretical research stating the opposite result. My colleagues in the Industrial Mathematics Group and I studied previous mathematical treatments and demonstrated that the disagreement can be traced to several issues including the incorrect formulation of the governing equations; the use of parameter values orders of magnitude different to the true values model choices that are based on permitting a reduction using similarity variables as opposed to representing an actual physical situation; presentation of results using different scalings for each fluid. We recently submitted a paper on this topic to *Microfluidics and Nanofluidics*.

3) Nanofluid-based Direct Absorption Collectors (NDASCs): Solar energy has the poten- tial to solve one of the most pressing needs facing modern society: namely the development of a environmentally-friendly and sustainable energy source. The current challenge is to establish a truly widespread, cost-effective system which efficiently converts solar energy. NDASCs use a solution of nanoparticles and fluid to absorb sunlight, and have the capacity to harness solar energy significantly more efficiently than traditional collectors. This research has been presented at two international conferences (i.e., NanoMath 2016, MACSI10) this past year.

   Following on from my 2015 NDASC paper in the *International Journal of Heat and Mass Transfer*, I have been working closely with PhD candidate Gary Keefe (University of Limerick, Ireland). Gary is currently extending my research to examine more complex configurations (e.g., parabolic trough collector).

As mentioned, I have also been using applied mathematical techniques to explain industrial processes that involve phase change phenomena.

• **Contact melting of a phase change material (PCM) with temperature-dependent properties**: PCM Contact melting is a process where a PCM is placed in contact with a surface that is maintained above the melt temperature. The solid begins to melt so that a thin fluid layer develops between the two surfaces. The weight of the solid acts to squeeze out the liquid, and thus the melt layer remains thin. A standard approximation when modelling this process is to assume that the material properties are temperature-invariant. Typically, this approach is applicable when there are small temperature changes in the system of interest. However, this is not always the case so the aim of my research was to investigate the impact of temperature-dependent properties on the contact melting process.

I submitted a paper on this topic to the International Journal of Heat and Mass Transfer. I demonstrated that in the case of the PCM n-octadecane, the inclusion of temperature-dependent effects slows down the melting process.

• **Optimisation of a lead sulphate settling process**: In collaboration with Waterford Crystal (Ireland) and Dr. William Lee (University of Portsmouth), I developed a model for the growth of lead sulphate particles in a gravity separation system. The particles are an undesirable byproduct, and the model was used to ascertain the optimal system temperature configuration such that particle extraction is maximised. Our research was published in the *Journal of Physics: Conference Series*.

• **Boiling Crisis**: Finally, I am continuing to collaborate with Dr. Adewunmi Fareo (University of the Witwatersrand) and Prof. Brian Wetton (University of British Columbia) on developing models to explain the so-called boiling crisis. Whilst boiling has been studied extensively, the underlying physics are still not fully understood. Due to the complexity of the process, full models have not been

developed to predict the boiling heat fluxes as a function of heater surface superheat. Our model will combine elements from fluid flow, heat transfer and moving boundary phenomena. The goals are to (1) derive analytical expressions for the heat transfer coefficient, before and after film boiling (2) describe in detail film boiling, and (3) ascertain the key factors leading to the boiling crisis.

□ Publications

Articles

- T.G. Myers, H. Ribera Ponsa, and V. Cregan, *Does mathematics contribute to the nanofluid debate?* International Journal of Heat and Mass Transfer. **111** (2017), 279–288.
- V. Cregan and William T. Lee, *Slow and fast diffusion in a lead sulphate gravity separation process*. Journal of Physics: Conference Series **811** (2017) 012001.
- V. Cregan, William T. Lee and L. Clune, *A soft sensor for the Bayer process*. Journal of Mathematics in Industry **7** (2017), 7.
- V. Cregan, J. Williams and T.G. Myers, *Contact melting of a phase change material with linear temperature-dependent thermal conductivity and viscosity*. (Submitted to International Journal of Heat and Mass Transfer.).
- V. Cregan, T.G. Myers and S.L. Mitchell, *Nanoparticle evolution by the precipitation method*. (In preparation).
- T.G. Myers, A. Fareo, V. Cregan and B. Wetton, *A model for the onset of film boiling*. (In preparation).

Matt Hennessy

I have been using mathematical models to understand how thermal energy (heat) is transport across objects with nanometer length scales. A collaboration between members of the UAB Physics Department and the CRM led to the development of a simple model that accurately predicts the size dependence of material properties of nanowires. Another major focus has been understanding how phase change occurs at the nanoscale. Using asymptotic methods, it was possible to show that non-classical mechanisms of heat transport can drastically alter the kinetics of solidification, leading to substantial departures from the classical predictions obtained using

I have also been collaborating with researchers at Imperial College London (UK) to study the light-driven growth of elastic polymer networks, a process that is relevant to 3D printing and photolithography. A non-traditional formulation of nonlinear elasticity was used to develop a model that describes the mechanical response of a polymer network that is simultaneously growing and swelling. The results from the model provided key insights into the onset of mechanical instability in these systems.

Over the past year, I have been co-developing a project with Iain Moyles (University of Limerick, Ireland) that addresses overheating of lithium-ion batteries. An aim of this work is to derive simplified models that capture the key physical processes that occur during the charging and discharging of a battery. The model will then be used to understand and predict the conditions that lead to the onset of thermal runaway. This is joint work with Brian Wetton (University of British Columbia, Canada) and Tim Myers (CRM).

Publications

Articles

- M. Calvo-Schwarzwalder, M.G. Hennessy, P. Torres, T.G. Myers, and F.X. Alvarez, *A slip-based model for the size-dependent effective thermal conductivity of nanowires*. International Communications in Heat and Mass Transfer 91 (2018), 57–63. https://www.sciencedirect.com/science/article/pii/S0735193317303068.

- M.G. Hennessy, A. Vitale, O.K. Matar, and J.T. Cabral, *Monomer diffusion into static and evolving polymer networks during frontal photopolymerisation*. Soft Matter 13 (2017), 9199–9210. https://doi.org/10.1039/C7SM01279A.

- A.R. Purnama, M.G. Hennessy, A. Vitale, and J.T. Cabral, *Coarse-grained models for frontal photopolymerization with evolving conversion profile*. Polymer International 66 (2017), 752–760. http://onlinelibrary.wiley.com/doi/10.1002/pi.5344/full.

- M.G. Hennessy, G.L. Ferretti, J.T. Cabral, and O.K. Matar, *A minimal model for solvent evaporation and absorption in thin films*. Journal of Colloid and Interface Science 488 (2017), 61–71. http://www.sciencedirect.com/science/article/pii/S0021979716308402.

Preprints

- M.G. Hennessy, M. Calvo-Schwarzwalder, and T.G. Myers, *Asymptotic analysis of the Guyer-Krumhansl-Stefan model for nanoscale solidification*. Submitted to Applied Mathematical Modelling

Research projects

- *Mathematical Modelling of Nanoscale Heat Flow and Phase Change*, European Commission H2020-MSCA-IF-2015, Grant number 707658. CRM Sept 2016–Sept 2018. Principal investigator: Tim Myers,158,121.60 EUR

- *Mathematical Modelling of Nanoscale and Energy Technologies*. 2016 New Foundations grant from the Irish Research Council. CRM, University of Limerick Nov 2016–Nov 2107Iain Moyles, 5000 EUR

Activity in research training

- M. Calvo-Schwarzwalder, PhD student (CRM).

Teaching activity

Lectures and short courses

- *Mathematical models in technology*. UPC. September–December 2017.
- *Perturbation Methods*. CRM, June-July 2017.
- *Analytical methods for PDEs*. CRM, June 2017.

□ Scientific activities

Communications in conferences

- M.G. Hennessy, Swelling of static and evolving polymer networks during frontal photopolymerisation. Oral communication. APS Division of Fluid Dynamics Annual Meeting, USA (Denver) November 2017.

Seminars

- M.G. Hennessy. *Swelling-induced instabilities in growing polymer networks.* CRM Applied Mathematical Physics Seminar at the CRM, February 2017.

□ Other activities

- Member of the Americal Physical Society.

Santiago Molina

During 2017 I have been working on p-adic L-functions attached to automorphic forms, abelian K-surfaces with quaternionic multiplication, and Stark-Heegner-Darmon points on modular abelian varieties. I have published one paper on the Galois action on points in Shimura curves attached to K-surfaces [2], and I have published another paper on the Eichler Shimura isomorphism for quaternionic automorphic forms [1]. I have submitted one paper on the exceptional zero phenomenon of the anticyclotomic (definite and indefinite) p-adic L-function attached to a Hilbert automorphic form [3], and I have submitted another paper another paper (joint work with X. Guitart and M. Mardeu) on a general construction of Stark-Heegner-Darmon points [4]. I have started a joint project with D. Barrera on p-adic L-functions attached to triples of automorphic forms, and I have started a joint project with V. Hernandez on the Eichler-Shimura isomorphism in families of quaternionic automorphic forms over totally real fields.

□ Publications

Preprints

- S. Molina, *Eichler-Shimura isomorphism and group cohomology on aritmetic groups*. Journal of Number Theory 180, November 2017, 280–296. `https://doi.org/10.1016/j.jnt.2017.04.007`. [1]
- S. Molina, *Galois action on Q^--isogeny classes of abelian L-surfaces with quaternionic multiplication*. Acta Arithmetica 181 (2017), 369-392. doi:10.4064/aa170504-20-9. [2]
- S. Molina, *Anticyclotomic p-adic l-functions and the exceptional zero phenomenon*. (Submitted). https://arxiv.org/pdf/1509.08617.pdf. [3]
- X. Guitart, M. Masdeu, and S. Molina, *An automorphic approach to Darmon points*. (Submitted). `http://mat.uab.cat/~masdeu/files/papers/AutomorphicDarmonPoints.pdf`. [4]

Josep Sardanyés

I have been working on nonlinear dynamics and dynamical systems in biology. Specifically, in the dynamics and evolution of cancer taking into account phenotypic variability. Mainly, I have been interested in potential bifurcations involving tumor cells regression or clearance. Both ordinary differential equations and stochastic models have been used to identify these possible bifurcations in variable phenotypic populations of tumor cells. Another research line developed has been in the field of theoretical virology, where models for viral RNA genomes replication have been studied from both deterministic and stochastic approaches. For both the cancer and viruses studies we have characterized novel mechanisms of noise-induced bistability. Finally, I have been also doing research on the origins of life problem studing the hypercycle model for prebiotic catalytic systems.

Besides, I have been conducting several research collaborations with the Complex Systems Lab at the Department of Experimental and Health Sciences at Universitat Pompeu Fabra (UPF) and the Institute of Evolutionary Biology (CSIC-UPF), with the Institute for Integrative Systems Biology in València and the Institute of Molecular and Cellular Plant Biology (CSIC-Universitat Politècnica de València), with the Department of Mathematics at Universitat Autònoma de Barcelona (UAB), the Department of Mathematics and Computer Science at Universitat de Barcelona (UB), as well as with research groups on dynamical systems at Universitat Politècnica de Catalunya (UPC). I have co-supervised two Bachelors' degree thesis on Mathematics with researchers from UB and UPC.

Publications

Articles

- G. Farré, J. Sardanyés, A. Guillamon, E. Fontich, *Coexistence stability in a four-member hypercycle with error tail through center manifold analysis*. Nonlinear Dynamics 90 (2017), 1873–1883.

Preprints

- J. Duarte, C. Januário, N. Martins, C. Correia Ramos, C. Rodrigues, J. Sardanyés, *Optimal homotopy analysis of a chaotic HIV-1 model incorporating AIDS-related cancer cells*. CRM Preprint núm. 1228, to appear in *Numerical Algorithms* 2018.
- J. Puig, G. Farré, E. Fontich, A. Guillamon, J. Sardanyés, *Bifurcation gaps in asymmetric and high dimensional hypercycles*. CRM Preprint núm. 1230, to appear in *Int. J. Bif. and Chaos* 2018.

Activity in research training

- J. Fornés, Mathematics degree (Universitat Politècnica de Catalunya). Bachelor's thesis: *Nonlinear dynamics of replication modes in tunable deleterious fitness landscapes*, July 2017. Work co-supervised with Dr. J. Tomás Lázaro (Universitat Politècnica de Catalunya)
- R. Colomer, Mathematics degree (Universitat de Barcelona). Bachelor's thesis: *Exploring the error threshold through a Poincaré compactification*. Work co-supervised with Dr. Xavier Jarque, July 2017

Diffusion activity

• *Sobre els mecanismes matemàtics dels canvis en la nature*, 3er Cicle de Conferències Dilluns de Ciència, 19 Octubre 2017.

Teaching activity

• Complex Diseases, Bachelor's degree in Biomedical Engineering, Universitat Pompeu Fabra, May-June 2017.

• Complexity Science, Computational Biomedical Engineering Master, Universitat Pompeu Fabra, October-December 2017.

Lectures and short courses

• *Bifurcating systems*. Short lecture on Dynamical Systems and bifurcations held at the CRM lectrue: An Introduction to Applied Mathematics, June 21, 2017.

Scientific activities

Invited lectures in conferences

• CEDYA + CMA 2017 XXV Congreso de Ecuaciones Diferenciales y Aplicaciones / XV Congreso de Matemática Aplicada, Invited talk in session: Dynamical Systems in models of Science. Title: *Bifurcation theory and catastrophic shifts: from cancer evolution to complex ecosystems*, June 2017, Cartagena, Spain.

• Poster presentation. Poster Title: *Multicellular logic circuits with memory: Mathematics meets synthetic biology*. Centre de Recerca Matemàtica in: Intensive Research Programme on the Mathematics of Memory (MATHMEM)

Seminars

• J. Sardanyés. *Dynamical systems for cooperation: from viruses to origins of life and beyond* Dynamical Systems seminar UB-UPC, Department of Mathematics and Computer Science (UB), Febrer 2017.

• J. Sardanyés. *Nonlinear dynamics and catastrophic extinctions in unstable tumor cells populations.* CAMP Seminar at the Centre de Recerca Matemàtica, April 2017.

• J. Sardanyés. *On catastrophes in cancer dynamics through the trans-heteroclinic bifurcation.* Dynamical Systems seminar at Dept. Mathematics UAB, December 2017.

Communications in conferences

• J. Sardanyés. The 10th CHAOS 2017 International Conference, Barcelona May, 30th to June 2nd, 2017

• J. Sardanyés. CEDYA + CMA 2017 XXV Congreso de Ecuaciones Diferenciales y Aplicaciones / XV Congreso de Matemática Aplicada, June, 26th to 30th, 2017, Cartagena, Spain

□ Other activities

- Member of Editorial board, Frontiers in Microbiology.
- Member of Editorial Board, Advances in Life Sciences.

Helmut Schmidt

Since June 2016 I was a postdoctoral researcher in the Computational Neuroscience Group at the CRM (led by Alex Roxin), funded by the Barcelona Graduate School of Mathematics.

My research was focussed on modelling the dynamics of networks of spiking neurones, specifically the role of oscillations in cognitive tasks related to short-term and long-term memory. At the core of my research was a model that describes the macroscopic dynamics of neuronal networks in the limit of a large number of neurones, thus facilitating analytical and numerical methods to investigate this problem. As a result, we identified distinct frequency bands with different functional roles, which can either evoke, maintain, or clear short-term memory states; similarly, oscillations can serve to activate, switch between, or clear long-term memory states in neuronal networks.

The second project revolved around investigating the formation of patterns and localised solutions in spatially extended neuronal networks. We have identified several mechanisms that can lead to the formation of such solutions, ranging from classical 'Snakes-and-Ladders' structures, to the emergence of localised solutions due to spatial inhomogeneities. At the core of the investigation was an eigen-decomposition of the model equations, which makes it accessible to numerical continuation methods in order to map out the bifurcation structure in parameter space.

In addition, I have been involved in a project with researchers from the University of Exeter and King?s College London (UK) in which we studied the role of brain networks in the emergence of seizure dynamics in various forms of epilepsy. Specifically, we combined mathematical modelling with EEG data analysis, which yielded a tool to model seizure activity in a subject-specific manner. This tool determines the seizure propensity of a neural network, and what type of seizure emerges. It has therefore the potential to be used as a diagnostic tool in the clinic.

□ Publications

Preprints

- Helmut Schmidt, Daniele Avitabile, Ernest Montbrió, and Alex Roxin, *Network mechanisms underlying the role of oscillations in cognitive tasks*. (Submitted)
- Wessel Woldman, Helmut Schmidt, Eugenio Abela, *et al.*, *Whether seizures appear focal or generalised can be determined by mathematical analysis of interictal scalp EEG*. (Submitted)
- Helmut Schmidt, Daniele Avitabile, and Alex Roxin, *Bumps and patterns in networks of spiking neurons*. (In preparation)

□ Scientific activities

Communications in conferences

- H. Schmidt, *Macroscopic response of quadratic integrate-and-fire neurons to oscillatory forcing*. Brainmodes, December 1^{st} to 2^{nd}, 2016, Brussels (poster).

□ Teaching activity

- Supervision of a project student, project title: *Neural field models with multiple firing thresholds*.

□ Scientific activities

Invited lectures in conferences

- H. Schmidt, *Spatially Localized Patterns in Networks of Spiking Neurons*. Minisymposium on "Emergence and Interactions of Spatially Localized Patterns", SIAM Conference on Applications of Dynamical Systems, May 21^{st} to 25^{th}, 2017, Snowbird, USA.

Communications in conferences

- H. Schmidt, *Network topology determines seizure generation in generalized epilepsy*. Computational Neurology, February 20^{th} to 21^{st}, 2017, Newcastle, UK (poster).
- H. Schmidt, *Macroscopic response of quadratic integrate-and-fire neurons to oscillatory forcing*. International Conference on Mathematical Neuroscience, May 30^{th} to Jun 2^{nd}, 2017, Boulder, USA (talk)
- H. Schmidt, *Switching memories with oscillations: The emergence of functionally distinct frequency bands*. BARCCSYN, 15^{th} to 16^{th}, 2017, Barcelona, Spain (talk).
- H. Schmidt, *Network topology fetermines seizure generation in generalized epilepsy. Brain dynamics on multiple scales - paradigms, their relations, and integrated approaches*. June 19^{th} to 23^{rd} ,2017, Dresden, Germany (poster).
- H. Schmidt, *Emergence of functionally distinct frequency bands in networks of quadratic integrate-and-fire neurons. Brain dynamics on multiple scales - paradigms, their telations, and integrated approaches*. June 19-23 2017, Dresden, Germany (poster).

