CRM

CENTRE DE RECERCA MATEMÀTICA

Memòria d'Activitats
Report of Activities

2015

CENTRE DE RECERCA MATEMÀTICA

Centres de recerca de Catalunya

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MEMÒRIA D'ACTIVITATS 2015

REPORT OF ACTIVITIES 2015

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Presentació

L'any 2015 el CRM s'ha dedicat a desenvolupar i consolidar projectes iniciats anteriorment amb el gran èxit col·lectiu de l'obtenció d'un projecte María de Maeztu per part de la BGSMath. Pel que fa a la recerca, sens dubte, un dels projectes més importants és el programa formatiu en Recerca Matemàtica Col·laborativa finançat per la Fundació de l'Obra Social "la Caixa" (la primera crida d'aquest programa va fer-se a finals del 2013 i ja està completament desplegat) però també cal destacar el Doctorat Industrial, el "Simons visiting program" adreçat específicament a potenciar els programes de recerca intensius que el centre ha estat organitzant des de fa anys. En la mateixa direcció, el Clay Mathematical Institute ha donat també suport al CRM en l'organització d'aquests programes.

Per altra banda, s'ha continuat desplegant el contracte programa 2014–2019 fins on és possible, donada l'actual congelació de recursos. A diferència de l'anterior pla pel període 2008–2013, el nou pla no va acompanyat d'un contracte-programa plurianual amb la Generalitat de Catalunya, sinó que la seva implementació es fa mitjançant contracte-programa any per any. El contracte per l'any 2015 va ser acordat i signat juntament amb els seus respectius indicadors a començaments d'any.

La Unitat de Transferència de Tecnologia posada en marxa el 2012 ha realitzat i iniciat diversos projectes de consultoria, un d'ells emmarcat dins del Doctorat Industrial del centre.

Els resultats de la recerca pel que fa a publicacions, impacte, visibilitat internacional, formació, etc. són prou bons, com el lector podrà contrastar en aquesta memòria. Així mateix, tots els investigadors del CRM tenen projectes competitius vius dins de les convocatòries de plans estatals.

En canvi, els resultats no són tan bons pel que fa als recursos competitius captats pels nostres grups, encara que això sembla que comença a canviar. L'import assignat a aquests projectes és baix, conseqüència de la poca dimensió dels grups. Tal com el nostre pla estratègic destaca, l'assignatura pendent dels grups del CRM és la mateixa que la de gairebé tots els grups en Matemàtiques, i no és altra que la presència en els programes europeus i el H2020 molt particularment.

La Barcelona Graduate School of Mathematics va formalitzar la seva personalitat jurídica a final de 2014 mitjançant la signatura del conveni entre la UB, la UPC, la UAB i el CRM creant formalment la BGSMath com a unitat interuniversitària i reconeixent al CRM com a entitat gestora de la BGSMath. Això faculta la BGSMath a actuar sota la identitat jurídica del CRM. La primera actuació que la BGSMath ha dut a terme amb el CRM com a entitat de gestió ha estat l'exitosa obtenció d'un projecte María de Maeztu del MINECO per a unitats d'excel·lència, de 2M € per quatre anys, liderat científicament pel Dr. Marc Noy. Aquest és un projecte en que la comunitat matemàtica suma, ja que cap de les quatre institucions participants en la BGSMath té dimensió suficient per a obtenir un projecte anàleg separadament de les

altres institucions. Aquest projecte ens permetrà injectar recursos al sistema de recerca català en matemàtiques en forma de beques pre i postdoctorals, i realitzar activitats de suport i reforç de la recerca catalana com, per exemple, els planejats "Monthly research programs". Així mateix la BGSMath ha sol·licitat un projecte COFUND per a complementar el finançament de les beques postdoctorals.

El director Joaquim Bruna va acabar la seva tasca després de 8 anys i mig liderant el CRM en data 31 de desembre de 2015. A la reunió del Consell de Direcció del CRM de l'1 de desembre de 2015 es va nomenar Lluís Alsedà com a nou director amb responsabilitats a partir de l'1 de gener de 2016

Lluís Alsedà, Director

Presentation

During the year 2015, the CRM has been dedicated to developing and consolidating projects initiated previously with great collective success of BGSMath obtaining a María de Maeztu project. Regarding research, undoubtedly one of the most important projects is the training program in Collaborative Mathematics Research funded by the Fundació de l'Obra Social de "la Caixa" (the first call of this program took place at the end of 2013 and is fully deployed), but also include the Industrial Doctorate, the "Simons visiting program" aimed specifically at promoting intensive research programs that the center has been organizing for years. In the same direction, the Clay Mathematical Institute has also given support to the CRM in the organization of these programs.