Research stays

- March 13^{th} to 19^{th}, 2017, Nottingham, visiting Dr. Daniele Avitabile

□ Other activities

- Best poster award at Computational Neurology, February 20^{th} to 21^{st}, 2017, Newcastle, UK

Isabel Serra

During 2017, I was finishing postdoctoral researcher position in Complex System Group of the CRM as a member of the mathematic research collaborative programme of LaCaixa Foundation. In October I got a position in CRM as Head of Knowledge and Technology Transfer Advice Unit.

My research activities are developing on the framework of Extreme Value Analysis (EVA). The main activities can be classified as: theoretical development, in order to improve statistical modeling techniques in EVA, and practical development, in order to improve data analysis result in complex systems and data mining techniques in the framework of data science. The first was developed in several frameworks on complex system, the main project was joining with Department of Physics in UB on the treatment of collected data from Synthetic Earthquakes for developing bivariate statistic methodologies, which is a project of collaborative mathematic programme with La Caixa Foundation. Simultaneously, the analysis of real earthquakes was developed, see my Publicatiuons. The second was in collaboration with Department of mathematics in UAB, the Department of Econometry in UB, Department of Computer Science in UPC and Institute of Photonic Sciences, Mediterranean Technology Park (ICFO).

My public engagement activity is concentrated in to take part in several conferences and teach in several Master studies. Moreover, I was supervising some Final Degree project and Final Master project. Several times I was member of Master Thesis committee. I participated as a member of the local organizing committees of some research activities as invited speaker in international conference and I was guest editor for a special issue in Journal of Data Analysis and Technical Statistics.

Finally, I am a member of Barcelona Risk Analytics (BRA), Barcelona Graduate School of Mathematics (BGSMath), Red española de bioestadística (BIOSTATNET), Sociedad Catalana de Estadística (SoCE) and Member of local commity of XXIX International Biometric Conference (IBC 2018).

Since October, my position in complex system group is collaborative researcher and this activity is combined with advisoring for transfering knowledge and technology to industry, society and environmental. Consequently, my research is mainly addressed to develop my data science knowledge in complex systems.

□ Publications

Articles

- I. Serra and A. Corral, *Deviation from power law of the global earthquake seismic moment distribution*. Nature Scientific Reports **7** (2017).
- J. Del Castillo, J. Daoudi, and I. Serra, *The full tails gamma distribution applied to model estreme value*s. ASTIN Bulletin **47** (2017).

Preprints

- V. Navas-Portella, I. Serra, A. Corral, E. Vives, *Increasing power-law range in avalanche amplitude and energy distributions*.
- P. Rochet I. Serra, *The Mean/Max Statistic in Extreme Value Analysis*.
- J. Castillo, I. Serra, M. Padilla, D. Moriña, *Fitting tails by the empirical residual coefficient of variation: The ercv package.*

Research projects

- *Grup de Recerca en Matemàtica Col·laborativa del CRM*, Generalitat de Catalunya, 2014SGR-01307, AGAUR 20142016 (extended to April 2017), PI: Álvaro Corral

Teaching activity

Lectures and short courses

- *Temporal estimation of rate*. UB-UPC. Master's degree in Statistics and Operations Research (MESIO). February 2017 (20h.)
- *Mathematics for Big Data*. UAB-CRM. UAB. Máster Modelling for Science and Engineering. May 2017 (16h.)
- *Statistics in finance*. UB-UPC. Master's degree in Statistics and Operations Research (MESIO). November 2017 (12h.)
- *Extreme value analysis in insurance*. Màster universitario en ciencias actuariales y financieras (MCCAF). November 2017 (16h.)
- *Random walk model by finance data*. UAB-CRM. Màster de Matemàtiques per als Instruments Financers (MMIF). December 2017 (16h.)

Scientific activities

Organisation

- II BGSMath Junior meeting. May 15
- Member of local commity of *12th Metaheuristics International Conference: MIC2017 and XXIX International Biometric Conference (IBC 2018)*.

Invited lectures in conferences

- I. Serra, *Model for management risk of burglaries* in 9th International Conference of the ERCIM. Computational and Methodological Statistics (CMStatistics2015), Seville, Spain.

Seminars

- I. Serra, *Exponential families for modelling tails*. Seminar in University of Nantes, Dept. Statistics

Courses attended

- *Topological Data Analysis*, Curso organizado por el Servicio de Estadística Aplicada (SEA).

2.2.3. Col·laboradors Científics

Durant l'any 2017, tres investigadors pertanyents a altres institucions han format part de la comunitat del CRM com a Col·laboradors Científics: Aurora Hernández-Machado de la Universitat de Barcelona, que participa en el Laboratori de Microreologia de Biofluids del CRM (vegeu Secció 2.3.2) i col·labora amb els grups de Biologia Matemàtica i Computacional i Matemàtica Industrial; Ricard Alemany, de Crèdit Andorrà Financial Group i Néstor Costa, de Hohner Automáticos S.L.

2.2.3. Scientific Collaborators

During the year 2017, three researchers from other institutions have been part of the CRM community as Scientific Collaborators: Aurora Hernández-Machado from the Universitat de Barcelona, who is participating in the CRM's Microrheology of Biofluids Lab (see section 2.3.2.) and collaborates with the Mathematical Biology and Industrial Mathematics groups; Ricard Alemany, from the Crèdit Andorrà Financial Group and Néstor Costa, from Hohner Automáticos S.L.

Ricard Alemany

Ricard Alemany works at Crèdit Andorrà Financial Group, an Andorran based institution, as the Managing Director of Market Risk. He teaches risk management on the Master on Mathematics for Financial Instruments degree program at the Centre for Mathematical Research (MMIF). Ricard has also served as a scientific collaborator in the Financial Mathematics and Risk Control research group at CRM since August 2014.

He is an IESE visiting professor of Financial Risk Management in the Department of Finance at the IESE Business School.

Ricard participates in the analysis of existing credit risk rating methodologies. Emphasis was placed on deriving an explicit probability of default at a given time horizon. Efforts were also directed at incorporating the effects driven by both global developing trends and natural cyclical trends. Particular attention was focused on issues relating to monetary policies and their effects on the perception of risk premium.

Néstor Costa

Néstor Costa Jimeno is a pre-doctoral student developing an Industrial PhD between a research center and a company: Centre de Recerca Matemàtica and Hohner Automáticos S.L, respectively. He is graduted in physics in the Universitat de Barcelona, and he received the MsC in Photonics from the Universitat Politècnica de Catalunya. In the company, he is part of the R+D+i department, performing innovation tasks focused in the optical rotary encoder field. His work is mainly focused on providing and testing different optical ideas with strong mathematical basis.

Aurora Hernández-Machado

We have been working on the development of a new framework to the study non-Newtonian behaviour of fluids at the microscale based on the analysis of front advancement. We have applied this methology to study the non-linear rheology of blood in microchannels and characterized blood aging. A second project we have developed an innovative technology for measuring the viscosity of blood by means of a micro-rheometer device that is economic, ease-to-use and portable.

□ Publications

Articles

- C. Trejo-Soto, E. Costa-Miracle, I. Rodriguez-Villareal, J. Cid, M. Castro, T. Alarcón, A. Hernández-Machado, *Front microrheology of the non-Newtonian behavior of blood: scaling theory of erythrocite aggregation by aging*. Soft Matter, 13 (2017), 3042, doi:10.1039/C6SM02412B.

□ Research projects

- *Biomechanics of biofluids and biomembranes at the microscale: Experiments and theory*. Ministerio de Economía y Competitividad. Programa Estatal de Fomento de la Investigación Científica y Técnica de Excelencia FIS2016-78883-C2-1-P. From 2017 to 2019. 60.000 euros. Coordinator: A. Hernandez-Machado.

- *Dynamics of interfacial systems at the micro and nanoscale: Biomembranes and microfluidicsy*. Ministerio de Economia y Competitividad, Programa Estatal de Fomento de la Investigación Científica y Técnica de Excelencia, FIS2013-47949-C2-1-P. From 2014 to 2017. 72.600 euros. Coordinator: A. Hernandez-Machado.

- *Cost Action '"Flowing Matter"(MP1305)*. European Union Framework Programme Horizon 2020 From 2014 to 2018. 100.000.000 euros. Coordinator: F. Toschi Participation: A. Hernandez-Machado.

□ Scientific activities

Invited lectures in conferences

- A. Hernández-Machado, Keynote lecture: *Drop emission by dynamic wetting in thin films at the microscale: A Phase-Field Model Approach*. 19h International Conference on Finite Elements in Flow Problems - FEF 2017, Rome, Italy.

- A. Hernández-Machado, Keynote lecture: *Front microrheology of the Non-Newtonian behavior of blood*. Workshop on Fluid Mechanics 2017, Tarragona, Spain.

□ Technology transfer

- Participation in Collider, the technology transfer venture builder of Mobile World Capital Foundation (2017–2018)
- Participation in Eada Business School Barcelona Program of Business Plan Research (2017–2018)
- Patent: T. Alarcon, A.I. Rodriguez-Villarreal, J. Colomer, A. Hernández-Machado, P.L. Miribel, *Method, apparatus and micro-rheometer for measuring rheological properties of newtonian and non-newtonian fluids*, European Patent Office number: 15382248.1 (2016) United States Patent Application Serial No. 15/574.021

2.2.4. Estudiants de doctorat

Presentem a continuació els estudiants de doctorat dels grups del centre i la seva activitat més rellevant durant el 2017. Tal com s'ha anat indicant en altres part d'aquesta memòria, les beques d'aquests estudiants es financien per diverses fonts: beques competitives de la Generalitat de Catalunya (FI) o del Ministeri (FPI, FPU), beques del programa de recerca col·laborativa "la Caixa"-CRM, beques pròpies del CRM i una beca del programa especial de l'Obra Social de "la Caixa" vinculada a la Universitat Politècnica de Catalunya. A l'apartat 2.5.1. es detalla la procedència de cadascuna de les beques.

2.2.4. PhD Students

Next we present the postgraduate students of the CRM research groups and their activity along the year 2017. As pointed out in other parts of this report, the grants of these students are funded from different sources: competitive grants of the Generalitat de Catalunya (FI) or Spanish Ministeries (FPI, FPU), grants from the "la Caixa"-CRM program collaborative research, CRM-funded grants and one grant from a special program of the "la Caixa" Foundation, which is based at the Universitat Politècnica de Catalunya. Details about the sourcing of each fellowship are given in Section 2.5.1.

□ Publications

Articles

- **M. Calvo-Schwarzwälder**, M.G. Hennessy, P. Torres, T.G. Myers, F.X. Alvarez, *A slip-based model for the size-dependent effective thermal conductivity of nanowires*. International Communications in Heat and Mass Transfer 91 (2017), 57–63.
- **G. Colldeforns**, L. Ortiz-Gracia, C. W. Oosterlee, *Two-dimensional Shannon wavelet inverse Fourier technique for pricing European options*. Appl. Numer. Math. 117 (2017), 115–138. `http://www.sciencedirect.com/science/article/pii/S0168927417300624?via%3Dihub`.
- **G. Colldeforns**, L. Ortiz-Gracia, *Computation of market risk measures with stochastic liquidity horizon*. Submitted for publication 2017 `https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2877347`.

• **A. Debernardi**, *Uniform convergence of double sine transforms of general monotone functions*. Anal. Math. 43 (2) (2017), 193–217.

• **A. Debernardi**, *Uniform convergence of sine integrals with general monotone functions*. Math. Nachr. 290 (17–18) (2017), 2815–2825.

• **N. Folguera**, E. Cuyàs, J. Menendez, and T. Alarcón, *Epigenetic regulation of cell fate reprogramming in aging and disease: A predictive computational model*. Provisionally accepted in PLOS (February 2018).

• **H. Ribera**, B. Wetton, T.G. Myers, *Cellular Automata model for substitutional binary diffusion in solids*. Submitted to Journal of Cellular Automata, December 2017.

• **H. Ribera**, B. Wetton, T.G. Myers, *Mathematical model for substitutional binary diffusion in solids*. Submitted to Applied Mathematical Modelling, December 2017.

• **H. Ribera**, T.G. Myers, and M.M MacDevette, *Optimising the heat balance integral method in spherical and cylindrical Stefan problems*. Submitted to Heat and Mass Transfer, November 2017.

• **M. Vegué**, R. Perin, A. Roxin, *On the structure of cortical microcircuits inferred from small sample sizes*. Journal of Neuroscience 37 (2017), no. 35, 8498–8510.

Preprints

• **G. Colldeforns**, L. Ortiz-Gracia, *Computation of market risk measures with stochastic liquidity horizon*. Submitted for publication (2017). `https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2877347`.

• **G. Colldeforns**, L. Ortiz-Gracia, C. W. Oosterlee, *Quantifying credit portfolio losses under multi-factor models*. Submitted for publication (2017). `https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3077993`.

• **A. Debernardi**, *Hankel transforms of general monotone functions*, submitted.

• **A. Debernardi**, *Uniform convergence of Hankel transform*, submitted.

• **A. Debernardi**, *Weighted norm inequalities for generalized Fourier-type transforms and applications*, submitted.

• **A. Debernardi**, E. Liflyand, S. Tikhonov, and M. Zeltser, *Pringsheim convergence and generalized monotonicity*.

• **C. Fanelli**, V. Cregan, T.G. Myers, S.L. Mitchell, H. Ribera, M. Calvo-Schwarzwälder, S. Serna, and A. Marquina, *Nanoparticle evolution via the precipitation method*. In preparation.

• **C. Fanelli** and T.G.Myers, *Mathematical modelling of nanosphere growth*. In preparation.

• **V. Navas**, I. Serra, A. Corral, and E. Vives, *Increasing power-law range in avalanche amplitude and energy distributions*. `arXiv:1711.06007`.

Scientific reports

• R. Bacsa, W. Bacsa, M. Calvo Schwarzwälder, V. Cregan (report coordinator), M. Fernandez-Pendas, S. Fernandez-Mendez, B. Florio, N. Gómez Bastus, A. Marquina, I. Moyles, T. G. Myers, H. Ribera, S. Rusconi, S. Serna, C. Vázquez-Cendón, and J. Piella (2016), *Synthesis of monodisperse spherical nanocrystals*. Proceedings of the 115th ESGI, Centre de Recerca Matemàtica (Spain).

Conference proceedings

• **C. Fanelli** Interdisciplinary Meeting of Predoctoral Researchers, Edificio Histórico de la Universidad de Barcelona, Barcelona, Spain.

• **C. Fanelli** Graduate Industrial Mathematics Modelling Camp 2017, International Centre for Mathematical Science, Edinburgh, Scotland.

• **C. Fanelli** 15th School on Interactions between Dynamical Systems and Partial Differential Equations, Centre de Recerca Matemàtica, Barcelona, Spain.

• **C. Fanelli** BMS - BGSMath Junior Meeting, Edificio Histórico de la Universidad de Barcelona, Barcelona, Spain.

Research projects

• *Methods of constructive approximation and Fourier analysis,* Ministery of Science and Innovation (MICINN) from the Spanish government, MTM2014-59174-P. From 01-01-2014 to 31-12-2017. Principal investigator: Sergey Tikhonov, **A. Debernardi**.

Activity in research training

• An introduction to Applied Mathematics, May - Jun, 2017 Centre de Recerca Matemàtica, Barcelona, Spain. (**C. Fanelli**)

Diffusion activity

• **C. Fanelli** Bojos per les matemàtiques. Presenter at the Mathematics and Science Outreach seminar, organized by the Federació d'Entitats per a l'Ensenyament de les Matemàtiques a Catalunya (FEEMCAT) i la Societat Catalana de Matemàtiques (SCM), Centre de Recerca Matemàtica, Barcelona.

• **H. Ribera** Bojos per les matemàtiques. Presenter at theMathematics and Science Outreach seminar, organized by the Federació d'Entitats per a l'Ensenyament de les Matemàtiques a Catalunya (FEEMCAT) i la Societat Catalana de Matemàtiques (SCM), Centre de Recerca Matemàtica, Barcelona.

• **H. Ribera** Final high school project (Treball de Recerca) co-supervisor. Mathematics at the nanoscale by Ariadna Moreno Sells.

Teaching activity

- **E. Beltrán**, teaching activity: Biostatistics (problems and practices), Degree in Biology, UAB, First Semester, 2017.

- **M. Calvo-Schwarzwälder**, Mathematics I, Statistics I (EAE Business School, Barcelona, Fall 2017).

- **C. Fanelli**, 2017 Bachelor thesis co-supervisor, Co-supervisor of thebachelor's thesis entitled Mathematical modelling of nanocrystal growth in solution by Daniel Salgado Rojo, Mathematics and Physics degree at the Universitat Autònoma de Barcelona, Barcelona, Spain.

- **C. Fanelli**, 2017 Bachelor thesis co-supervisor, Co-supervisor of the bachelor's thesis entitled Monodisperse Nanocrystal growth in solution by Curial Gallart Rodríguez, Nanoscience and Nanotechnology degree at the Universitat Autònoma de Barcelona, Barcelona, Spain.

- **V. Navas**, EAE Business School – UPC: Course of Mathematics I. Business Administration Degree, Barcelona, Spain.

- **V. Navas**, EAE Business School – UPC: Course of Statistics I. Business Administration Degree, Barcelona, Spain.

- **H. Ribera** Lecturer and mentor in the course Mathematical models of technology at the undergraduate level. Universitat Politècnica de Catalunya (Spain).

- **C. Sáez** Matrius i Vectors (Elementary Linear Algebra), Universitat de Barcelona, Fall 2017.

Scientific activities

- **M. Calvo-Schwarzwälder**, *EMS-SCM 2017*, Edinburgh, September 27^{th} to 29^{th}, 2017.

- **V. Navas**, American Geophysical Union (AGU) Fall Meeting - New Orleans, Louisiana, USA.

- **V. Navas**, Joint Workshop: Red de Excelencia: "Avalanches in Biophysics, Geophysics, Materials and Plasmas", University of Barcelona Institute of Complex Systems, Barcelona.

- **V. Navas**, Jornada de Doctorat CRM a Cosmocaixa.

- **V. Navas**, Jornades Complexitat, Castelldefels Barcelona.

- **V. Navas**, Data Science Workshop, BGSMath, Barcelona.

- **V. Navas**, Workshop on Avalanche Processes in Condensed Matter Physics and Beyond, Barcelona.

- **A. Nurtay**, Perturbation Methods, CRM, Barcelona, Spain. May 5^{th}, 2017.
- **A. Nurtay**, Stochastic modelling, CRM, Barcelona, Spain. May 24^{th}, 2017.
- **A. Nurtay**, Analytical methods for solving PDEs, CRM, Barcelona, Spain. June 7^{th}, 2017.
- **A. Nurtay**, Bifurcating systems, CRM, Barcelona, Spain. June 21^{st}, 2017.
- **G. Prat**, Participation IDIBAPS Compte lab weekly Journal Club.
- **G. Prat**, CRM weekly Camp Seminar.
- **G. Prat**, IDIBAPS Compte lab weekly lab meeting.
- **G. Prat**, Postdoc and predoc seminar Neurochats.

Communications in conferences

- **M. Calvo-Schwarzwälder**, *Heat Transfer and Phase Change at the Nanoscale*. ICMS, Edinburgh, September 29^{th}, 2017.
- **G. Colldeforns**, *Wavelet approach for quantifying credit risk portfolio losses under multi-factor Gaussian and t-copula models*. Poster: Barcelona workshop on Mathematical Finance, Barcelona March 29^{th} to 30^{th}, 2017. `https://wis.kuleuven.be/events/ub`.
- **G. Colldeforns**, *Wavelet approach for quantifying credit risk portfolio losses under multi-factor Gaussian and t-copula models*. Oral communication: CEDYA + CMA 2017, XXV CONGRESO DE ECUACIONES DIFERENCIALES Y APLICACIONES / XV CONGRESO DE MATEMÁTICA APLICADA, SE 12. Matemáticas Aplicadas a las Finanzas, Cartagena June 26^{th} to 30^{th}, 2017. `http://www.cedya2017.org`.
- **G. Colldeforns**, *Wavelet approach for pricing derivatives and for quantifying market and credit risk*Oral communication. ICCF 2017, 2nd International Conference on Computational Finance, Thematic session: Computational models and methods, Lisbon September 4^{th} to 8^{th}, 2017. `http://cemapre.iseg.ulisboa.pt/iccf2017/`.
- **G. Colldeforns**, *Wavelet approach for quantifying credit risk portfolio losses under multi-factor Gaussian and t-copula models*. Poster:Jornada de Doctorat CRM a COSMOCAIXA, Barcelona October 3^{rd}, 2017. `http://www.crm.cat/SiteAssets/Lists/Noticies/EditForm/programa.pdf`.
- **A. Debernardi**, *Weighted norm inequalities for generalized Fourier-type transforms*. International Conference on Weighted Estimates of Differential and Integral Operators and their Applications, L. N. Gumilyov Eurasian National University, May 4th to 6th, 2017, Astana, Kazakhstan.
- **A. Debernardi**, *Uniform convergence of weighted Hankel transforms*. Function theory, functional analysis and their applications, L. N. Gumilyov Eurasian National University, May 25th to 26th, 2017, Astana, Kazakhstan.

• **A. Debernardi**, *Weighted norm inequalities for integral transforms with kernels bounded by power functions*. Follow up: Approximation Theory & Function Spaces, June 26th to 30th, 2017, Centre de Recerca Matemàtica, Barcelona, Spain.

• **A. Debernardi**, *Weighted norm inequalities for integral transforms with kernels bounded by power functions*. Third Summer School on Harmonic Analysis and Partial Differential Equations, July 10th to 14th, 2017, Basque Center for Applied Mathematics, Bilbao, Spain.

• **A. Debernardi**, *Weighted norm inequalities for integral transforms with kernels bounded by power functions*. 6th Workshop on Fourier Analysis and Related Fields, August 24th to 31st, 2017, University of Pécs, Pécs, Hungary.

• **N. Folguera**, Poster exhibition at the 1st BGSMath Data Science Workshop. 22^{nd} of February 2017, Institut d'Estudis Catalans (IEC), Barcelona.

• **V. Navas**, Poster Presentation: *Effect of Earthquake Coulomb Stresses on the Gutenberg- Richter law?*, American Geophysical Union (AGU) Fall Meeting ? New Orleans, Louisiana, USA.

• **V. Navas**, Poster Presentation: *Renormalization of correlated point processes*, Joint Workshop: Red de Excelencia: *Avalanches in Biophysics, Geophysics, Materials and Plasmas*, University of Barcelona Institute of Complex Systems, Barcelona.

• **V. Navas**, Poster Presentation: *Avalanches and force drops in deformation-driven compression of porous glasses*, Jornada de Doctorat CRM a Cosmocaixa - Barcelona.

• **V. Navas**, Poster Presentation: *Renormalization of correlated point processes*, Jornades Complexitat, Castelldefels, Barcelona.

• **V. Navas**, Poster Presentation: *Avalanches and force drops in deformation-driven compression of porous glasses*, Data Science Workshop – BGSMath, Barcelona.

• **V. Navas**, Poster presentation and Flash Talk: *Avalanches and force drops in deformation driven compression of porous glasses*, Workshop on Avalanche Processes in Condensed Matter Physics and Beyond, Barcelona.

• **A. Nurtay**, Annual Review, CRM, Barcelona, Spain, July 13^{th}, 2017.

• **A. Nurtay**, Joint meeting of the Edinburgh Mathematical Society and Societat Catalana de Matemàtiques, Edinburgh, United Kingdom, 27 September 27^{th} to 29^{th}, 2017.

• **A. Nurtay**, Jornada de Doctorat, CosmoCaixa, Barcelona, Spain, October 4^{th}, 2017.

• **G. Prat**, *Modifying the magnitude of stimulus noise can distinguish between neural mechanisms of evidence integration*. SFN, Washington.

• **G. Prat**, *Modifying the magnitude of stimulus noise can distinguish between neural mechanisms of evidence integration,*. SENC, Alicante.

- **G. Prat**, *Modifying the magnitude of stimulus noise can distinguish between neural mechanisms of evidence integration*. BARCCSYN, Barcelona.

- **G. Prat**, *Attractor Models of Perceptual Decision Making Exhibit a Resonant Performance for Non-zero Noise Level*. Memory school, CRM, Bellaterra.

- **G. Prat**, *Attractor Models of Perceptual Decision Making Exhibit a Resonant Performance for Non-zero Noise Level*. Symposia on memory, CRM, Bellaterra.

- **C. Sáez** *Finite subgroups of diffeomorphisms of 4-manifolds*. Oral communication: Catalan/Spanish/Swedish Mathematical Societies joint meeting. Umea University, Sweden, June 2017.

- **C. Sáez** *Actions of finite groups on manifolds, smooth and symplectic*. Oral communication: BMS-BGSMath Junior Meeting, Institut d'Estudis Catalans, Barcelona 2017.

- **C. Sáez** *Acciones simplécticas de grupos finitos en* $S^2 \times S^2$. Oral communication: Bilbao, October 2017.

- **M. Vegué**, *On the structure of cortical microcircuits*. I Neurochats, May 18^{th}, 2017 (oral communication).

- **M. Vegué**, *On the structure of cortical microcircuits inferred from small sample sizes*. BARCCSYN, June 16^{th} and 17^{th}, 2017 (oral communication).

Seminars

- **M. Calvo-Schwarzwälder**, *Phase Change at the Nanoscale*, September 28^{th}, 2017.

- **A. Debernardi**, *Natural decomposition of the Fourier transform*. Analysis Ph. D. Students' Seminar, February 2017, Universitat Autònoma de Barcelona, Spain.

- **A. Debernardi**, *Uniform convergence of sine transforms of general monotone functions*. Group Seminar, May 2017, L. N. Gumilyov Eurasian National University, Astana, Kazakhstan.

- **C. Sáez** *Virtual moduli cycles: John Pardon's approach*. Seminar in Symplectic Topology, Universitat de Barcelona, 2017.

Research stays

- Short Term Scientific Mission. 3 months in the University of Limerick. (**M. Calvo-Schwarzwälder**)

- May, 2017: L. N. Gumilyov Eurasian University in Astana, Kazakhstan. (**A. Debernardi**)

- July 10th to 14th, 2017: Third Summer School on Harmonic Analysis and Partial Differential Equations in Basque Center for Applied Mathematics, Bilbao, Spain. (**A. Debernardi**)

- April 18^{th} to June 2^{nd}, 2017: Mathematical Institute, University of Oxford, visiting Professor Helen Byrne. (**N. Folguera**)

Courses attended

- J.M. Lago Alonso (lecturer of the course), *Anàlisi i gestió de dades amb Python*. Servei d'Estadística Aplicada, Universitat Autònoma de Barcelona, February 27^{th}–March 2^{nd}, 2017. `http://sct.uab.cat/estadistica/content/analisi-i-gestio-de-dades-amb-python`. (**G. Colldeforns**)
- *Linux Course*, L. Alsedà Soler (lecturer of the course), Centre de Recerca Matemàtica, Bellaterra, November, 2017. `http://mat.uab.cat/~alseda/CursLinux/` (**G. Colldeforns**)
- *Data analysis with Python*. December 2017. Centre de Recerca Matemàtica,(CRM), Barcelona (Spain).
- *Linux Course.* November 2018. Taught by Lluís Alsedà, Centre de Recerca Matemàtica (CRM). (**N. Folguera**)
- *EMBO Practical Course Multi-level modelling of morphogenesis*. July 16^{th} to 28^{th}, 2017. John Innes Centre, Norwich, United Kingdom. (**N. Folguera**)
- *Introduction to Python Course*. February 27^{th} to March 2^{nd}, 2017. Taught by the Servei d'Estadística Aplicada (SEA), Universitat Autònoma de Barcelona. (**N. Folguera**)
- *Linux Course*. Taught by Lluis Alsedà Centre de Recerca Matemàtica (**V. Navas**)
- *Introduction to Python Course*. Servei d'Estadística Aplicada (SEA), Universitat Autònoma de Barcelona (UAB) (**V. Navas**)
- Modelling Camp 2017. International Centre for Mathematical Sciences (Scotland). May 2017. (**H. Ribera**)
- BMS - BGSMath Junior Meeting. Barcelona (Spain). October 2017. (**H. Ribera**)
- Memory School, CRM, January 16^{th} to 20^{th}, 2017. (**M. Vegué**)
- Symposia on Memory, CRM, March 6^{th} to 10^{th}, 2017 (**M. Vegué**)

□ Other activities

- JIPI 2017, Barcelona September 9^{th}, 2017. (**M. Calvo-Schwarzwälder**)
- Study week: WakEUpCall Study Week with the Financial Industry. Madrid May 8^{th} to 12^{th}, 2017. `http://fineng.ewi.tudelft.nl/WFM2017/`. (**G. Colldeforns**)
- Attendance to conference: Jornada d'Investigadors Predoctorals Interdisciplinària (JIPI), Barcelona February 9^{th}, 2017. `https://jipi.cat/ca/`. (**G. Colldeforns**)
- Attendance to conference: 1st BGSMath Data Science Workshop, BarcelonaFebruary 22^{nd}, 2017. `https://bgsmath.cat/event/1st-bgsmath-data-science-workshop/`. (**G. Colldeforns**)

• Awarded with the grant "Borsa Ferran Sunyer i Balaguer" from Fundació Ferran Sunyer i Balaguer and Institut d'Estudis Catalans to carry out a research visit of one month to the university L. N. Gumilyov Eurasian National University in Astana, Kazakhstan. (**A. Debernardi**)

• Member of Editorial Board, Demonstratio Mathematica (Assistant Editor). (**A. Debernardi**)

• Awarded 'Borsa de viatge' (' Travelling grant') from Fundació Ferran Sunyer i Balaguer to visit Professor Helen Byrne (1 month). (**N. Folguera**)

• Awarded STSM (Short Term Scientific Mission) scholarship under the Cost Action TD1409 MI-NET, *Mathematics for Industry Network*. (**N. Folguera**)

• Awarded EMBO travel grant to attend the EMBO course Multi-level modelling of morphogenesis (July 2017). (**N. Folguera**)

2.3. Transferència de Coneixement

2.3.1 Equip de Transferència de Coneixement

L'equip de Transferència de Coneixement del CRM es va formar el 2012 amb l'objectiu d'aplicar el coneixement i el saber fer adquirits en la recerca que es desenvolupa al centre, donant prioritat a aquells projectes que apostin per la innovació o que tinguin més relació amb la base matemàtica dels grups de recerca del CRM.

L'octubre del 2017 s'ha creat la Unitat de transferència de coneixement i tecnologia, amb la finalitat d'anar més enllà, el repte que ens proposem és transferir a la indústria, societat i medi ambient, la recerca científica on l'aportació de les matemàtiques hi jugui un rol rellevant. Els avantatges competitius del nou projecte de transferència és la capacitat de treballar amb eines punteres i afrontar qualsevol necessitat de modelització matemàtica, optimització o investigació operativa entre altres.

El primer projecte amb el que ha arrencat la unitat s'ha desenvolupat per a Zurich Insurance Group, sota el marc de col·laboració en l'àmbit de la ciència de dades. Per altre banda, sha iniciat la col·laboració amb EAE Bussiness School, per tal

2.3. Knowledge Transfer

2.3.1. Knowledge Transfer Team

The Knowledge Transfer team of CRM was founded on 2012 with the objective of applying the knowledge and know how acquired on research developed at the center, giving priority to those projects that bet for innovation or that are closely related with the mathematical expertise of the research groups in CRM.

In October 2017 we have founded the Knowledge and Technology Transfer unit, with the objective of going further. The challenge we face is to transfer to industry, society and environment, the scientific research in which mathematics play a key role. The competitive advantage of this new transference project is the opportunity to work with top new tools and face any need for mathematical modeling, optimization or operative research, among other things..

The first project the unit has started with has been developed by a Zürich Insurance Group, under the collaboration framework in the field of data science. On the other hand, we have started a collaboration with EAE Business School, to allow PhD students

que els estudiants de doctorat del CRM, puguin exercir tasques docents curriculars i el resultat està essent molt beneficiòs per ambdues parts. Una altre iniciativa, per apropar els investigadors a la indústria ha arribat de la col·laboració amb el departament de matemàtiques de la UAB, amb la unitat encarregada de pràctiques en empresa, oferint des del CRM ajut en la supervisió de les tasques que es desenvolupen a la indústria.

in CRM to perform educational curricular tasks, and the results are being very positive for both parts. Another initiative, to bring researchers closer to industry, has come from collaborations with the Department of Mathematics of UAB, with its practices unit, offering help from CRM on supervision of tasks developed in industry.

Al 2017 s'ha presentat la sol·licitud de patent nacional EU i patent regional a US, com a resultat del procés de PCT que es va iniciar al 2015 i ja va ser referenciat a memòries anteriors amb el títol: *Method, apparatus and micro-rheometer for measuring rheological properties of Newtonian and non-Newtonian fluids*. A finals del 2017, s'han iniciat els tràmits de llicenciar aquesta patent a través del programa Collider. El projecte inclou la creació durant el 2018 d'una Spin-off: Rheo dx, en la qual el CRM hi participarà com a entitat societària juntament amb mVenture, propiestat de World Mobile Capital. L'aplicabilitat de la patent es focalitza en l'àmbit de la salut i s'estan explorant altres línees des del CRM.

On 2017 it has been presented a EU national patent application, and a US regional patent application, as result of the process of PCT started in 2015, that has been already referenced in previous notes, with the title 'Method, apparatus and micro-rheometer for measuring rheological properties of Newtonian and non-Newtonian fluids'. At the end of 2017, we started procedures for licensing this new patent through the Venture Builder program 'The Collider'. The project includes the creation, during 2018, of a Spin-off: RheoDx SL, in which CRM will participate as corporate entity, together with mVentures SL, property of Mobile World Capital Barcelona. The applicability for the patent is focused on health care, and other lines are explored from CRM.

Respecte a la transferència de coneixement seguim ampliant els contactes i els camps ens els qual creiem que podem aportar valor col·laborant amb empreses. Seguim explorant la via del doctorat industrial i alhora la dels serveis. Tanmateix s'ha seguit amb les tasques que ja s'havien engegat al 2016:

About the Knowledge Transfer, we keep expanding our contacts and the fields in which we think we could add value collaborating with enterprises. We keep exploring the way of industrial PhD and, at the same time, the provision of services. However, we have continued with tasks that had already been started on 2016:

- Optimitzar serveis en el cas d'una multinacional.
- Millora d'un procés intern per Hohner.
- Es manté la col·laboració amb la Xarxa Math-in.

- Optimize services in case of a multinational company
- Improvement of an internal process for Hohner.
- Collaboration with de Net Math-in is maintained.

2.3.2. Laboratori de Microreologia de Biofluids

El Laboratori de Microreologia de Biofluids del CRM és una unitat d'investigació experimental. Aquesta unitat s'ha establert conjuntament pels grups de Biologia Matemàtica i Computacional, de Matemàtica Industrial i de Transferència de Coneixement per tal de proporcionar una instal·lació experimental que permeti avançar en la investigació d'aquests grups, proporcionant resultats experimentals rellevants per alguns dels seus projectes relacionats amb la dinàmica de biofluids a micro-escala. L'objectiu científic d'aquesta unitat d'investigació és l'estudi, tant per mitjà de models matemàtics com per mitjà d'investigació experimental directa, de les propietats mecàniques de biofluids en situacions dinàmiques. Aquest laboratori s'ha endegat en col·laboració amb el grup de Dinàmica d'Interfícies en Nanotecnologia, Fluídica i Biofísica de la Facultat de Física de la Universitat de Barcelona, dirigit per la Prof. Aurora Hernández-Machado, col·laboradora científica del CRM.