Furthermore, we continued to deploy the center program contract 2014–2019, as far as the economical situation allows it given the current freezing of available resources. Unlike the previous plan for the period 2008-2013, the new plan is not accompanied by a multiannual program contract with the Government of Catalonia, but its implementation is done by a yearly program contract. The contract for 2015 was agreed and signed with their respective indicators at the beginning of the year.

The Technology Transfer Unit was launched in 2012 and has held various consulting projects started, one of them framed within the Industrial Doctorate Centre.

The research results regarding publications, impact, international visibility, training, etc. are good enough, as the reader can verify in this memory. Also, all CRM researchers have lived competitive projects within rational plan calls for state plans.

However, the results are not as good with respect to competitive resources captured by our groups, although this appears to be changing. The amount devoted to these projects is low, due to the limited group size. As our strategic plan highlights, the pending issue for the CRM's groups, as well as for all other groups in mathematics, is the presence in European programs and particularly H2020.

The Barcelona Graduate School of Mathematics formalized its legal personality at the end of 2014 through the signing of an agreement among the UB, UPC, UAB and CRM, creating formally BGSMath as an inter-university unit recognizing the CRM as the BGSMath's managing institution. This empowers BGSMath to work under the legal identity of CRM. The first action that BGSMath conducted with CRM as a managing institution has been the successful obtention of a María de Maeztu MINECO project for excellence units, of € 2M for four years, led scientifically by Dr. Marc Noy. This project is a sum-up for the mathematical community since none of the four participating institutions in BGSMath is large enough to obtain a similar project separately from the other ones. This project will allow us to inject resources in the Catalan mathematical research system in the form of pre and postdoctoral fellowships,

to develop activities to support and strengthen the Catalan research, for example, the planned "Monthly research programs." Also the BGSMath has applied for a COFUND project to complement the financing of postdoctoral fellowships.

The director Joaquim Bruna finished his work after eight and a half years leading the CRM on December 31^{st}, 2015. At the meeting of the Governing Board of the CRM that took place on December 1^{st}, 2015 Lluís Alsedà was appointed as new director with responsibilities starting on January 1^{st}, 2016.

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 de 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 tipus d'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 in our country. The scientific policy of the CRM towards fulfilling its mission is structured around two main core concepts, quoted in its strategic plan within the contract-program with the Generalitat de Catalunya for the period 2014–2019:

- *To give support to catalan 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 centers in the CERCA Institution of research centers 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, consists 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 19 de juny de 2015. En aquesta reunió, la Generalitat de Catalunya va estar representada per Josep Maria Martorell com a director general de recerca, que va presidir el Consell.

L'IEC hi va estar representat per Joaquim Agulló i per Joan Girbau. Lluís Tort, vicerector de Projectes Estratègics i de Planificació de la UAB, hi va assistir a la sessió en representació del rector de la UAB. Hi van assistir també el director del CRM, Joaquim Bruna, i la gerent, Àngels Huertos. Com a representant del CERCA va assistir el senyor Lluís Rovira Pato. Va actuar com a secretari Josep-Maria Alcoberro. El Consell es va tornar a reunir virtualment el 29 de maig i físicament l'1 desembre de 2015.

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

The Governing Board met on June 19^{th}, 2015. In that meeting, the Generalitat de Catalunya was represented by Josep Maria Martorell, in his capacity as Director General de Recerca, who assumed the position of Chairman of the Board.

The IEC was represented by Joaquim Agulló and by Joan Girbau. Lluís Tort, the vice-rector of Strategic Projects and Planning of the UAB, attended the meeting on behalf of the rector of the UAB. The CRM director, Joaquim Bruna, and the general manager, Àngels Huertos, also attended the meeting. CERCA was represented by Lluís Rovira Pato. Josep-Maria Alcoberro acted as Secretary. Two more meetings were held in May 29^{th} and December 1^{st}, 2015, respectively.

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 20 de febrer de 2015. 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 23 de maig de 2011, 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 February 20^{th}, 2015. Throughout the year, on-line meetings were held.