2.3.2. Lab for Microrheology of Biofluids

The CRM Lab for Microrheology of Biofluids is an experimental research unit based at CRM. This unit is established in collaboration with the Computational & Mathematical Biology Group, the Industrial Mathematics Group, and the Technology Transfer Unit in order to provide an in-house experimental facility that allows to advance the mathematical research of those groups by providing experimental results relevant to some of their projects related to the dynamics of biofluids at the micro-scale. The scientific aim of this research unit is to study, both by means of mathematical models as well as by direct experimental investigation, the mechanical properties of biofluids in dynamical situations. This laboratory is ran by the Computational & Mathematical Biology Group and the Industrial Mathematics Group in collaboration with the Dynamics of Interfaces in Nanotechnology, Fluidics and Biophysics Group of the Faculty of Physics of the Universitat de Barcelona leaded by Prof. Aurora Hernández-Machado, scientific collaborator of CRM.

2.3.3. Personal

Isabel Serra

In October I got a position in CRM as Head of Knowledge and Technology Transfer Advice Unit. My main activity is to know, participle and/or advice, in the research projects with potential for transferring knowledge and/or technology to industry, society and/or environmental. The KTT capabilities of mathematics covers a large set of scientific development in science, social science and engineering, then I work on to increase my knowledge of capabilities for KTT in this communities of Catalonia. Day by day,

My main objective is to act as a connector between the world of research and the different sectors: industry, society and environment. On the one hand, to help the developed in the world of research, become improvements in these sectors. And on the other hand, to help the needs of these sectors are translated into challenges for future research.

Samantha López

BSc in Biology (Universitat Autònoma de Barcelona) and MSc in Biostatistics and Bioinformatics (Universitat Oberta de Catalunya). Experience in microbiology and molecular biology laboratory techniques, genomics data analysis, and bioinformatics software development. Current investigator in Complex Fluids Laboratory, at Centre de Recerca Matemàtica. Founder and CSO at Rheo Diagnostics SL, developing microfluidics-based technology for diagnostics.

Her role at Centre de Recerca Matemàtica is on experimental research at Complex Fluids Laboratory, with microfluidics technology applied to blood experimentation, and data analysis. Founder of the first spin-off company of CRM, Rheo Diagnostics SL, to bring to the market a microfluidics-based technology patented in the center, applied to diagnosis of blood diseases.

2.3.4. Red Española Matemática-Industria

Un dels objectius del projecte i-MATH, que va acabar l'any 2011, va ser la creació en una plataforma de transferència de tecnologia per a promoure la interacció entre els grups de matemàtiques de les universitats i la industria. Això va portar a la formació de la *Red Española Matemática-Industria (math-in)*.

El CRM va signar un acord de col·laboració amb math-in al maig de 2012, amb l'objectiu d'involucrar als investigadors del CRM en la

2.3.4. Red Española Matemática-Industria

One of the goals of the i-MATH project, which ended in 2011, was the setting up a Technology Transfer platform to promote interaction between university mathematics groups and industry. This led to the formation of the Red Española Matemática-Industria (math-in).

The CRM signed a collaboration agreement with math-in in May 2012, with the goal of involving CRM researchers in technology transfer, through

transferència de tecnologia, mitjançant l'intercanvi d'informació, coordinant propostes de subvencions, oferint recolzament en l'organització de congressos i establint vincles amb empreses i centres de recerca.

the exchange of information, co-ordinating grant proposals, support in conference organisation and establishing links with companies and research centres.

La creació de la "Red math-in" ha estat una de les prioritats del Pla de Transferència de Tecnologia del projecte i-MATH i pretén ser l'evolució de la plataforma de Mathematica CONSULTING. La idea és que es converteixi en un foro per a la comunicació i l'intercanvi d'informació i experiències per a promoure la transferència dels resultats de recerca produïts en el camp de les matemàtiques.

The creation of the Red math-in network has been one of the priorities of the Technology Transfer Plan of the i-MATH project, and tries to be the evolution of the Mathematica platform CONSULTING. It is intended to become a forum for communication and exchange of information and experiences to promote the transfer of research results produced into the field of mathematics.

http://www.math-in.net/

2.3.5. Doctorat Industrial

El CRM ha aportat propostes de Doctorat Industrial des de la creació d'aquest pla per part de la Generalitat de Catalunya. Afortunadament, en aquesta segona convocatòria s'ha pogut iniciar un dels projectes proposats, junt amb l'empresa Hohner Automáticos S.L. L'estudiant que realitzarà el seu doctorat en aquest projecte és Néstor Costa Jimeno.

2.3.5. Industrial Doctorate

The CRM has provided proposals for Industrial Doctorates since the set up of this plan by the Generalitat de Catalunya. Fortunately, in this second call, one of the proposed projects has been initiated, together with the company Hohner Automáticos S.L. The student who will carry out his PhD thesis in this project is Néstor Costa Jimeno.

http://doctoratsindustrials.gencat.cat/
http://doctoratsindustrials.gencat.cat/files/file/attachment/1367/P_DI_2014_038_HOHNER.pdf

2.4. Investigadors visitants

Diversos investigadors fan estades temporals al CRM durant el curs acadèmic, la majoria dels quals són participants invitats als programes de recerca i la resta s'acullen a les convocatòries públiques del CRM per a estades de recerca en col·laboració amb matemàtics/ques de les universitats catalanes, que són de tres tipus diferents:

- Estades de recerca al CRM.
- Estades de recerca en col·laboració.
- Places "Lluís Santaló" per a visitants d'Amèrica llatina (finançada per l'IEC).

El llistat de visitants de 2017 es detalla a continuació. Aquest llistat no inclou el personal investigador propi del CRM ni els visitants que hagin fet estades inferiors a vuit dies.

2.4. List of visitors

A number of researchers visit the CRM temporarily every academic year. Most of them are invited participants at CRM research programmes, and the rest apply to competitive calls for research stays in collaboration with mathematicians in local universities, namely:

- *Visiting the CRM.*
- *Research in pairs at CRM.*
- *"Lluís Santaló" visiting positions for Latin-American researchers (sponsored by IEC).*

The list of 2017 visitors is the following. This list does not include CRM staff researchers nor visitors whose stay was shorter than eight days.

Kevin Aguyar Brix	University of Copenhagen
Jorge Antezana	Instituto Argentino de Matemática
Ramon Antoine Riolobos	Universitat Autonòma de Barcelona
Pere Ara	Universitat Autonòma de Barcelona
Pere Barber Lloréns	Universitat Autònoma de Barcelona
Joan Bosa Puigredon	University of Glasgow
Roisin Braddell	Trinity College
Ana Cristina Buira Rodríguez	Universitat Autonòma de Barcelona
Joan Claramunt Carós	Universitat Autonòma de Barcelona
Laurent Cantier	Universitat Autonòma de Barcelona
Marta Cavero Lázaro	Universitat Autònoma de Barcelona
Kristin Courtney	University of Virginia
Laura De Carli	Florida International University
Amadeu Delshams	Universitat Politècnica de Catalunya
Rafael de la Llave	Georgia Institute of Technology
Caleb Eckhardt	Miami University
Kari Eifler	Texas A&M University
Søren Eilers	University of Copenhagen
George A. Elliott	University of Toronto
Michael Firrisa	Dartmouth College

Eusebio Gardella	University of Münster
Maria Grazia Viola	Lake Head University
Adewunmi Gideon Fareo	University of the Witwatersrand
Jamie Gabe	University of Southampton
Thierry Giordano	University of Ottawa
Sara Gómez Reverter	Universitat Autonòma de Barcelona
Rodrigo Gonçalves Schaefer	Universitat Politècnica de Catalunya
Dmitry Gorbachev	Tula State University
Antoni Guillamon Grabolosa	Universitat Politècnica de Catalunya
Pedro Hack Makarovic	Universitat Autònoma de Barcelona
Alfredo Hernández Cavieres	Universitat Autonòma de Barcelona
Ilan Hirshberg	Ben-Gurion University of the Negev
Eider Ibiricu	Universitat Autonòma de Barcelona
Valerii Ivanov	Tula State University
Abigail Jimenez	University of Ulster
Thaís Jordao	Universidade de São Paulo
Ainur Jumabayeva	L.N. Gumilyov Eurasian National University
Klaus Keimel	Technische Universität Darmstadt
Iurii Kolomoitsev	Institute of Mathematics of NAS of Ukraine
Yurii Kolomoitsev	Institute of Mathematics of NAS of Ukraine
Jorge A. León	CINVESTAV
Huaxin Lin	University of Oregon
Pierre Liotet	Universidad Politecnica de Valencia
Matias Lolk	University of Copenhagen
Samantha López	Centre de Recerca Matemàtica
Martino Lupini	California Institut of Technology
Simone Marchesi	Universidade Estadual de Campinas
Juan E. Martínez Legaz	Universitat Autònoma de Barcelona
Luis D. Martínez Magán	Universidad Carlos III de Madrid
Toke Meier Carlsen	Norwegian University of Science and Technology
Eva Miranda	Universitat Politècnica de Catalunya
Gianluigi Mongillo	CNRS
Askhat Mukanov	L.N. Gumilyov Eurasian National University
Magdalena Musat	Kobenhavns Universitet
Gary O'keeffe	Limerick University
Cédric Oms	Universitat Politècnica de Catalunya

Eduard Ortega Esparza	Norwegian University of Science and Technology
Stefano Pedarra	Università degli studi di Padova
N. Christopher Phillips	University of Oregon
Arnau Planas Bahí	Universitat Politècnica de Catalunya
Ian Putnam	University of Victoria
Carles Raich Bros	Universitat de Barcelona
Anna Maria Riera Escandell	Universitat Autònoma de Barcelona
Leonel Robert	York University
Mikael Rørdam	Kobenhavns Universitet
Alex Roxin	Centre de Recerca Matemàtica
Eduardo Scarparo	University of Copenhagen
Azin Shahiri	Universitat Autònoma de Barcelona
Elena Shchepakina	Samara State Aerospace University
Adam Sierakowski	University of Wollongong
Aidan Sims	University of Wollongong
Vladimir Sobolev	Samara State Aerospace University
Vladimir Stepanov	Peoples Frienship University of Russia
Daria Stepanova	Universitat Autònoma de Barcelona
Karen Strung	Polskiej Akademii Nauk
Gabor Szabó	University of Münster
Vladimir Temlyakov	University of South Carolina
Hannes Thiel	University of Copenhagen
Yerzhan Toleugazy	L.N. Gumilyov Eurasian National University
Claudia A. Trejo Soto	Universitat de Barcelona
Enrico Valdinoci	Weierstrass Inst. for Applied Analysis & Stochasti
Gerard Valentí i Rojas	Universitat de Barcelona
Josep Vives	Universitat de Barcelona
Stuart White	University of Glasgow
Dana Williams	Dartmouth College
Aizhan Ydyrys	L.N. Gumilyov Eurasian National University
Joachim Zacharias	University of Glasgow

En total, el CRM ha hostatjat 266,50 mesos d'estada d'investigadors al llarg de l'any 2017.

Summing up, the CRM has hosted 266,50 months of stays of researchers during 2017.

2.5. La formació en recerca

Hi ha tres vessants de formació al CRM: per a estudiants de grau i màster, doctoral i postdoctoral. Aquest darrer nivell ha estat tractat a les Seccions 2.1 i 2.2 d'aquesta memòria. A continuació expliquem l'activitat referent als dos primers estadis durant el 2017.

2.5.1. La Unitat de Formació Doctoral

El CRM ofereix la possibilitat a estudiants graduats de participar en un projecte de tesi doctoral dins d'un grup de recerca o d'una xarxa temàtica del CRM. Els estudiants de doctorat del CRM s'inscriuen a la Unitat de Formació Doctoral del CRM (UFD-CRM). Cal que compleixin els requisits necessaris per ser admesos en un programa de doctorat en matemàtiques de les universitats catalanes i queden automàticament inscrits a la Barcelona Graduate School of Mathematics. La UFD està coordinada actualment per Álvaro Corral, amb el suport de l'equip de direcció del CRM.

La UFD compta amb un programa d'activitats que consisteixen en:

- Un cicle de cursos de perfeccionament impartits per investigadors i/o col·laboradors de les xarxes temàtiques del CRM. Aquests cursos s'integren dins de la Barcelona Graduate School of Mathematics, i, per tant, queden a disposició de tots els estudiants de doctorat de l'àrea de Barcelona. Els temes d'aquests cursos seran d'interès general per a tots els estudiants.

- Un seminari juvenil organitzat pels estudiants sobre una base mensual i amb la participació només de joves investigadors (estudiants de doctorat i postdoctorats).

- Un taller anual on els estudiants presentaran informes sobre l'estat actual de les seves tesis.

2.5. Research training

There are three training levels at CRM: undergraduate and masters, doctoral and post-doctoral. The latter has been exposed in Sections 2.1 and 2.2 of this report. Next, we explain the activity in the first two stages during 2017.

2.5.1. The Doctoral Training Unit

The CRM offers the possibility for graduate students to engage in a PhD Dissertation project within a research group or thematic network of CRM. Doctoral students of CRM are enrolled in the CRM-Doctoral Training Unit (UFD-CRM). They are required to fulfill the requisites to be admitted to a doctoral programme in Mathematics in a Catalan university and they become automatically enrolled in the Barcelona Graduate School of Mathematics. The UFD is currently co-ordinated by Álvaro Corral with the support of the CRM direction team.

The UFD has a programme of activities consisting of:

- *A cycle of advanced courses given by CRM researchers and/or collaborators from the thematic networks. These courses will be integrated within the Barcelona Graduate School of Mathematics, and thus made available to all the PhD students of the Barcelona area. The subjects of these courses will be of general interest for all students.*

- *A junior seminar organised by the students on a monthly basis and attended only by junior researchers (PhD students and postdocs).*

- *An annual workshop where students will present reports of the current state of their theses.*

El estudiants de doctorat del CRM es financien a través de diferents fonts: beques competitives de la Generalitat de Catalunya (FI) o ministeris espanyols (FPI, FPU), beques del programa "la Caixa"-CRM d'investigació en matemàtica col·laborativa, beques finançades pel CRM i altres. Els estudiants de doctorat associats al CRM durant l'any 2016 han estat els següents (a la secció 2.2.4 trobareu informació detallada sobre la feina desenvolupada):

CRM PhD students are funded from different sources: competitive grants of the Generalitat de Catalunya (FI) or Spanish Ministeries (FPI, FPU), grants from the "la Caixa"-CRM program collaborative research, CRM-funded grants and others. PhD students associated to the CRM during this year (detailed information on their research can be found in section 2.2.4):

Elisa Beltrán is working on her PhD thesis, supervised by Tomás Alarcón since October 2014. Funded by FPU Grant of Spanish MECD.

Marc Calvo is working on his PhD thesis, supervised by Tim Myers since December 2015. Funded by "la Caixa"-CRM.

Gemma Colldeforns is working on her PhD thesis, supervised by Luis Ortiz since September 2014. Funded by "la Caixa"-CRM.

Enric Costa has been working PhD thesis, supervised by Tomás Alarcón until September 2017. Funded by CRM program and FPI BGSMath grant.

Roberto de la Cruz is working on his PhD thesis, supervised by Tomás Alarcón since February 2013. Funded by FI-AGAUR scholarship.

Alberto Debernardi is working on his PhD thesis, supervised by Sergey Tikhonov since January 2014. Funded by CRM program.

Núria Folguera is working on her PhD thesis, supervised by Tomás Alarcón since November 2014. Funded by "la Caixa"-CRM.

Víctor Navas is working on his PhD thesis, supervised by Álvaro Corral since December 2015. Funded by "la Caixa"-CR.

Anel Nurtay is working on her PhD thesis, supervised by Andrei Korobeinikov since March 2015. Funded by "la Caixa"-CRM.

Patricia Paredes is working on her PhD thesis, supervised by Isabel Serra and Anna Espinal since September 2017. Funded by the Equatorian Govenment

Genís Prat is working on his PhD thesis, supervised by Alexander Roxin since September 2014. Funded by "la Caixa"-CRM.

Helena Ribera is working on her PhD thesis, supervised by Tim Myers since October 2014. Funded by "la Caixa"-CRM.

Bernat Rovira is working on his PhD thesis, supervised by Alex Roxin since January 2014. Funded by FPI scholarship.

Daria Stepanova is working on her PhD thesis, supervised by Tomás Alarcón since September 2017.

Marina Vegué is working on her PhD thesis, supervised by Alexander Roxin since November 2013. Funded by "la Caixa"-Becas España.

Victoria Ponce is working on her PhD thesis, supervised jointly by Thomas Carraro, Dr. Tomás Alarcón, Helen Byrne and Philip K Maini since March 2017. Founded by DFG grant GSC 220 in the German Universities Excellence Initiative.

2.5.2. Curs de màster

El Màster de Matemàtiques per als Instruments Financers es va impartir per dinovena vegada el 2016 gràcies a la col·laboració del Departament de Matemàtiques de la UAB i el CRM amb diverses entitats: la Borsa de Barcelona (patrocinadora), els departaments d'Economia Aplicada, d'Economia de l'Empresa, i d'Economia i d'Història Econòmica de la UAB, i el Departament d'Econometria, Estadística i Economia Espanyola de la UB, juntament amb destacats especialistes que treballen en contacte directe amb els mercats. Les empreses col·laboradores que hi donen suport, mitjançant les beques per a la realització de pràctiques, aporten el component necessari d'aprenentatge pràctic. Així, s'estableix una línia directa de col·laboració entre els mons acadèmic i professional, que permet desenvolupar i ensenyar les últimes tècniques de valoració de productes financers derivats, càlcul d'estratègies de cobertura i avaluació i control de riscos.

El màster està estructurat en tres etapes: dues de teòriques (cadascuna amb 120 hores de docència) i una tercera etapa pràctica en una empresa de finances. La responsabilitat del màster recau en una Comissió Acadèmica i un Comitè Executiu. L'any 2017 han acabat el màster 12 alumnes.

2.5.2. Master's Course

The CRM master's course on Financial Mathematics was held for the nineteenth time in 2016 thanks to the collaboration of the Mathematics Department of the UAB and the CRM with several financial companies such as the Barcelona Stock Exchange, which is the sponsoring institution. Other collaborating institutions are the departments of Economics and Economics History, Applied Economics, and Business Economics of the UAB, the Department of Econometrics, Statistics and Spanish Economy of the UB, and several outstanding specialists who work in direct contact with the markets. The collaborating companies promote practical training opportunities to the students by offering them grants. This facilitates a direct contact between the academic world and the professional world, allowing them to develop and teach innovative techniques about the valuation of derived financial products, calculation of coverage strategies, risk assessment and risk control.

The course is structured in three terms, two theoretical, each with 120 hours of teaching, and a third practical in a financial company. The master's responsibility lies on an Academic Commission and an Executive Committee. In 2017 a total of 12 students completed the master's course.

2.5.3. Estades d'iniciació a la recerca

El CRM va endegar el 2012 una convocatòria d'estades de recerca amb l'objectiu d'atraure l'interès dels joves cap a la recerca en matemàtiques. En el marc del programa, el CRM acull, en estades de 2 mesos, estudiants de grau o màster per tal de desenvolupar una etapa formativa en algun grup de recerca del CRM. Durant el 2017, un total de 22 estudiants van participar en aquest programa:

2.5.3. Internships for initiation to research

The CRM launched in 2012 a call for research stays aiming at attracting the interest of young people towards mathematical research. The CRM hosts, for a 2-month stay, undergraduate or master students willing to experience a training period in some of the CRM research groups. During 2017, 22 students visited the CRM within this program:

- Biologia Matemàtica i Computacional/*Computational & Mathematical Biology*
  - Andreu Arderiu
  - Andreu Fernández-Gallen
  - Carles Raich
- Epidemiologia Matemàtica/*Mathematical Epidemiology*
  - Ana Cristina Buira
  - Marta Cavero Lázaro
  - Sara Gomez Reverter
  - David Masip
  - Brian Martín Icochea López
  - David Moreno
  - Stefano Pedarra
  - Ramon Tous Fernandez
  - Anna Maria Riera Escandell
- Matemàtica Industrial/*Industrial Mathematics*
  - Pere Barber
  - Daniel Salgado
- Neurociència Computacional/*Computational Neuroscience*
  - Cristià Estany
  - Pedro Hack
  - Guifré Sánchez
  - Gerard Valentí
- Sistemes Complexos/*Complex Systems*
  - Irina Espejo
  - Alfredo Hernández

- Eider Ibiricu
- Daniel López

2.5.4. Premis Extraordinaris de Batxillerat

Iniciativa que l'ACER desenvolupa en col·laboració amb el Departament d'Ensenyament de la Generalitat de Catalunya. La finalitat és que els alumnes premiats amb els Premis Extraordinaris de Batxillerat fan estades de recerca a centres de recerca triats per ells mateixos per conèixer els grups de recerca.

A la convocatòria de l'any 2017 els estudiants premiats que han estat al CRM són:

- Leonor Lamsdorff-Galagane (tutor: Alex Roxin)
- Martí Jané (tutor: Álvaro Corral)

2.5.4. Special Undergraduate Award

Initiative developed by the ACER in partnership with the Education Department of the Generalitat de Catalunya. The objective is for the awarded students with the Special Undergraduate Award to conduct research stays at research centres of their choosing to know about the research groups.

At the 2017 call the awarded students that have visited the CRM are:

3

Organització d'activitats científiques

Organization of Scientific Events

El CRM organitza des de fa anys, sobre una base competitiva mitjançant convocatòries al seu web, quatre tipus d'activitats:

- Programes de recerca intensius
- Congressos internacionals i workshops
- Cursos avançats
- Jornades temàtiques

Les sol·licituds es presenten mitjançant les instruccions que es poden trobar a la secció corresponent de la web del CRM, actualment a *Visitors& Events > Scientific Events*.

Since long ago the CRM organises on a competitive basis, through open calls in its website, four types of activities:

- *Intensive Research Programmes*
- *International Conferences and Workshops*
- *Advanced Courses*
- *Thematic Days*

Applications can be formulated by following the guidelines given in the Visitors& Events > Scientific Events section of the CRM website.

`http://www.crm.cat/ca/Activities/Pagines/CallsForActivities.aspx`

El CRM també organitza *activitats divulgatives* i *seminaris de recerca*.

The CRM also organises Dissemination Activities and Research Seminars.

3.1. Programes de recerca

Un programa de recerca del CRM consisteix en un període intensiu de recerca en una àrea determinada de les matemàtiques i les seves aplicacions, durant el qual s'apleguen al CRM investigadors procedents de diferents institucions d'arreu del món per treballar en problemes oberts del seu àmbit d'especialització i per analitzar-ne l'estat i les perspectives.

3.1. Research Programmes

The CRM Research Programmes consist of periods of intensive research in a given area of the mathematical sciences and their applications, bringing together researchers from different institutions to work on open problems in the chosen area and to analyse its present state and perspectives.

Els programes de recerca del CRM duren, normalment, entre dos i cinc mesos. S'estructuren en dos vessants: els investigadors visitants i les activitats programades. Cada programa té un comitè científic responsable de planificar les activitats incloses en el programa, elaborar la llista dels investigadors visitants i lliurar un informe final. Típicament, en un programa hi participen investigadors locals a temps complet, investigadors visitants a temps complet, becaris postdoctorals i estudiants de doctorat avançats. Les activitats d'un programa inclouen generalment un o dos seminaris setmanals, un *workshop* intensiu (preferentment obert a investigadors que no participin en el programa), un congrés internacional i un curs avançat dirigit a estudiants de doctorat.

Research Programmes can run for periods from two to five months. They are based on two aspects: visiting researchers and activities organised within. Every programme has a scientific committee, which is fully responsible for the planning of all activities included in the programme, elaboration of the list of participants, and submission of a final report. Typically, participants in a programme include local full-time researchers, visitors on a full-time basis, post-doctoral fellows and advanced doctoral students. A research programme generally includes one or two weekly seminars, one intensive workshop (preferably open to researchers not participating in the programme), a conference and an advanced course addressed to graduate students.

Els programes de recerca del CRM es convoquen a nivell internacional amb dos anys d'antelació i són avaluats pel Consell Científic. A continuació es descriuen els programes de recerca organitzats durant l'any 2017. La informació general sobre els programes de recerca es pot trobar a

The CRM Research Programmes are called internationally two years in advance and are evaluated by the Scientific Advisory Board. The CRM Research Programmes that took place in 2017 are described below. General information of Research Programmes can be found at

www.crm.cat/en/Activities/Pages/ResearchProgrammes.aspx

3.1.1. CRM Research Programme on Mathematics of Memory (MathMem)

January 16^{th} *to March* 10^{th}, 2017

Scientific organizers	Nicolas Brunel	University of Chicago
	Sandro Romani	Janelia Research Campus
	Alex Roxin (coordinator)	Centre de Recerca Matemàtica

Summary

The goal of this intensive research program is to push the boundaries of theoretical work on memory formation, consolidation and recall in humans and non-human animals. We aim to do this by 1. Bringing together top theoretical researchers working on models of memory, 2. Providing an in-depth introduction to memory science and a review of previous theoretical work in an open, relaxed school-like forum which will be open to student and young researchers, and 3.

Exploring current challenges in memory science where theory and experiment meet. This last point will involve lectures by top researchers on their own cutting-edge work, as well as discussion sessions emphasizing brain storming and planting the seeds for future collaboration. We will invite both theoretical and experimental researchers

All program information can be found at:
`http://www.crm.cat/en/Activities/Curs_2016-2017/Pages/IRP-MATHMEM.aspx`

Visiting Researchers

Nikolai Axmacher (Universität Bonn), Alberto Bernacchia (University of Cambridge), Jan Born (Universität Tübingen), Nicolas Brunel (University of Chicago), Neil Burgess, (UCL Institute of Cognitive Neuroscience), Claudia Clopath (Imperial College London), Jozsef Csicsvari (Institute of Science and Technology, Austria), Howard Eichenbaum (Boston University), Robert Crooks Froemke (New York University), Stefano Fusi (Columbia University), Wulfram Gerstner, (Laboratory of Computational Neuroscience), Michael Graupner (Université Paris Descartes), Michael Hasselmo (Boston University), Edvard Ingjald (Norwegian University of Science and Technology), Vivek Jayaraman, (Janelia Research Campus), Albert Lee (Janelia Research Campus), John Lisman (Brandeis University), Jeff Magee (Janelia Research Campus), Gianluigi Mongillo, (CNRS), Panayiota Poirazi (FORTH-Inst. of Molecular Biology & Biotechnology), Sandro Romani (Janelia Research Campus), Alex Roxin (Centre de Recerca Matemàtica), Harel Shouval (University of Texas), Nelson Spruston (Janelia Research Campus), Joaquin Torres (Universidad de Granada), Alessandro Treves, (Scuola Intern. Sup. di Studi Avanzati (SISSA)), Misha Tsodyks (Weizmann Institute of Science), Mark van Rossum (University of Edinburgh), Tim Vogels (University of Oxford), Yaniv Ziv (Weizmann Institute), Michaël Zugaro (Collège de France / CNRS / INSERM).

- **Memory School**

January 16^{th} *to* 20^{th}, 2017
Participants: 79

Lecturers and Titles

Synaptic Plasticity

Harel Shouval, University of Texas
General introduction to synaptic plasticity and memory
Models of unsupervised learning

Mark van Rossum, University of Edinburgh
Modeling plasticity: biophysics, presynaptic effects, statistical approaches
Homeostasis and consolidation models

Learning

Nicolas Brunel, University of Chicago
Simplified models of synaptic plasticity
Models of supervised learning

Mark van Rossum, University of Edinburgh
Supervised learning

Misha Tsodyks, Weizmann Institute of Science
Attractor neural networks: theory

Memory in networks

Misha Tsodyks, Weizmann Institute of Science
Attractor neural networks: interpreting experimental results
Modeling episodic recall

Gianluigi Mongillo, CNRS
Models of active memory maintenance
Working Memory II

Memory in networks

Gianluigi Mongillo, CNRS
Working Memory III

Alberto Bernacchia, University of Cambridge
Short-term memory traces in heterogeneous neural networks

Models of hippocampus and related areas

Alberto Bernacchia, University of Cambridge
Dimensionality reduction of neural activity during working memory

Sandro Romani, Janelia Research Campus
Memory for continuous quantities I
Memory for continuous quantities II

- **Master lectures**

January 20^{th} *to March* 6^{th}, 2017

Scientific Committee	Nicolas Brunel	University of Chicago
	Sandro Romani	Janelia Research Campus
	Alex Roxin (coordinator)	Centre de Recerca Matemàtica

Lecturers and Titles

Joaquin Torres, Universidad de Granada
Neurophysics: a new physics frontier to understand the structure of the brain and its function

Neil Burgess, UCL Institute of Cognitive Neuroscience
Neural mechanisms of spatial cognition and episodic memory

Nikolai Axmacher, Universität Bonn
The fate of the human engram

Tim Vogels, Oxford University
The dance of excitation and inhibition

• Symposia on Memory

March 6^{th} *to* 10^{th}, 2017
Participants: 96

Scientific Committee

Nicolas Brunel	University of Chicago
Sandro Romani	Janelia Research Campus
Alex Roxin (coordinator)	Centre de Recerca Matemàtica

Lecturers

Jan Born, Universität Tübingen
Sleep to form memory

Nicolas Brunel, University of Chicago
Inferring learning rules in cortical circuits

Claudia Clopath, Imperial College London
Emergence of microcircuits

Jozsef Csicsvari, Institute of Science and Technology (Austria)
The role of hippocampal formation in spatial learning

Shaul Druckmann, Janelia Research Campus
Relating circuit dynamics to computation: coding and non-coding spaces in short-term memory

Howard Eichenbaum, Boston University
The hippocampus: memory in space and time

Robert Crooks Froemke, New York University
Oxytocin, maternal behavior and excitatory-inhibitory balance

Stefano Fusi, Columbia University
Computational principles of biological memory

Wulfram Gerstner, Laboratory of Computational Neuroscience
Synaptic plasticity controlled by surprise

Michael Graupner, CNRS
Natural firing patterns reduce sensitivity of synaptic plasticity to spike timing

Michael Hasselmo, Boston University
Neural coding of space and time in entorhinal cortex

Vivek Jarayaman, Janelia Research Campus
Internal representations and attractor dynamics in a small brain

Albert Lee, Janelia Research Campus
The formation and statistical structure of the representation of space in the hippocampus

John Lisman, Brandeis University
Progress in understanding the molecular basis of memory

Jeff Magee, Janelia Research Campus
Circuit mechanisms of CA1 place fields

Gianluigi Mongillo, CNRS
Inhibitory connectivity defines the realm of excitatory plasticity

Edvard Ingjald Moser, Norwegian University of Science and Technology
Grid cells and the cortical map of space

Panayiota Poirazi, FORTH - Inst. of Molecular Biology & Biotechnology
Linking memories across time via neuronal and dendritic overlaps in model neurons with active dendrites

Sandro Romani, Janelia Research Campus
Path planning and path integration with recurrent neural networks

Alex Roxin, Centre de Recerca Matemàtica
A model of plasticity-dependent activity in rodent hippocampus during spatial exploration

Harel Z. Shouval, University of Texas
Its about time

Nelson Spruston, Janelia Research Campus
The diversity and complexity of hippocampal neurons

Alessandro Treves, International School for Advanced Studies (SISSA)
Grid cells get back to the memory game

Misha Tsodyks, Weizmann Institute of Science
Synaptic origins of working memory capacity

Yaniv Ziv, Weizmann Institute
Multiplexing information about where and when in hippocampal neural codes for long term memory

Michaël Zugaro, École des Neurosciences, Paris Île-de-France
Network mechanisms of memory formation and consolidation

3.1.2. CRM Research Programme on Operator Algebras: Dynamics and Interactions

March 1^{st} *to July* 21^{st}, 2017

Scientific organizers	Nathanial P. Brown	The Pennsylvania State University
	Francesc Perera	Universitat Autònoma de Barcelona
	Aidan Sims	University of Wollongong
	Stuart White	University of Glasgow
	Wilhelm Winter	University of Münster

Summary

The classification of simple nuclear C^*-algebras has been work of many hands that has spanned over years. The AF-algebras - C^*-algebras that can be expressed as the norm closure of an increasing union of finite-dimensional subalgebras – constituted one of the first classes of simple C^*-algebras to be classified. This was achieved by Elliott in the 1970's; his classification was essentially in terms of K-theory. But many tractable examples of simple C^*-algebras lie outside this class, and the focus of classification theory quickly shifted to nuclear C^*-algebras – those in which the identity map can, on any finite collection of elements, be approximately factored via two completely positive contractions, through a finite-dimensional C^*-algebra. This leads to a beautiful connection back to von Neumann algebras: a separable C^*-algebra is nuclear precisely when its double dual has the property of being Approximately Finite Dimensional. Inspired by von Neumann algebraic techniques developed by McDuff, and present in Kirchberg's work on purely infinite C^*-algebras, Toms and Winter showed that tensorial absorption of a strongly self-absorbing C^*-algebra such as the Jiang-Su algebra or the Cuntz algebra $\mathcal{O}_\infty$ provide additional regularity properties required for a classification (using K-theoretical information) to hold.

These developments have resulted in a burst of activity in the area of simple nuclear C^*-algebras with dramatic new advances (some very recent) in classification and structure being drivenby techniques directly analogous to those used in the classification of amenable von Neumann factors. At the same time, the rapidly-increasing scope of the theory has led to a demand for good models, akin to the realization of AFD factors as crossed products, for each new class of C^*-algebras encompassed by classification results.

Objectives. This Intensive Research Program is designed simultaneously to speed up and contribute to the next game-changing developments in classification and structure theory for C^*-algebras, and to prepare for the new state of play in the area once those developments arrive. According to current developments, the IRP will strive to blend different techniques coming both from C^* and von Neumann algebras and find a common ground to maximize outputs. The program will bring together many of the world's leading researchers working on

C^*-algebras, von Neumann algebras, dynamical systems, and the interactions between these areas. There are three key objectives:

1. To advance classification programs for C^*-algebras and for C^*-dynamical systems.
2. To investigate further suitable models for classifiable C^*-algebras arising from dynamics.
3. To encourage further interaction between C^*-algebras and von Neumann algebras in light of current progress in both areas.

We expect the participation of young researchers, both predoctoral and postdoctoral in the activities planned during the program, particularly seminars, workshops, the intensive course and the conference.

All program information can be found at:
`http://www.crm.cat/en/Activities/Curs_2016-2017/Pages/IRP-OAL.aspx`

Visiting Researchers

Judith A. Packer (University of Colorado Boulder), Kevin Aguyar (University of Copenhagen), Astrid an Huef (University of Otago), Ramon Antoine (Universitat Autònoma de Barcelona), Pere Ara (Universitat Autònoma de Barcelona), Scott Atkinson (Vanderbilt University), Joan Bosa (University of Glasgow), Nathanial P. Brown (The Pennsylvania State University), Jan M. Cameron (Vassar College), Laurent Cantier (Universitat Autònoma de Barcelona), Toke Meier Carlsen (University of the Faroe Islands), Jose Carrion (Texas Christian Univesity), Jorge Castillejos (Katholieke Universiteit Leuven), Sarah Chehade (University of Houston), Yeong Chyuan Chung (Texas A&M University), Joan Claramunt (Universitat Autònoma de Barcelona), Kristin Courtney (University of Virginia), Joachim Cuntz (Universität Münster), Marius Dadarlat (Purdue University), Robin Deeley (University of Hawai'i-West O'ahu), Caleb Eckhardt (Miami University), Kari Eifler (Texas A&M University), Søren Eilers (University of Copenhagen), George A. Elliott (University of Toronto), Ilijas Farah (York University), Michael Firrisa (Dartmouth College), James Gabe (University of Southampton), Eusebio Gardella (Universität Münster), Elisabeth Gillaspy (Universität Münster), Thierry Giordano (University of Ottawa), Ilan Hirshberg (Ben-Gurion University of the Negev), Yasuyuki Kawahigashi (The University of Tokyo), Klaus Keimel (Technische Universität Darmstadt), Kang Li (Universität Münster), Xin Li (Queen Mary University of London), Huaxin Lin (University of Oregon), Fernando Lledó (Universidad Carlos III), Matias Lolk (University of Copenhagen), Martino Lupini (California Institut of Technology), Luis Diego Martínez (Universidad Carlos III), Martin Mathieu (Queen's University), Magdalena Musat (Kobenhavns Universitet), Chi-Keung Ng (Nankai University), Eduard Ortega (Norwegian University of

Science and Technology), Enrique Pardo (Universidad de Cádiz), Francesc Perera (Universitat Autònoma de Barcelona), N. Christopher Phillips (University of Oregon), Sorin Popa (University of California at Los Angeles), Ian Putnam (University of Victoria), Timothy Rainone (Arizona State University), Sarah Reznikoff (Kansas State University), Leonel Robert (University of Louisiana at Lafayette), John Clark Robertson (University of Hawai'i-West O'ahu), Mikael Rørdam (Kobenhavns Universitet), Eduardo Scarparo (University of Copenhagen), Azin Shahiri (Universitat Autònoma de Barcelona), Aidan Sims (University of Wollongong), Christian Skau (Norwegian University of Science and Technology), Karen Strung (Polskiej Akademii Nauk), Gabor Szabó (University of Aberdeen), Hannes Thiel (Universität Münster), Aaron Tikuisis (University of Aberdeen), Mark Tomforde, Qingyun Wang (University of Oregon), Kun Wang (Texas A&M University), Stuart White (University of Glasgow), Rufus Willett (University of Hawai'i-Manoa), Dana Williams (Dartmouth College), Wilhelm Winter (Universität Münster), Joachim Zacharias (University of Glasgow).