The Governing Board approved on May 23^{th}, 2011, the new composition of the Scientific Advisory Board:

Stephen O'Brien, University of Limerick
Helen Byrne, University of Oxford

Wolfgang Dahmen, RWTH Aachen
Charles Fefferman, Princeton University
Peter Imkeller, Humboldt-Universität zu Berlin
Mogens H. Jensen, University of Copenhaguen
Gábor Lugosi, Universitat Pompeu Fabra, Barcelona
Consuelo Martínez, Universidad de Oviedo
Jaroslav Nešetřil, Charles University, Prague
Joan Porti, Universitat Autònoma de Barcelona

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 and the Catalan Government was signed on June 18, 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 attracting 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.
- Objectiu 10: enfortir les activitats de difusió dirigides als joves (*Saló de l'Ensenyament*, *Fira de la Ciència*, entrevistes gravades,

- *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.*
- *Goal 10: reinforce the diffusion activities addressed to young students (Saló de l'Ensenyament, Fira de la Ciència, recorded*

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 post-doctoral 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.
- 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.

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.*
- *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 to 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 center.*

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*.

The CRM as a centre promoting researchers' mobility:

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

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-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.

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:

- *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-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

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*

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.

1.6.1. 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

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 centers 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 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

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.

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.

Les institucions promotores de la BGSMath són la Facultat de Matemàtiques de la Universitat de Barcelona, el Departament de Matemàtiques de la Universitat Autònoma de Barcelona, la Facultat de Matemàtiques i Estadística de la Universitat Politècnica de Catalunya i el Centre de Recerca Matemàtica. L'Institut de Matemàtica de la Universitat de Barcelona també hi participa com a entitat de suport.

The promoting institutions of the BGSMath are the Facultat de Matemàtiques de la Universitat de Barcelona, the Departament de Matemàtiques de la Universitat Autònoma de Barcelona, the Facultat de Matemàtiques i Estadística de la Universitat Politècnica de Catalunya and the Centre de Recerca Matemàtica. The Institut de Matemàtica de la Universitat de Barcelona also participates as a research support entity.

La BGSMath va estar guardonada amb la distinció "María de Maeztu" pel Ministeri d'Economia i Competitivitat del Govern Espanyol com a part del seu Programa d'Excel·lència". La cerimònia va tenir lloc a Madrid el passat 19 de juliol de 2015. 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 de doctorands i postdoctorals internacionals a Barcelona.

BGSMath was awarded a "María de Maeztu" grant by the Spanish Ministry of Economy and Competitiveness under its "Excellence Program". The ceremony was held in Madrid on July 19^{th}, 2015. 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 students and postdocs to complete stays in Barcelona.

http://www.bgsmath.cat/

1.6.2. ERCOM

ERCOM és l'acrònim del comitè European Research Center 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

1.6.2. ERCOM

ERCOM is the acronym of the European Research Center on Mathematics committee of the European Mathematical Society (EMS), composed by the scientific directors of European research center in mathematics. Only centers 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

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. Des de 2006 fins a 2009, ERCOM va ser presidit per Jan Karel Lenstra, director del Centrum voor Wiskunde en Informatica d'Amsterdam. A finals de l'any 2009 va ser escollit president Gert-Martin Greuel, director del Mathematisches Forschungsinstitut Oberwolfach.

La reunió anual d'ERCOM de 2015 tingué lloc els dies 27 i 28 de març, a Zuric.

Per a més informació: www.ercom.org

1.6.3. EPDI

Des de desembre de 2000, el CRM és membre de l'EPDI (European Post-Doctoral Institute for the Mathematical Sciences), que agrupa deu prestigiosos instituts d'investigació europeus: Institut des Hautes Études Scientifiques, a Bures-sur-Yvette (el director del qual és el coordinador de l'EPDI); Max-Planck-Institut für Mathematik, a Bonn; Isaac Newton Institute for the Mathematical Sciences, a Cambridge; Max-Planck-Institut für Mathematik in den Naturwissenschaften, a Leipzig; Institute Mittag-Leffler, Djursholm; Banach Center, a Varsòvia; Erwin Schrödinger Institut, a Viena; Forschungsinstitut für Mathematik, a Zuric; Mathematisches Forschungsinstitut a Oberwolfach; i el CRM.

L'EPDI convoca anualment beques postdoctorals de dos anys de durada en l'àmbit de les matemàtiques i de la física matemàtica, ofertes a joves investigadors de països europeus.

Per a més informació: www.ercom.org/EPDI.htm

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. From 2006 to 2009, ERCOM has been chaired by Jan Karel Lenstra, director of the Centrum voor Wiskunde en Informatica, Amsterdam. In 2009, Gert-Martin Greuel, director of the Mathematisches Forschungsinstitut Oberwolfach, was elected new chairman.

The annual meeting of ERCOM in 2015 was held on March 27^{th} and 28^{th}, in Zürich.

Further information: www.ercom.org

1.6.3. EPDI

Since December 2000, the CRM has been a member of the EPDI (European Post-Doctoral Institute for the Mathematical Sciences), which currently groups ten European research institutes: Institut des Hautes Études Scientifiques (IHÉS) in Bures-sur-Yvette (the Director of which is the coordinator), Max-Planck-Institut für Mathematik in Bonn, Isaac Newton Institute for the Mathematical Sciences in Cambridge, Max-Planck-Institut für Mathematik in den Naturwissenschaften in Leipzig, Institute Mittag-Leffler in Djursholm, Banach Center in Warsaw, Erwin Schrödinger Institut in Vienna, Forschungsinstitut für Mathematik (FIM) in Zürich, Mathematisches Forschungsinstitut in Oberwolfach, and CRM.

The EPDI annually awards two-year post-doctoral grants in mathematics and mathematical physics, which are offered to young researchers in European countries.

Further information: www.ercom.org/EPDI.htm

http://www.ercom.org/EPDI.htm

1.6.4. 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. Per altra banda, Tomás Alarcón ha obtingut una plaça ICREA senior de la convocatòria 2015.

1.6.4. 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. Tomas Alarcón also obtained an ICREA senior position in the 2015 call.

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 2015. 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 2015. 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 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:

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

L'objectiu del programa és promoure la recerca matemàtica col·laborativa i interdisciplinària que estigui més ben representada en el sistema català de recerca, tant en universitats con en altres centres CERCA. 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".

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 contracte dura 3 anys i té assignat un projecte de formació en un tema específic escollit entre un investigador en matemàtiques que actua de director i un codirector d'una altra disciplina. Durant el 2015 es van concedir les següents beques o contractes (investigadors, temes, supervisor al CRM, supervisors externs):

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 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 the funding of the training program on Collaborative Mathematics presented by the CRM. See:

The aim of the program is to encourage interdisciplinary and collaborative mathematical research in the better represented interfaces in the Catalan research system, both in universities and in other centers CERCA. 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".

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 within 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 2015 (researcher, topic, CRM supervisor, external supervisors):

Contractes postdoctorals / *Postdoctoral contracts*:

- Juan Calvo, *Modelling the Growth of Kidney Cancer: A Hibrid Multiscale-Image Analysis Approach*. Tomás Alarcón (CRM), Simone Balocco (CVC), Anna Messeguer, Joan Morote (Vall d'Hebron).
- Vincent Cregan, *Mathematical Modelling of Nanoparticle Evolution*. Tim Myers (CRM), Victor Puntes (Institut Català de Nanotecnologia).
- Isabel Serra, *Statisticals, Models and Prediction of Synthetic Earthquakes*. Álvaro Corral (CRM), Eduard Vives (UB).

Beques predoctorals / *Predoctoral grants*:

- Gemma Colldeforns, *Wavelets-based Methods to Compute Solutions of BSDES Arising in Finance*. Luis Ortíz-Gracia (CRM), Cornelis W. Oosterlee (Centrum voor Wiskunde en Informatica, Amsterdam).
- Genís Prat, *The Neural Basis of Stochastic Behavior*. Alex Roxin (CRM), Jaime de la Rocha (IDIBAPS).
- Helena Ribera, *Mathematical Modelling of Nanoparticle Evolution*. Tim Myers (CRM), Victor Puntes (Institut Català de Nanotecnologia).
- Núria Folguera, *Metabolic Reprogramming of Cancer Stem Cells: A Stochastic Modelling Approach*. Tomás Alarcón (CRM), Javier A. Menéndez (Institut Català d'Oncologia).
- Isabel Moreno, *The Quantitative Laws of Musical Discourse: Models and Applications*. Álvaro Corral (CRM), Joan Serrà (IIIA-CSIC), Josep Lluís Arcos (IIIA-CSIC), Marián Boguñá (UB).
- Narani van Laarhoven, *The Dynamics of Up- and Down-State Activity in the Cerebral Cortex*. Alex Roxin (CRM), Jaime de la Rocha (IDIBAPS).

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. El CMI va aprovar una proposta

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. Starting 2013, a CRM proposal

del CRM, que s'ha iniciat al 2013, consistent en finançar tant investigadors rellevants sèniors com joves postdocs en el marc dels Programes Intensius de Recerca. Durant el 2015, l'ajut del CMI ha permès finançar dos tipus d'accions: la millora de les condicions econòmiques de 5 investigadors sènior i la participació de 12 estudiants doctorals i investigadors postdoctorals interessats en participar en esdeveniments científics dels programes de recerca.