Activities

- **Weekly Seminar**

Speakers

Martino Lupini, California Institut of Technology
Borel complexity and C^*-dynamics
March 29^{th}, 2017

Eusebio Gardella, Universität Münster
Actions of nonamenable groups on strongly self-absorbing C^*-algebras
April 5^{th}, 2017

Eusebio Gardella, Universität Münster
Regularity properties for amenable group actions on simple C^*-algebras
April 12^{th}, 2017

Magdalena Musat, Kobenhavns Universitet
Quantum information theory and the Connes embedding problem
April 12^{th}, 2017

Mikael Rordam, Kobenhavns Universitet
Just-infinite C^*-algebras: their invariants and their role among RFD C^*-algebras
April 19^{th}, 2017

Huaxin Lin, University of Oregon
Classification of stably projectionless simple Z-stable C^*-algebras
April 20^{th}, 2017

Joachim Zacharias, University of Glasgow
A dynamical version of the Cuntz semigroup
April 26^{th}, 2017

Fernando Lledó, Universidad Carlos III
Amenability and uniform Roe C^*-algebras
April 26^{th}, 2017

Joachim Cuntz, Universität Münster
Semigroup C^*-algebras and toric varieties
April 27^{th}, 2017

Ilijas Farah, York University
Kadison-Kastler stability of stable rank
April 27^{th}, 2017

Ian Putnam, University of Victoria
Groupoid C^*-algebras in the Elliott classification program
May 5^{th}, 2017

Søren Eilers, University of Copenhagen
Flow equivalence and stable isomorphism of Cuntz-Krieger algebras
May 5^{th}, 2017

Thierry Giordano, University of Ottawa
Old and new examples of approximate transitive actions
May 10^{th}, 2017

Christian Skau, Norwegian University of Science and Technology
Bratteli diagrams and symbolic dynamical systems
May 10^{th}, 2017

Yasuyuki Kawahigashi, The University of Tokyo
Moonshine and operator algebras
May 19^{th}, 2017

Jamie Gabe, University of Southampton
A new proof of Kirchberg's O_2-stable classification
June 12^{th}, 2017

Sam Evington, University of Glasgow
W^*-bundles and continuous families of subfactors
June 13^{th}, 2017

Joan Bosa, University of Glasgow
TBA
June 14^{th}, 2017

Kevin Aguyar Brix, University of Copenhagen
The C^*-algebra associated to symbolic dynamical systems
June 15^{th}, 2017

Jose Carrion, Texas Christian University
Some remarks on groups of piecewise projective homeomorphisms
June 16^{th}, 2017

Alessandro Vignati, York University
Set theory and isomorphisms of reduced products
June 28^{th}, 2017

Eusebio Gardella, Universität Münster
Amenability and actions on strongly self-absorbing C^*-algebras
June 28^{th}, 2017

N. Christopher Phillips, University of Oregon
Existence of idempotents in operator algebras on L^p spaces
July 5^{th}, 2017

N. Christopher Phillips, University of Oregon
Existence of idempotents in operator algebras on L^p spaces - Part 2
July 10^{th}, 2017

Jianchao Wu, University Park
Rokhlin dimension beyond residually finite groups
July 12^{th}, 2017

George Elliott, University of Toronto
How close are simple C^*-algebras?
July 18^{th}, 2017

- **An invitation to C^*-algebras**
March 6^{th} to 24^{th}, 2017

- **Advanced Course on Operator Algebras: Groupoids, crossed products, and Rokhlin dimension**
March 13^{th} to 17^{th}, 2017
Participants: 43

Scientific Committee	Nathanial P. Brown	The Pennsylvania State University
	Francesc Perera	Universitat Autònoma de Barcelona
	Aidan Sims	University of Wollongong
	Stuart White	University of Glasgow
	Wilhelm Winter	University of Münster

Organizing Committee	Ramon Antoine	Universitat Autònoma de Barcelona
	Pere Ara	Universitat Autònoma de Barcelona
	Joan Claramunt	Universitat Autònoma de Barcelona
	Francesc Perera	Universitat Autònoma de Barcelona
	Azin Shahiri	Universitat Autònoma de Barcelona

Lecturers

Aidan Sims, University of Wollongong
Groupoid C^*-algebras

Gabor Szabó, University of Aberdeen
Rokhlin dimension

Dana Williams, Dartmouth College
Crossed products

• Workshop on C^*-algebras and Dynamical Systems
March 20^{th} *to* 24^{th}, 2017
Participants: 43

Scientific Committee

Nathanial P. Brown	The Pennsylvania State University
Francesc Perera	Universitat Autònoma de Barcelona
Aidan Sims	University of Wollongong
Stuart White	University of Glasgow
Wilhelm Winter	University of Münster

Organizing Committee

Ramon Antoine	Universitat Autònoma de Barcelona
Pere Ara	Universitat Autònoma de Barcelona
Laurent Cantier	Universitat Autònoma de Barcelona
Joan Claramunt	Universitat Autònoma de Barcelona
Francesc Perera	Universitat Autònoma de Barcelona
Azin Shahiri	Universitat Autònoma de Barcelona

Speakers

Ramon Antoine (Universitat Autonòma de Barcelona), Pere Ara (Universitat Autonòma de Barcelona), Marat Aukhadiev (Universität Münster), Joan Bosa (University of Glasgow), Jan Cameron (Vassar College), Jorge Castillejos (Katholieke Universiteit Leuven), Joan Claramunt (Universitat Autònoma de Barcelona), Jamie Gabe (University of Southampton), Eusebio Gardella (Universität Münster), Ilan Hirshberg (Ben-Gurion University of the Negev), Alla Kuznetsova (Kazan Federal University), Kang Li (Universität Münster), Martino Lupini (California Institut of Technology), Eduard Ortega (Norwegian University of Science and Technology), Enrique Pardo (Universidad de Cádiz), Timothy Rainone (Arizona State University), Leonel Robert (University of Louisiana at Lafayette), Aidan Sims (University of Wollongong), Karen Strung (Polskiej Akademii Nauk), Gábor Szabó (University of Aberdeen), Hannes Thiel (Universität Münster), Dana Williams (Sartmouth College), Wilhelm Winter (Universität Münster).

• Lecture series von Neumann algebras by Yasuyuki kawahigashi (The University of Tokyo)
May 11^{th} *to* 19^{th}, 2017

• **Barcelona Conference on C^*-algebras: Structure, Classification and Dynamics**

June 19^{th} *to* 23^{rd}, 2017

Participants: 62

Scientific Committee	Nathanial P. Brown	The Pennsylvania State University
	Francesc Perera	Universitat Autònoma de Barcelona
	Aidan Sims	University of Wollongong
	Stuart White	University of Glasgow
	Wilhelm Winter	University of Münster
Organizing Committee	Ramon Antoine	Universitat Autònoma de Barcelona
	Pere Ara	Universitat Autònoma de Barcelona
	Laurent Cantier	Universitat Autònoma de Barcelona
	Joan Claramunt	Universitat Autònoma de Barcelona
	Francesc Perera	Universitat Autònoma de Barcelona
	Azin Shahiri	Universitat Autònoma de Barcelona

Speakers

Ramon Antoine (Universitat Autonòma de Barcelona), Marius Dadarlat (Purdue University), Caleb Eckhardt (Miami University), Søren Eilers (University of Copenhagen), George A. Elliott (University of Toronto), Ilijas Farah (York University), Elisabeth Gillaspy (Universität Münster), Ilan Hirshberg (Ben-Gurion University of the Negev), Astrid an Huef (University of Otago), Judith A. Packer (University of Colorado Boulder), N. Christopher Phillips (University of Oregon), Sarah Reznikoff (Kansas State University), Karen Strung (Polskiej Akademii Nauk), Aaron Tikuisis (University of Aberdeen), Rufus Willett (University of Hawai'i Mānoa).

Contributed

Maria Stella Adamo (Università di Catania), Scott Atkinson (Vanderbilt University), Ingrid Beltiță (Simion Stoilow Institute of Mathematics of the Romanian), Rasmus Bentmann (Georg-August Universität Göttingen), Toke M. Carlsen (University of the Faroe Islands), Robin J. Deeley (University of Hawai'i-West O'ahu), Marzieh Forough (Institute for Research in Fundamental Sciences), Ben Hayes (Vanderbilt University), Bartosz Kwaśniewski (Uniwersytet w Bialymstoku), Kang Li (Universität Münster), Chi-Keung Ng (Nankai University), Eduard Ortega (Norwegian University of Science and Technology), Cornel Pasnicu (University of Texas at San Antonio), Eduardo Scarparo (University of Copenhagen), Christopher Schafhauser (University of Waterloo), Adam Sierakowski (Univerity of Wollongong), Andrew Toms (Purdue University), Hannes Thiel (Universität Münster).

3.1.3. Follow up of the Research Program Geometry and Dynamics of Integrable System

June to July, 2017

Organizers	Vladimir Matveev	Universität Jena
	Eva Miranda	Universitat Politècnica de Catalunya
	Francisco Presas	Consejo Superior de Investigaciones Científicas, ICMAT

Summary

This is a follow-up on the program on Geometry and Dynamics which took place at CRM in 2013. The main objectives of the follow-up program are:

- to assess the impact of the CRM program in the research topic in the last years. In particular to evaluate the 2013 Research program as a model of good training program in terms of defended Ph.D., postdoc mobility etc....
- to promote the scientific collaboration among several participants
- to design a concrete action plan to enhance the topic of research through future activities (this includes Network applications)
- to enhance the participation of young researchers in the area in training and dissemination activities.

All program information can be found at:

`http://www.crm.cat/en/Activities/Curs_2016-2017/Pages/Follow-up-of-the-research-program-Geometry-and-Dynamics-of-Integrable-Systems-.aspx`

Visiting Researchers

Anton Alekseev (Université de Genève), Romero Barbieri (Pontificia Universidade Católica do Rio de Janeiro), Michael Bialy (Tel Aviv University), Alexey Bolsinov (Loughborough University), Roisin Braddell (Trinity College), Xavier Cabré (Universitat Politècnica de Catalunya), Roger Casals (Massachusetts Institute of Technology), Matteo Cozzi (Universitat Politècnica de Catalunya), Daniela De Silva (Columbia University), Amadeu Delshams (Universitat Politècnica de Catalunya), Viktor L. Ginzburg, (University of California at Santa Cruz), Rodrigo Gonçalves (Universitat Politècnica de Catalunya), Marcel Guàrdia (Universitat Politècnica de Catalunya), Sergei Gukov (California Institut of Technology), Vadim Kaloshin (University of Maryland), Andreas Knauf (Friedrich-Alexander-Universität-Erlangen), Jean-Pierre Marco (Université Pierre et Marie Curie), David Martínez (PUC do Rio de Janeiro), Tere Martínez-Seara (Universitat Politècnica de Catalunya), Vladimir Matveev (Friedrich-Schiller Universität Jena), Eva Miranda (Universitat Politècnica de Catalunya), Cédric Oms (Universitat Politècnica de Catalunya), Jose Luis Pérez (ICMAT/CSIC

Madrid), Francisco Presas (Instituto de Ciencias Matemáticas), Emma Previato (Boston University), Maria Przybylska (University of Zielona Gora), Ovidiu Savin (Columbia University), Yuri B. Suris (Technische Universität Berlin), Sergei Tabachnikov (The Pennsylvania State University), Dmitry Treschev (Lomonosov Moscow State University), Pol Vanhaecke (Université de Poitiers), Jonathan Weitsman (Northeastern University).

Invited participants to the follow-up program	Vladimir Matveev	Universität Jena
	Eva Miranda	Universitat Politècnica de Catalunya
	Francisco Presas	Consejo Superior de Investigaciones Científicas, ICMAT

Activities

- **Workshop Finite Dimensional Integrable Systems in Geometry and Mathematical Physics (FDIS 2017)**

July 3^{rd} *to* 7^{th}, 2017

Participants: 99

Organizing Committee	Amadeu Delshams	Universitat Politècnica de Catalunya
	Yuri Fedorov	Universitat Politècnica de Catalunya
	Vladimir S. Matveev	Universität Jena
	Eva Miranda	Universitat Politècnica de Catalunya
	Francisco Presas	CSIC-ICMAT Madrid
	Sergei Tabachnikov	Pennsylvania State University

Scientific Committee	Alexey Bolsinov	Loughborough University
	Robert L. Bryant	Duke University
	Allan P. Fordy	University of Leeds
	Boris Kruglikov	University of Tromsø
	Andrzej Maciejewski	University of Zelena Gora
	Juan Jose Morales Ruiz	Universidad Politécnica de Madrid
	Emma Previato	Boston University
	Vladimir Rubtsov	University of Angers
	Dmitry Treschev	Steklov Mathematical Institute
	Galliano Valent	Université Paris VI, LPTHE
	Nguyen Tien Zung	Université Toulouse III

Speakers

Anton Alekseev (University of Geneva), Michael Bialy (Tel Aviv University), Alexey Bolsinov (Loughborough University), Sergei Gukov (California Institute of Technology), Vadim Kaloshin (University of Maryland), Andreas Knauf (Friedrich-Alexander-Universität Erlangen), David Martínez Torres (Pontificia universidade Catolica do Rio de Janeiro), Emma Previato, (Boston University), Maria Przybylska (University of Zielona Gora), Yuri B. Suris (Technische Universität Berlin), Dmitry Treschev (Moscow State University), Pol Vanhaecke (Université de Poitiers), Jonathan Weitsman (Northeastern University).

• Workshop Finite Dimensional Integrable Systems in Geometry and Mathematical Physics (FDIS 2017)
July 3^{rd} *to* 7^{th}, 2017
Participants: 99

• Seminar of the follow-up program

• Junior GESTA Working group (tentative organizers: Roisin Braddell, Álvaro del Pino, Cédric Oms and Arnau Planas)

• Satellite activity: RET Summer School on h-Principles

`http://www.ub.edu/h-principles/`

• 15th School on Interaction Between Dynamical Systems, Geometry, and Partial Differential Equations
June, 26^{th} *to* 30^{th}, 2017
Participants: 85

Organizing Committee	Xavier Cabré	ICREA and Universitat Politècnica de Catalunya
	Matteo Cozzi	Universitat Politècnica de Catalunya
	Amadeu Delshams	Universitat Politècnica de Catalunya
	Eva Miranda	Universitat Politècnica de Catalunya
	Marcel Guàrdia	Universitat Politècnica de Catalunya
	Tere M. Seara	Universitat Politècnica de Catalunya
Scientific Committee	Jean-Michel Roquejoffre	Paul Sabatier University

Lecturers

Daniela De Silva, Columbia University
Free Boundary Problems

Viktor L. Ginzburg, University of California at Santa Cruz
Periodic Orbits of Hamiltonian Systems: the Conley Conjecture and Beyond

Ovidiu Savin, Columbia University
The Monge-Ampere equation

Jean-Pierre Marco, Université de Paris VI - Pierre et Marie Curie
Non Perturbative Arnold Diffusion

3.1.4. Follow up: Approximation Theory & Function Spaces

June 26^{th} *to* 30^{th}, 2017

Organizing Committee	Vladimir Temlyakov	University of South Carolina
	Sergey Tikhonov	ICREA/CRM

Summary

This conference is a follow-up workshop to Intensive Research Program Constructive Approximation and Harmonic Analysis?, which took place in CRM during March-July 2016.

The workshop will promote the modern research connecting Fourier analysis, function spaces, and their links to modern developments in the high-dimensional approximation theory. The purpose of this meeting is to bring together the leading experts, and disseminate the latest progress in research, and in the interaction of these fields.

The topics of the workshop include:

- Function spaces and Embedding/Duality/Extension theorems
- Smoothness of multivariate functions
- Fourier transforms inequalities
- Weighted inequalities
- Hyperbolic cross approximation
- Sparse approximation
- Constructive methods of approximation
- Applications to industrial mathematics

We plan to organize a special section on applications of Fourier analysis and approximation theory in industrial mathematics. The main topics of this section include: optics, encoders, sensors, etc. It is a workshop in a style of the Banff and Oberwolfach workshops.

The workshop is expected to be partially supported by CRM and NSF.