A principis de l'any 2015, el CMI confirma la seva participació en l'organització de Programes de Recerca del CRM pel curs 2015–2016.

on this program was approved by CMI to support participation of senior outstanding researchers and young postdocs in the CRM Intensive Research Programs. During 2015, the CMI support has been allocated in two directions: to enhance the economical conditions of five senior researchers and to support the participation of 12 doctoral students and post-doctoral researchers interested in participating in the scientific events organized during intensive research programmes.

In early 2015, the CMI confirmed its participation in the organization of CRM research programs for the 2015–2016 academic year.

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 2014–15, el CRM va acollir els primers investigadors dins del *Simons Visiting Program* i ha continuat col·laborant durant el curs 2015–2016

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 academic year.

SIMONS FOUNDATION

https://www.simonsfoundation.org/

1.8. Transferència de coneixement

1.8.1 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. Aquest és un avantatge competitiu perquè ens permet treballar amb eines punteres i afrontar qualsevol necessitat de modelització matemàtica, optimització o investigació operativa entre altres.

Al 2015 s'ha presentat, conjuntament amb la Universitat de Barcelona (UB), la sol·licitud de patent EP15382248.1 amb títol "Method, apparatus and micro-rheometer for measuring rheological properties of Newtonian and non-Newtonian fluids" a data 14 de maig de 2015. A part s'ha treballat en una avaluació de l'interès comercial amb experts independents per saber si podria ser considerat un dispositiu Point of Care (POC) pel diagnòstic d'anèmia i altres malalties que afecten les propietats de la circulació de la sang. També s'ha fet un estudi per saber què caldria per poder comercialitzar aquest dispositiu.

Respecte a la transferència de coneixement no patentable, hem seguit treballant amb les empreses amb qui vam elaborar projectes citats en la memòria anterior. És el cas d'una millora d'un procés intern per una PIME catalana y la creació d'un programa per optimitzar serveis en el cas d'una multinacional. En tots dos casos s'ha seguit millorant el producte, ampliant funcionalitats i, en el cas de la PIME, es segueix amb èxit el doctorat industrial (DI2014) concedit a Néstor Costa.

Alhora s'han creat noves vies de col·laboració amb el sector bancari i amb altres empreses que comportaran la necessitat de crear nous productes i serveis durant el 2016. Es manté la col·laboració amb la Xarxa Math-in.

1.8. Knowledge transfer

1.8.1. Knowledge Transfer Team

The CRM Knowledge Transfer Team was set up in 2012 aiming at applying the knowledge derived from the research developed in the centre, giving priority to those pulling for innovation or those more related to the mathematical basis of the CRM research groups. This is a competitive advantage since it allows to work with cutting-edge tools and face any need of mathematical modelling, optimisation or operational research among others.

On May 14^{th}, 2015, the CRM and the University of Barcelona (UB) jointly submitted patent application EP15382248.1 under the title "Method, apparatus and micro-rheometer for measuring rheological properties of Newtonian and non-Newtonian fluids". The CRM has also worked with independent experts to assess commercial interest in the technology and determine whether it could serve as a point-of-care (POC) device for diagnosing anemia and other diseases that affect properties related to blood circulation. A study was also carried out to determine what steps would need to be taken to place the device on the market.

As for non-patentable knowledge, we have continued to work with the companies with which we developed projects mentioned in the previous report, improving an internal process for a Catalan SME and creating a service optimization program for a multinational firm. In both cases, further improvements have been made to products and functionalities have been extended. In the case of the SME, Néstor Costa continues to make good progress on his industrial doctorate (DI2014).

The CRM has also opened up new avenues of collaboration with the banking sector and various companies, which will lead to the creation of new products and services in 2016. We continue to work with the math-in network.

1.8.2. Red Española Matemática-Industria

El CRM signà el mes de maig de 2012 un conveni de col·laboració amb l'associació *Red Española Matemática-Industria* (Math-in). L'objectiu d'aquest conveni és impulsar la valorització dels resultats de la recerca realitzats dins dels propis grups de recerca del CRM.

La creació de la *Red Math-in* ha constituït una de les accions prioritàries del Pla de Transferència Tecnològica del projecte i-MATH, i pretén ser l'evolució de la plataforma MATHEMATICA CONSULTING i constituir-se com un fòrum de comunicació, d'intercanvi d'informació i d'experiències per a la promoció de la transferència dels resultats de recerca dins l'àmbit de les matemàtiques.

1.8.2. Red Española Matemática-Industria

In May 2012, the CRM signed a collaboration agreement with the association Red Española Matemática-Industria (math-in). The goal of this agreement is to impulse the appraisal of the research values achieved by the CRM research groups.

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.

[math-in].net
Red Española Matemática-Industria

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

1.8.3. 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.

1.8.3. 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.

DOCTORATS INDUSTRIALS

hohner AUTOMATICOS

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

1.9. Estructura i administració

1.9.1. 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 Joaquim Bruna, que va ser nomenat per al període de 2007 a 2011.

A la reunió del Consell de Direcció del dia 10 de desembre de 2010 es decidí renovar l'acord de nomenament de Joaquim Bruna com a director del CRM per a un període addicional de quatre anys, amb efectes a partir de l'1 d'abril de 2011. També es proposà el nomenament d'Antoni Guillamon com a Adjunt de Direcció, aprovat per unanimitat pel Consell de Direcció en la reunió del 25 de maig de 2011.

El director Joaquim Bruna va acabar la seva tasca després de 8 anys i mig liderant el CRM en data 31 de desembre de 2015. En aquest moment també va cessar Antoni Guillamon com a sotsdirector del CRM. A la reunió del Consell de Direcció del CRM de l'1 de desembre de 2015 es va nomenar Lluís Alsedà com a nou director amb responsabilitats a partir de l'1 de gener 2016.

El director, l'adjunt de direcció, 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.

1.9.2. Gerència

La Sra. Àngels Huertos ocupa el càrrec de gerent des d'octubre del 2014.

1.9. Structure and administration

1.9.1. 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 Joaquim Bruna, who was elected for the period from 2007 to 2011.

At the meeting of the Governing Board on December 10^{th}, 2010, it was decided to renew the agreement for the appointment of Joaquim Bruna as the CRM Director for an additional period of four years, starting on April 1^{st}, 2011. The appointment of Antoni Guillamon as Deputy Director was also proposed and approved unanimously by the Governing Board in the meeting on May 25^{th}, 2011.

The director Joaquim Bruna finished its work after eight and a half years leading the CRM on 31^{st} December 2015. At the same time Antoni Guillamon resigned as deputy director of the CRM. At the meeting of the Board of trustees of the CRM on December 1^{st}, 2015 Lluís Alsedà was appointed new director with responsibilities starting on January 1^{st}, 2016.

The director, the assistant director, 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.

1.9.2. General Management

Àngels Huertos has been the CRM's general manager since October 2014.

mahuertos@crm.cat telèfon 93 586 8424

1.9.3. Equip d'administració

L'equip d'administració del CRM durant el 2015 ha estat format per les persones següents:

Ana García-Donas	agarcia@crm.cat	Tel: 93 581 2953
Núria Hernández	nhernandez@crm.cat	Tel: 93 586 8192
Raquel Hernández	rhernandez@crm.cat	Tel: 93 581 2953
Guillem Pérez	gperez@crm.cat	Tel: 93 586 8423
Jordi Mullor	jmullor@crm.cat	Tel: 93 586 8496
Neus Portet	nportet@crm.cat	Tel: 93 581 4086
Consol Roca	croca@crm.cat	Tel: 93 581 1081
Mari Paz Valero	mpvalero@crm.cat	Tel: 93 581 1081

1.9.3. Management team

The following people made up the management team in 2015:

Ana García-Donas	agarcia@crm.cat	Tel: 93 581 2953
Núria Hernández	nhernandez@crm.cat	Tel: 93 586 8192
Raquel Hernández	rhernandez@crm.cat	Tel: 93 581 2953
Guillem Pérez	gperez@crm.cat	Tel: 93 586 8423
Jordi Mullor	jmullor@crm.cat	Tel: 93 586 8496
Neus Portet	nportet@crm.cat	Tel: 93 581 4086
Consol Roca	croca@crm.cat	Tel: 93 581 1081
Mari Paz Valero	mpvalero@crm.cat	Tel: 93 581 1081

1.10. 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 2015, 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

1.10. 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.