All program information can be found at:

`http://www.crm.cat/en/Activities/Curs_2016-2017/Pages/Follow-up-Approximation-Theory-and-Function-Spaces.aspx.`

Visiting Researchers

Dauren Bazarkhanov (Kazakh Institute of Math), Dmitriy Bilyk (University of Minnesota), Peter Binev (University of South Carolina), Andrii Bondarenko (Norwegian University of Science and Technology), Fernando Cobos Diaz (Universidad Complutense de Madrid), Néstor Costa (Centre de Recerca Matemàtica), Feng Dai (University of Alberta),Oleg Davydov (University of Giessen), Alberto Debernardi (Centre de Recerca Matemàtica), Laura De Carli (Florida International University), Anton Dereventsov (University of South Carolina), Stephen Dilworth (University of South Carolina), Oscar Domínguez Bonilla (Universidad Complutense de Madrid), Gustavo Garrigos (Universidad de Murcia), Michael Gnewuch (Kiel Univesität), Amiran Gogatishvili (Academy of Sciences of the Czech Republic), Dmitry Gorbachev (Tula State University), Eugenio Hernández (Universidad Autónoma de Madrid), Valerii Ivanov (Tula State University), Thaís Jordão (Universidade de São Paulo), Ainur Jumabayeva (L.N. Gumilyov Eurasian National University), Boris Kashin (Steklov Mathematical Institute), Iurii Kolomoitsev (Universität zu Lübeck), Thomas Kühn (Universität Leipzig), Michael Lacey (Georgia Institute of Technology), Dany Leviatan (Tel Aviv University), Yura Malykhin (Steklov Mathematical Institute), Askhat Mukanov (L.N. Gumilyov Eurasian National University), Michael Ruzhansky (Imperial College), Alexei Shadrin (University of Cambridge), Winfried Sickel (Friedrich-Schiller Universität Jena), Serhii Stasyuk (Institute of Mathematics),Stefan Steinerberger (Yale University), Vladimir Stepanov (Steklov Mathematical Institute), Alex Stokolos (Georgia Southern University), Giancarlo Travaglini (Università degli Studi di Milano-Bicocca), Mario Ullrich (Johannes Kepler Universität Linz), Tino Ullrich (Universität Bonn), André Uschmajew (Universität Bonn), Soledad Villar (The University of Texas at Austin), Aizhan Ydyrys (L.N. Gumilyov Eurasian National University), Zhanibek Ydyrys (L.N. Gumilyov Eurasian National University).

3.1.5. Monthly Programs de la BGSMath on Algebraic and Combinatorial Phylogenetics

June 19^{th} *to July* 7^{th}, 2017

Scientific organizers	Marta Casanellas	Universitat Politècnica de Catalunya
	Jesús Fernández-Sánchez	Universitat Politècnica de Catalunya
	Piotr Zwiernik	Universitat Pompeu Fabra

Summary

There is an increasing demand on the visualization of the interplay between mathematics and other sciences. The interaction between mathematics and biology has had an explosion since the genomic era of this millenium when sequencing of genomes has become possible and computers are filled with biological data. This BGSMath monthly program is the chance to make this interplay visible even from what is usually known as "pure mathematics" point of view and to benefit from the top level bioinformatics community in Barcelona. Phylogenetics is the study of ancestral relationships among species. Its interest relies not only on the study of the evolutionary processes that led to the living (current?) species, but also on the direct relation to genomics (comparative genomics) and in emerging fields such as traceability of cancer cells.

This program does not only look for interdisciplinary applications of mathematics, but it also seeks for intradisciplinary interactions. Although it is more or less known that statistics, probability, computation, differential equations and algorithmics play an important role in biology, biostatistics and bioinformatics, it is probably less evident that areas like combinatorics, geometry and algebra can also interact with biology. Combinatorics has always been an important part of phylogenetics, specially since the use of networks has shown to be relevant in this field. Algebra and geometry have showed up in phylogenetics via the new discipline "algebraic statistics".

All program information can be found at:

`https://bgsmath.cat/event/algebraic-and-combinatorial-phylogenetics-2/`

Activities

• Course by Mike Steel and Arndt von Haeseler: Phylogenetics and combinatorics
June 19th to 23rd, 2017
Participants: 18

• Workshop on Algebraic and Combinatorial Phylogenetics
June 26th to 30th, 2017
Participants: 35

• **Course by Piotr Zwiernik course on Semialgebraic statistics, latent tree models, and phylogenetics**
July 3rd to 7th, 2017
Participants: 10

3.1.6. Monthly Programs de la BGSMath on Random Discrete Structures and Beyond

May 22^{nd} *to June* 16^{th}*, 2017*

Scientific organizers	Josep Díaz Cort	Universitat Politècnica de Catalunya
	Gábor Lugosi	Universitat Pompeu Fabra
	Juanjo Rué Perna	Universitat Politècnica de Catalunya
	Oriol Serra	Universitat Politècnica de Catalunya

Summary

The BGSMath Monthly Program Random Discrete Structures and Beyond aims to bring together top leader researchers in combinatorics, probability theory and computer science in the area of random discrete structures, as well as early stage researchers on this active area. The monthly program will be articulated around 4 axes: long research stays of distinguished researchers on the area of random combinatorial structures, a scientific workshop (by invitation), a weekly seminar on random discrete structures and finally a wide spectrum of specialized graduate courses delivered by some of the guest researchers. The last point is a natural sequel of the BGSMath course Random Structures and the Probabilistic Method delivered in the Fall 2013.

The main objective of the program is to reinforce the existing community in the area within the BGSMath through the organisation of a program in the scope of the call which will certainly have an international impact. To that purpose we have confirmed the participation of leading top researchers in a wide variety of disciplines related to random discrete structures, with a strong record of collaboration with the members of the BGSMath involved in the project. The interplay between theory and applications is one of the objectives of the program, which has also shaped the profile of the invited researchers. As a BGSMath program, most particular attention will be put on the participation of early stage researchers (graduate students and postdoctoral researchers) and to the establishment of new collaborations. The program will also contribute to the permanent training of the members of the research groups involved in the proposal to maintain and improve their scientific profile and international visibility which may attract talent, particularly in the framework of the BGSMath. The monthly program aims to produce a synergy between the researchers in random graphs and those versed in the analysis of large scale networks. More precisely, the expected synergies of this monthly program are multiple, and in dierent levels: Provide courses delivered by top leading experts on the field will

definitely contribute to the training objectives of the doctoral, postdoctoral and faculty members of the BGSMath. We believe that the wide variety of courses we propose will make the activity completely visible also for international early-stage researchers, which will be potential future members of BGSMath (specially as postdoctoral fellows). Provide the right environment to continue research collaboration with some of the guest visitors, as well as to start new research projects. We expect to start new investigations with the visiting researchers that will produce a positive development of the activity of this branch in the Barcelona area.

All program information can be found at:

`https://bgsmath.cat/event/random-discrete-structures-and-beyond/`

Activities

• Tobias Muller (Utretch): Discrete Fourier analysis: combinatorics and percolation
May 22nd to 26th, 2017
Participants: 16

• David Conlon (Oxford): Embedding large structures in random graphs
May, 29th May to June 2nd, 2017
Participants: 24

• Seminar + BGSMath Workshop: Random Discrete Structures and Beyond
June 6^{th} to 7^{th}, 2017
Participants: 23

• Luc Devroye (McGill) Random trees: from Darwin to Janson, and Colin McDiarmid (Oxford): Random graphs from constrained graph classes
June 12^{th} to 16^{th}, 2017
Participants: 19

• Seminar

Wouter Cames van Batenburg, Radboud University Nijmege
Packing graphs of bounded codegree
May 30th, 2017

Gilles Zemor, Univ. Bordeaux
Unconditionally private communication through error correction
May 30th, 2017

Robert Hancock, Univ. of Birmingham
Independent sets in hypergraphs and Ramsey properties of graphs and the integers
June 6th, 2017

David Wood, Monash University
Improper relaxations of Hadwiger's Conjecture
June 6th, 2017

Benny Sudakov ETH Zurich
Rainbow cycles and trees in properly edge-colored complete graphs
June 14^{th}, 2017

Dieter van Melkebeek, University of Wisconsin-Madison
Kernelization lower bounds from AP(3)-free sets
June 14^{th}, 2017

3.1.7. Monthly Programs de la BGSMath on Number Theory

January 23^{rd} to March 5^{th}, 2017

Scientific Committee	Luis Victor Dieulefait	Universitat de Barcelona
	Víctor Rotger	Universitat Politècnica de Catalunya
	Xavier Xarles	Universitat Autònoma de Barcelona

Organizing Committee	Daniel Barrera	Centre de Recerca Matemàtica
	Francesc Fité	Centre de Recerca Matemàtica
	Xavier Guitart	Universitat de Barcelona
	Santiago Molina	Centre de Recerca Matemàtica
	Víctor Rotger	Universitat Politècnica de Catalunya

Summary

The STNB has experience in organizing international scientific events. In 1995, the STNB organized in Barcelona the 19èmes Journées Arithmétiques, a forum for presentation and discussion of recent number-theoretical developments with a long tradition and recognized as the main international meeting devoted to number theory.

In July 2001, the STNB organized an Advanced Course at the CRM on Modular forms and p-adic Hodge theory, co-financed by the program High Level Scientific Conferences of the European Commission.

In July 2002, the STNB organized a large conference on Modular Curves and Abelian Varieties, which took place at the CRM. Papers with the contents of some talks at the conference were published in the volume 224 of Progress in Mathematics, Birkhäuser-Verlag (2004).

In 2009-2010, the STNB organized the Research Program in Arithmetic Geometry, at the CRM, which included several advanced courses, conferences, and workshops and it enjoyed the participation of many of the most well-known number theorists in the field.

In the recent years, the field of Arithmetic Geometry has seen significant and exciting advances towards the complete or partial solution of some outstanding open conjectures, such as the Sato-Tate conjecture for Hilbert modular forms, some cases of the Weight Monodromy Conjecture, or the Iwasawa main conjecture for GL2.

Among the recent discoveries and new techniques that have emerged lately, special mention deserve the new cases of the Birch and Swinnerton-Dyer conjecture and new modularity theorems of automorphic representations, because of the active and crucial role played by some STNB and BGSMath members. These topics where explored in the 2009-2010 Research Program at the CRM and parts of these projects started during that period, taking advantage of the fruitful mathematical atmosphere it provided.

It seems thus the right time for the STNB to organize a six-week intensive program on number theory. It will contribute to maintain the level of exceptional research that is being done in Barcelona in the field. In addition, it will be a great opportunity to train a new generation of graduate students and to introduce them to this active, exciting, and fruitful area of research.

All program information can be found at:

`https://bgsmath.cat/event/number-theory/`

Activities

- **Seminar (*http://stnb.cat/ca/*)**

- **The adic eigenvariety by Adrian Iovita (Concordia University of Montréal)**
January 30^{th} *to February* 2^{nd}*, 2017*
Participants: 36

- **Siegel modular forms and abelian surfaces by Vincent Pilloni (École Normale Supérieure de Lyon)**
February 6^{th} *to* 9^{th}*, 2017*
Participants: 2

- **Conference on p-adic methods for Galois representations and modular forms**
February 13^th *to* 17^{th}*, 2017*
Participants: 69

- **Hilbert modular forms: p-adic and mod p aspects by Payman Kassaei (King's College London)**
February 20^{th} *to* 22^{nd}*, 2017*
Participants: 29

3.2. Congressos i Workshops

En aquest apartat es detallen els congressos i *workshops* que va organitzar el CRM durant l'any 2017 al marge dels programes de recerca.

3.2. Conferences and Workshops

This section lists the congresses and workshops organised by CRM during 2017 not included in research programmes.

Workshop on Avalanche Processes in Condensed Matter Physics and Beyond

January 9^{th} *to* 13^{th}, 2017
Participants: 49

Organizing Committee	Álvaro Corral (Centre de Recerca Matemàtica), Eduard Vives (Universitat de Barcelona).
Scientific Committee	Avadh Saxena (Los Alamos National Laboratory), Ekhard K.H. Salje (University of Cambridge), Antoni Planes (Universitat de Barcelona).
Lecturers	Mikko Alava (Aalto University) *Avalanches: durations, shapes, waiting times* Lucilla de Arcangelis (University of Naples) *Time-energy correlations as a hallmark of different branching processes* Xavier Balandraud (IFMA, Institut Pascal, Clermont Ferrand) *Analyzing the phase transformation intermittency in a shape memory alloy using the grid method* John Beggs (Indiana University) *Neuronal avalanches in condensed grey matter* Karin Dahmen (University of Illinois) *Universal slip statistics and dynamics – from compressed nanopillars to earthquakes?* Gianfranco Durin (INRIM Torino) *Quantitative scaling of avalanches in soft magnetic materials* Yan Kagan (University of California) *Earthquake and Scale-invariance* Ferenc Kun (University of Debrecen) *Record breaking bursts in a discrete element model of compressive failure* Ian Main (University of Edinburgh) *Localization of deformation in porous granular media* Joaquin Marro (Universidad de Granada) *Mind and phase transitions*

Kirsten Martens (Université Joseph Fourier, Grenoble)
Mesoscopic approaches to derive critical exponents and avalanche shapes for the yielding transition

Nicholas Moloney (London Mathematical Laboratory)
Precolation on trees as a Brownian excursion: from Gaussian to Kolmogorov-Smirnov to exponential statistics

David E. Newman (University of Alaska)
A diffusive sandpile as a model for the dynamics of avalanche based turbulent transport in plasmas and other natural systems

F.J. Perez-Reche (University of Aberdeen)
Exact results for avalanches on networks

Ekhard Salje (University of Cambridge)
Experimental determination of crackling noise in minerals: can mining accidents be prevented?

Raul Sanchez Fernandez (Universidad Carlos III)
Fractional diusion and the modelling of avalanche transport in magnetically con ned plasmas

Stephane Santucci (CNRS Laboratoire de Physique, ENS-Lyon)
Aftershocks in slow crack growth

Avadh Saxena (Los Alamos National Laboratory)
Avalanches in functional materials with magnus force: skyrmions and vortices

Doron Shilo (Technion Israel Institute of Technology)
Microstructural and rate effects in crackling noise systems

Jordi Soriano (Universitat de Barcelona)
Experiments in living neuronal networks: Dynamics and avalanche phenomena in a dish

Djordje Spasojevic (University of Belgrade)
On the 3D to 2D crossover in the random field ising model at $T = 0$

Bosiljka Tadic (Jozef Stefan Institute)
Physics perspective on the nature of avalanches in social systems

Gilles Tarjus (Université Pierre et Marie Curie)
Rare events and nonperturbative phenomena in the hysteresis behavior of the random-field Ising model

Llavefest: A broad perspective on finite and infinite dimensional dynamical systems (FIDDS-17)
June 12^{th} *to* 16^{th}, 2017
Participants: 151

Organizing Committee

Local	Imma Baldomá (Universitat Politècnica de Catalunya), Amadeu Deshalms (Universitat Politècnica de Catalunya), Ernest Fontich (Universitat de Barcelona), Àlex Haro (Universitat de Barcelona), Gemma Huguet (Universitat Politècnica de Catalunya), Pau Martín (Universitat Politècnica de Catalunya), Tere M. Seara (Universitat Politècnica de Catalunya),
Extended:	Renato Calleja (IIMAS–Universidad Nacional Autónoma de México), Marian Gidea (Yeshiva University), Jason Mireles James (Oklahoma University), Nikola Petrov (Oklahoma University), Yannick Sire (Johns Hopkins University).
Scientific Committee	Xavier Cabré (ICREA and Universitat Politècnica de Catalunya), Anatoly Neishtadt (Loughborough University), Carles Simó (Universitat de Barcelona), Eugene Wayne (Boston University).

Speakers

Sergey Bolotin (University of Wisconsin-Madison)
Topological approach to the generalized n-center problem

Luis A. Caffarelli (University of Texas at Austin)
Some obstacle like problems

Alessandra Celletti (University of Rome Tor Vergata)
Quasi-periodic attractors in dissipative (conformally symplectic) systems

Chong-Qing Cheng (Nanjing University)
Dynamics around the double resonance

Diego Córdoba (ICMAT–Consejo Superior de Investigaciones Científicas)
Stability shifting and mixing solutions for the Muskat problem

Amadeu Delshams (Universitat Politècnica de Catalunya)
Scattering maps and global instability in Hamiltonian systems

Jean-Pierre Eckmann (Université de Genève)
A geometric view on chemical reaction networks: Stability, large deviations, and multiple attractors

Corrado Falcolini (Università degli studi Roma Tre)
Families of periodic orbits in dissipative maps: the quasi–conservative case

Ernest Fontich (Universitat de Barcelona)
The parameterization method and parabolic manifolds

Irene Gamba (University of Texas at Austin)
Similarities and differences between for the quantum Boltzmann equation for bosons at very low temperature and wave turbulence theory for stratified flows

Àngel Jorba (Universitat de Barcelona)
The parametrization method on Poincaré sections

Ioannis Kevrekidis (Princeton University)
No equations, no variables, no parameters, no space, no time: Data and the computational modeling of complex systems

Hans Koch (University of Texas at Austin)
Spectral stability for the wave equation with periodic forcing

Rafael de la Llave (Georgia Institute of Technology)
A posteriori versions of KAM theory: Rigorous results, computations and conjectures

Robert MacKay (University of Warwick)
Hamiltonian geometry of classical transition state theory

Tere M. Seara (Universitat Politècnica de Catalunya)
A general mechanism of diffusion in Hamiltonian systems: qualitative results

Philip J. Morrison (University of Texas at Austin)
GEMPIC: An exact Poisson integrator for the full Vlasov-Maxwell system

Anatoly Neishtadt (Loughborough University)
Long-term dynamics of slow-fast systems with passages through resonances: examples from charged particles dynamics

Rafael Obaya (Universidad de Valladolid)
Principal Floquet subspaces and exponential separation for positive dynamical systems. From the deterministic to the random theory

Ireneo Peral (Universidad Autónoma de Madrid)
Towards a deterministic KPZ equation with fractional diffusion: The stationary problem

Yannick Sire (Johns Hopkins University)
Singular perturbation limits of fractional Allen-Cahn

Dmitry Treschev (Moscow State University)
Arnold diffusion in multidimensional a priori unstable Hamiltonian systems

Enrico Valdinoci (Weierstrass Institute)
Planelike minimizers under different perspectives

Eugene Wayne (Boston University)
Energy dissipation in Hamiltonian chains of rotators

Yingfei Yi (University of Alberta)
Reducibility of quasi-periodic linear KdV equation

Lai-Sang Young (NYU–Courant Institute)
Toward a smooth ergodic theory

Xiaoping Yuan (Fudan University)
KAM theorem for partial differential equations of dense pure point spectra

Chongchun Zeng (Georgia Institute of Technology)
Instability, index theorems, and exponential dichotomy of Hamiltonian PDEs