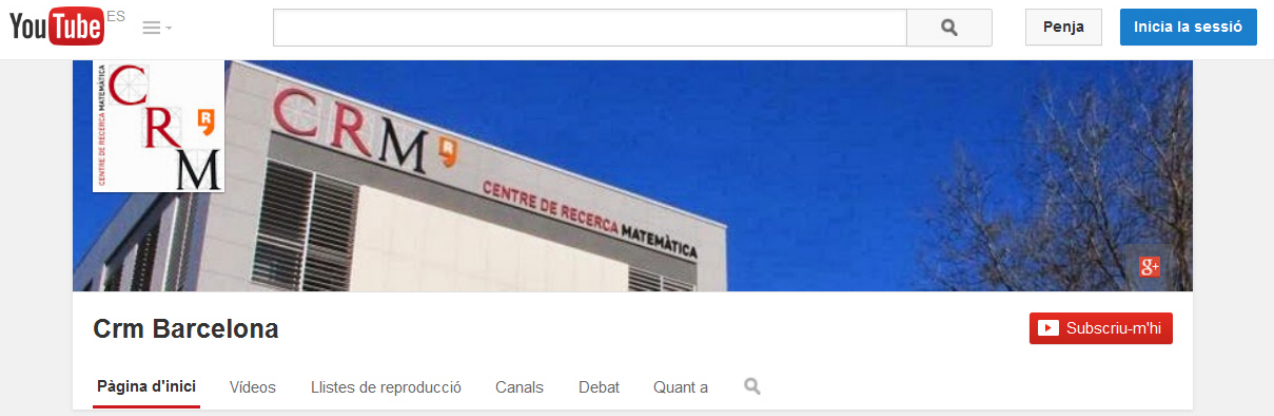
To host visiting researchers, the CRM uses the facilities provided by Vila Universitària at Bellaterra.

During 2015, 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*

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 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:

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 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



1.11. Serveis externs

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

1.11. External services

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

2

La recerca al CRM

Research at CRM

2.1. CRM Research Groups

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 2015 han estat:

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 2015 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 2015.

Next, we focus on the research lines of each group and the main activities they have carried on during 2015.

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 una 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

- 2014SGR 289. *Grup de teoria de funcions de la UB/UAB* *Generalitat de Catalunya*, 2014-pr. PI: C. Cascante.

Membres del grup
Research Team

- Sergey Tikhonov (team leader)
- Néstor Costa (PhD student)
- Alberto Debernardi (PhD student)
- Ainur Jumabayeva (PhD student)
- Askhat Mukanov (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 International University
• Erlan Nursultanov	Eurasian University
• Michael Ruzhansky	Imperial College London
• Walter Trebels	Technische Universität Darmstadt

Group Activity in 2015

During 2015 the members of the group studied the following topics:

Fourier series, function spaces, embedding theorems, weighted norm for integral transforms, polynomial inequalities, energy minimization, moduli of smoothness, regularity problems of the Monge-Ampère equation.

N. Costa studied optimal decoding and related problems of harmonic analysis A. Debernardi continued working on his PhD dissertation focusing on convergence of Fourier transforms of general monotone functions. A. Jumabaeva studied the (L_p, L_q) inequalities for moduli of smoothness of the generalized Liouville derivatives. A. Mukanov investigated different types of convergence of trigonometric series. S. Tikhonov has been working on sharp Fourier inequalities, restriction inequalities, and on polynomial inequalities.

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 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

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 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

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.

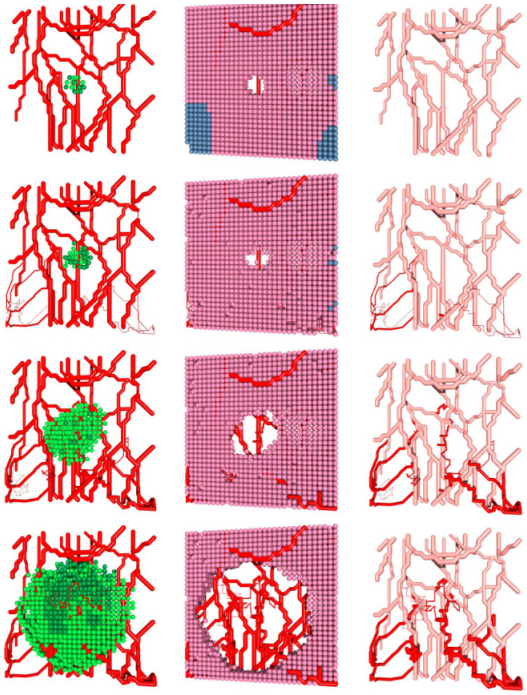
propose new models relevant to experimental biologists and clinicians and develop the analytical and computational tools necessary for their analysis. We pay special attention to problems with clinical relevance, in particular those related to cancer.

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

• *Mathematical models of biological population dynamics with complex structure*, 2011–2014. Extended for a further year until end 2016. PI: Tomás Alarcón.