Barcelona Computational, Cognitive and Systems Neuroscience (BARCCSYN) 2017

June 15^{th} *to* 16^{th}, 2017
Participants: 86

Organisers	Gemma Guillazo (Universitat Autònoma de Barcelona), Rubén Moreno-Bote (Universitat Pompeu Fabra), Vicky Puig (Institut Hospital del Mar d'Investigacions Mèdiques), Alex Roxin (Centre de Recerca Matemàtica).
Keynote Speakers	Alain Destexhe (CNRS, UNIC, Gif sur Yvette, France, and the European Institute for Theoretical Neuroscience, Paris) *Inhibition shapes neuronal activity and oscillations in different brain states in human and monkey cortex* Tatiana Pasternak, University of Rochester) *Defining a role for prefrontal cortex in memory-guided sensory decision-making* Alexandre Pouget, Université de Genève) *The agony of choice: optimal policies for value-based decision making*

Foundations of Computational Mathematics Barcelona

July 10^{th} *to* 19^{th}, 2017
Participants: 600

FoCM Executive Committee	Wolfgang Dahmen (RWTH Aachen, Germany (chair)), Angela Kunoth (University of Cologne, Germany (secretary)), Javier Peña (Carnegie Mellon University, USA (treasurer)).
Board of Directors	Albert Cohen (Université Pierre et Marie Curie, Paris (JFoCM editor)), Felipe Cucker (City University of Hong Kong, China (JFoCM editor)), Agnes Szanto (North Carolina State University, USA), Annalisa Buffa (IMATI - CNR, Italy), Andrew Odlizko (University of Minnesota, USA), Antonella Zanna (University of Bergen, Germany), Carlos Beltrán (Universidad de Cantabria, Spain), Frances Kuo (University of New South Wales, Australia), Hans Munthe-Kaas (University

	of Bergen, Germany), Martin Hairer (University of Warwick, UK), Michael Singer (North Carolina State University, USA), Ricardo Nochetto (University of Maryland, USA), Shmuel Weinberger (University of Chicago, USA), Teresa Krick (University of Buenos Aires, Argentina).
Committees:	
Local Organizing Committee	Maria Alberich (Universitat Politècnica de Catalunya), Josep Àlvarez (Universitat Politècnica de Catalunya), Marta Casanellas (Universitat Politècnica de Catalunya), Gemma Colomé (Universitat Pompeu Fabra), Teresa Cortadellas (Universitat de Barcelona), Carlos D'Andrea (Universitat de Barcelona), Jesús Fernández (Universitat Politècnica de Catalunya), Xavier Guitart (Universitat de Barcelona), Gábor Lugosi (ICREA & Universitat Pompeu Fabra), Eulàlia Montoro, (Universitat de Barcelona), Martín Sombra (ICREA & Universitat de Barcelona (chair)).
Administrative and logistic support	Gloria Albacete (Universitat de Barcelona), Ana García-Donas (CRM), Nuria Hernández (CRM), Raquel Hernández (CRM), Vanessa Ramírez (CRM), Patricia Vallez (Universitat de Barcelona), Mari Paz Valero (CRM), Pau Varela (CRM).
Technical support	Santiago Laplagne, Universidad de Buenos Aires, Argentina), Jordi Mullor (CRM).
Volunteers	Patricio Almirón, Universitat Politècnica de Catalunya), Guillem Blanco (Universitat Politècnica de Catalunya), Yairon Cid (Universitat de Barcelona), Gladston Duarte (Universitat de Barcelona), Marina Garrote, (Universitat Politècnica de Catalunya), Roser Homs (Universitat de Barcelona), Marc Jorba (Universitat de Barcelona), Dan Paraschiv (Universitat de Barcelona), Jordi Roca (Universitat Politècnica de Catalunya), Edu Soto (Universitat de Barcelona).
Workshops Committee	Wolfgang Dahmen (RWTH Aachen University, Germany), Martin Hairer (University of Warwick, UK), Teresa Krick (Universidad de Buenos Aires, Argentina (chair)), Angela Kunoth (Universität zu Köln, Germany), Andrew Odlyzko (University of Minnesota, USA), James Renegar (Cornell University, USA), Martín Sombra (ICREA & Universitat de Barcelona, Spain), Endre Süli (University of Oxford, UK), Agnes Szanto (North Carolina State University, USA), Shmuel Weinberger (University of Chicago).

Plenary Speakers Committee	Albert Cohen (University Pierre et Marie Curie, France), Felipe Cucker (City University of Hong Kong, China), Wolfgang Dahmen (Aachen University, Germany (chair)), Carlos D'Andrea (Universitat de Barcelona, Spain), Teresa Krick (Universidad de Buenos Aires, Argentina), Angela Kunoth (Universität zu Köln, Germany), Ricardo Nochetto (University of Maryland, USA), Michael Singer (North Carolina State University, USA).
Smale Prize Committee	Albert Cohen (University Pierre et Marie Curie, France), Wolfgang Dahmen (Aachen University, Germany (chair)), Percy Deift (New York University, USA), Stéphane Mallat (École Polytechnique, France), Marta Sanz-Solé (Universitat de Barcelona, Spain), Ricardo Nochetto (University of Maryland, USA), Martín Sombra (ICREA & Universitat de Barcelona, Spain), Shmuel Weinberger (University of Chicago, USA).

3.3. Cursos avançats

En aquest apartat es detallen els cursos avançats que va organitzar el CRM durant l'any 2016 al marge dels programes de recerca.

3.3. Advanced Courses

This section lists the advanced courses, not included in research programmes, organised by CRM during 2016.

An introduction to applied mathematics

May $10^{th}, 24^{th}$, 2017
Participants:

Lecturers	Tim Myers (Senior Researcher at the Centre de Recerca Matemàtica) *Perturbation methods* Tomás Alarcón (ICREA Research Chair at the Centre de Recerca Matemàtica) *Stochastic modelling* Matt Hennessy, (Marie Curie Research Fellow at the Centre de Recerca Matemàtica) *Analytical methods for solving PDEs* Josep Sardanyés, ("la Caixa", Senior Research Fellow at the Centre de Recerca Matemàtica) *Bifurcating systems*

3.4. Seminaris del CRM

El CRM difon l'activitat de tots els seminaris de recerca matemàtica de Catalunya, però també

3.7. CRM Seminars

The CRM disseminates the activity of all the research seminars in mathematics in Catalonia,

actua com a organitzador de seminaris en àrees emergents, bé a través de les seves xarxes temàtiques o bé a través dels investigadors del centre.

but it also organises seminars in emergent areas, either through its thematic networks or through the CRM's research staff.

The CRM Applied Mathematical and Physics (CAMP) seminar

Coordinator/*Coordinator*: Roberto de la Cruz (CRM).

19/10/2017. Konstantin Starkov, Instituto Politécnico Nacional, CITEDI, México, *umor clearance problem in dynamical cancer models with immunotherapy and global stability analysis*.

14/06/2017. Carsten Wiuf, University of Copenhagen, *Mathematical tools for analysing systems of ordinary differential*.

25/05/2017. Andrew Morozov, University of Leicester, *Detecting structural sensitivity in biological models: Developing a new framework*.

12/05/2017. Daniel Rodríguez Amor, MIT, *Dynamics between steady states in microbial ecosystems*.

11/05/2017. Andreas Meyerhans, UPF, *Virus infection fate regulation: transcriptional dynamics reveals a critical role of the Xcl1-Xcr1 communication axis in chronic infection*.

05/05/2017. Rodrigo Ledesma-Aguilar, Northumbria University, *Moving a droplet almost for free*.

04/05/2017. Daniele Avitabile, University of Nottingham, *Analysing coherent structures via interfacial dynamics: from spatio-temporal canards to coarse-grained computations*.

27/04/2017. Javier Macía Santamaría, UPF, *Genetic and electric circuits follow the same rules*.

25/04/2017. Abigail Jimenez, CRM, *Deception island: from the land of mist and snow*.

06/04/2017. Abigail Jimenez Lloret, Universidad de Almeria, *Operational earthquake forecasting: the seismologists quest*.

21/02/2017. Josep Sardanyès, Centre de Recerca Matemàtica, *Nonlinear dynamics and catastrophic extinctions in unstable tumor cells populations*.

09/02/2017. Bernat Corominas-Murtra, Medical University of Viena, *History-dependence, sample space reducing processes and the emergence of generalised scaling exponents*.

02/02/2017. Matthew Hennessy, Centre de Recerca Matemàtica, *Swelling-induced instabilities in growing polymer network*.

23/01/2017. Esther Ibañez-Marcelo, ISI Foundation Torino, Italy, *Introduction to topological data analysis and an application to fMRI data*.

10/01/2017. Pablo Padilla, UNAM & University of Cambridge, *Brain activity models*.

Computational Neuroscience Seminar

Organitzadors/*Organisers*: Alex Roxin (CRM), Albert Compte (Institut d'Investigacions Biomèdiques August Pi i Sunyer (IDIBAPS)), Gustavo Deco (UPF), Jaime de la Rocha (Institut d'Investigacions Biomèdiques August Pi i Sunyer (IDIBAPS)), Antoni Guillamon (UPC), Ruben Moreno-Bote (Fundació Sant Joan de Déu), Jordi G. Ojalvo (UPC).

09/11/2017. Rune W. Berg, University of Copenhagen, *Neuronal population activity responsible for rhythmic movements: lognormality spiking regimes and connectivity*.

3.5. Jornades temàtiques / Thematic days

- *Jornada de Doctorat a CosmoCaixa*, October 4^{th}, 2017.
- *The Mathematics of M.C. Escher*, October 4^{th}, 2017

3.6. Altres activitats / Other activities

- *Annual Barcelona Computational, Cognitive and Systems Neuroscience retreat*, November 30^{th} to December 2^{nd}, 2017.

4

Publicacions del CRM

CRM Publications

La publicació de documents de recerca és un dels canals de difusió del coneixement matemàtic per part del CRM. El CRM compta amb diverses sèries de publicacions estables: *Advanced Courses in Mathematics*, *Research Perspectives CRM Barcelona*, *CRM Documents*, *Quaderns*, *Preprints*, *Series on Popularization*, treballs finals de màster i tesis doctorals.

Per tal de coordinar aquesta activitat, es va crear, a finals de 2011, el **Comitè Editorial del CRM**. Durant l'any 2017, ha estat format per Enric Ventura (editor en cap) i Raquel Hernández (responsable d'edició). El Comitè Editorial es reuneix bimensualment.

A continuació, donem una breu descripció de cadascuna de les sèries i un llistat dels *preprints* que han aparegut al llarg de 2017.

The publication of research documents is one of the CRM channels for spreading mathematical knowledge. Apart from editing singular texts, the CRM has several stable publication series: Advanced Courses in Mathematics, Research Perspectives CRM Barcelona, CRM Documents, Quaderns, Preprints, Series on Popularization, master's projects and PhD theses.

With the purpose of coordinating this activity, the **CRM Editorial Board** *was created in November 2011. During 2017, it was formed by Enric Ventura (Editor-in-Chief) and Raquel Hernández (editing tasks). The Editorial Board meets every two months.*

We give next an overview of the different series and a list of the preprints issued along the year 2017.

4.1. Advanced Courses in Mathematics CRM Barcelona

Els volums d'aquests sèrie, publicada per l'editorial suïssa Birkhäuser, recullen el contingut d'alguns dels cursos avançats impartits al CRM, a partir de les notes prèvies lliurades als participants i

The volumes of this series, published by the Swiss publishing company Birkhäuser, cover the content of some of the advanced courses taught by specialists at the CRM. They are based on notes

reelaborades pels mateixos autors. Es tracta de llibres de text, especialment adreçats a estudiants de doctorat avançats i a joves investigadors postdoctorals.

handed out to students and later reworked by the authors. These volumes are especially addressed to advanced doctoral and young post-doctoral students.

Des de setembre de 2008 fins a finals de 2013, l'editor responsable d'aquesta sèrie va ser Carles Casacuberta (UB) qui va substituir en aquest càrrec a Manuel Castellet (UAB), que va iniciar la sèrie l'any 2001. Des de principis de 2014, el nou editor de la sèrie és Enric Ventura (UPC).

From 2008 to 2013, the responsible editor of this series was Carles Casacuberta (UB); he replaced Manuel Castellet (UAB), who started the series in 2001. Starting in 2014, the new editor of this series is Enric Ventura (UPC).

L'any 2017 ha aparegut un volum d'aquesta sèrie:

The following volume from this series has been published in 2017:

- Javier Aramayona, Volker Diekert, Christopher J. Leininger, Pedro V. Silva, Armin Weiss. *Algorithmic and Geometric Topics Around Free Groups and Automorphisms*, edited by Juan González-Meneses, Martin Lustig, Enric Ventura. Advanced Courses in Mathematics CRM Barcelona, Birkhäuser, Basel, 2017. ISBN 978-3-319-60939-3

4.2. Research Perspectives CRM Barcelona

L'any 2012, el Comitè Editorial del CRM es va embarcar en l'edició de resums ampliats de les comunicacions científiques del congressos i *workshops* hostatjats pel centre. La intenció era la d'accelerar la difusió dels avenços en recerca, especialment dels resultats encara no publicats, consolidar el profit científic dels esdeveniments del CRM i ajudar a actualitzar de manera fluïda l'estat

In 2012, the CRM Editorial Board committed itself to edit extended conference abstracts, emanated from the conferences and workshops organized by the center. The aim was bringing the opportunity to quickly spreading recent research, including interesting new results not yet published, consolidating the scientific profit of CRM meetings and helping to fluently update the state of the art

de l'art en el camp de recerca corresponent. Un acord amb Birkhäuser permet que aquesta editorial es faci càrrec de la publicació d'aquests materials, que s'han concebut com a una subsèrie de la sèrie *Trends in Mathematics*, anomenada *Research Perspectives CRM Barcelona*.

in each field. An agreement was reached allowing Birkhäuser to publish these materials as a new subseries of the series Trends in Mathematics; the new subseries is named Research Perspectives CRM Barcelona.

- *Extended Abstracts Spring 2016: Nonsmooth Dynamics,* edited by A. Colombo, M.R. Jeffrey, J.T Lázaro. J.M. Olm. Research Perspectives CRM Barcelona, vol. 8, in *Trends in Mathematics* Birkhäuser, Basel, 2017. ISBN 978-3-319-455641-3
- *Extended Abstracts Fall 2015: Biomedical Big Data; Statistics for Low Dose Radiation Research,* edited by E.A. Ainsbury, M.L. Calle, E. Cardis, J. Einbeck, G. Gómez, P. Puig. Research Perspectives CRM Barcelona, vol. 7, in *Trends in Mathematics* Birkhäuser, Basel, 2017. ISBN 978-3-319-55638-3
- *Extended Abstracts Summer 2015: Strategic Behaviour in Combinatorial Structures; Quantitative Finance,* edited by J. Díaz, L. Kirousis, L. Ortiz-Gracia, M. Serna. Research Perspectives CRM Barcelona, vol. 6, in *Trends in Mathematics* Birkhäuser, Basel, 2017. ISBN 978-3-319-51752-0

L'editor de la sèrie és Enric Ventura.

The series editor is Enric Ventura.

4.3. CRM Documents

El CRM va iniciar una nova sèrie de volums amb ISBN l'any 2008, anomenada *CRM Documents*. En aquesta sèrie s'hi publiquen monografies, actes de jornades o congressos, informes de projectes de recerca i altres reculls de material de qualitat.

The CRM launched a new series of volumes with ISBN in 2008, called CRM Documents. *These include monographs, proceedings of events, reports of research programmes, and other quality material.*

El volum de la sèrie publicat aquest any 2017 ha estat el següent:

The volume from the series published this year 2017 is the following:

- *Proceedings of the 115th European Study Group with Industry*, edited by T. Myers, J. Solá-Morales, M. Aguareles, M. Pellicer, CRM Documents vol. **14**, 2017, ISB: 978-84-697-5163-3.

4.4. Preprints

La sèrie de prepublicacions del CRM s'ha incrementat amb els 7 títols següents durant l'any 2017:

The CRM preprint series grew with the following 7 issues in 2017:

- G. Farré, Josep Sardanyés A. Guillamon, and E. Fontich. *Coexistence stability in a four-member hypercycle with error tail through center manifold analysis*, preprint no. 01/2017.
- J. Puig, G. Farré, E. Fontich, A. Guillamon, and Josep Sardanyés. *Bifurcation gaps in asymmetric and high dimensional hypercycles*, preprint no. 02/2017.

- Mikael Rordam. *Just-infinite C^*-algebras and their invariants*, preprint no. 03/2017.
- D. Pask, A. Sierakowski, and A. Sims. *Unbounded quasitraces, stable finiteness and pure infiniteness*, preprint no. 04/2017.
- A. Kumijian, D. Pask, and A. Sims,. *Graded C^*-algebras, graded K-theory and twisted P-graph C^*-algebras*, preprint no. 05/2017.
- V. Futorny and K. Iusenko. *Stable representations of posets*, preprint no. 06/2017.
- D. Martínez Torres and E. Miranda. *Zeroth Poisson homology, foliated cohomology and perfect Poisson manifolds*, preprint no. 07/2017.

5 Resum econòmic *Financial Summary*

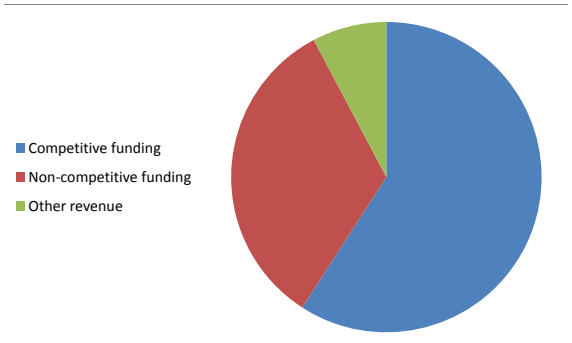
5.1 Ingressos — 5.1. Revenue

Ingressos competitius *Competitive funding*	1.631.402,45 €
Ingressos no competitius *Non-competitive funding*	913.945,69 €
Altres ingressos *Other revenue*	213.889,44 €
TOTAL	**2.759.237,58 €**

5.2 Despeses — 5.2. Expenses

Despeses de personal *Personnel expenses*	1.561.195,05 €
Despeses d'explotació *Operating expenses*	603.471,28 €
Amortització immobilitzat *Depreciation of intangibles*	159.740,67 €
Resultat financer (despesa) *Financial outcome (expenditure)*	18.881,53 €
Altres despeses i romanent *Other expenses and surplus*	465.300,35 €
Total resultat financer *Annual profit*	-49.351,30 €
TOTAL	**2.759.237,58 €**

Ingressos/Income



Despeses/Expenses