Membres del grup
Research Team

- Tomás Alarcón (ICREA Research Professor, team leader)
- Juan Calvo (Postdoctoral researcher, "la Caixa"-CRM)
- Ivón Rodríguez-V. (Postdoctoral researcher)
- 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)

Activitats relacionades
Related Activities

- Computational & Mathematical Biology Seminar

Col·laboradors
Collaborators

• Helen M. Byrne	University of Nottingham
• Pilar Guerrero	University College London
• Aurora Hernández-Machado	Universitat de Barcelona
• Henrik J. Jensen	Imperial College London
• Philip K. Maini	Centre for Mathematical Biology, Oxford
• Markus R. Owen	Centre for Mathematical Medicine, Nottingham
• Pablo Padilla	Universidad Nacional Autónoma de México
• Karen M. Page	University College London
• Juan Soler	Universidad de Granada
• Fabian Spill	MIT & Boston University
• Rui Travasso	Universidade de Coimbra

Group Activity in 2015

During 2015, 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 2015, four 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, Roberto de la

Cruz, whose PhD is on stochastic multiscale models of tumour growth, and, Núria Folguera–Blasco, who is doing her PhD on models of reprogramming of somatic cells.

Finally, as research output, the group has published 7 papers in peer-reviewed journals during 2015. All of these were published in ISI journals of top quality.

Epidemiologia matemàtica

Àmbit de recerca

Durant 2015, el Grup d'Epidemiologia Matemàtica ha continuat treballant en modelització matemàtica de les malalties infeccioses dels éssers humans, animals domèstics i salvatges i plantes. L'estudi de les malalties infeccioses és una àrea de recerca altament pràctica que s'està extenent ràpidament. L'objectiu del Grup de recerca en Epidemiologia matemàtica és l'estudi de l'aparició i propagació de malalties infeccioses des d'un punt de vista matemàtic. L'èmfasi particular del grup en 2015 es va posar en direccions com ara l'evolució de patògens, l'aparició de nous agents patògens, la dinàmica de les malalties infeccioses en una població, el control de malalties infeccioses tant en una població com a nivell d'un sol hoste, així com la dinàmica de microparàsits dins d'un hoste. També s'ocupa de la descripció matemàtica de la resposta immune, així com amb el seu fracàs, com en el cas de la infecció per VIH.

El Grup d'Epidemiologia Matemàtica, treballant en estret contacte amb científics experimentals i el Grup d'Investigació en Biologia Matemàtica i Computacional utilitza com a eines la modelització matemàtica i les tècniques matemàtiques de la teoria de sistemes dinàmics i la teoria de control òptim per descriure i estudiar la dinàmica de les malalties infeccioses. Estem particularment interessats en la invasió de noves infeccions emergents, en l'estabilitat i persistència d'un agent patògen, així com l'estabilitat de la resposta immune. També estem interessats en l'evolució

Mathematical Epidemiology

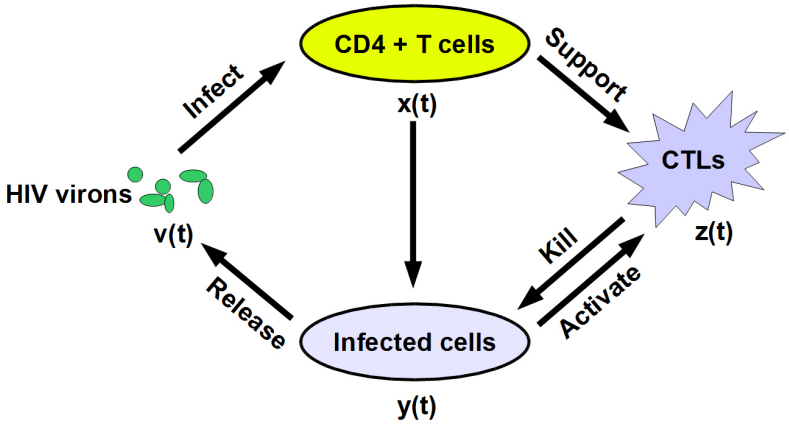
Research Field

During 2015, the Group of Mathematical Epidemiology continue to work in general area of the mathematical modelling of infectious diseases of the humans, domestic and wild animals and plants. The study of is infectious diseases is a rapidly expanding and a highly practically relevant area of research, and the aim of the Mathematical Epidemiology Research Group is to study the emergence and spread of infectious diseases from a mathematical point of view. The particular emphasis of the group in 2015 was in directions such as evolution of pathogens, the emergence of new pathogens, the dynamics of infectious diseases in a population, control of infectious diseases on both, population and a single host levels, 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.

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 and the Optimal Control Theory to describe and study the dynamic of infectious diseases. Our particular interests are in the invasion of newly 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

viral i microbiana, que és probablement el factor responsable més important de l'aparició de noves infeccions i del desenvolupament de soques resistents als fàrmacs, i la prevenció d'un desenvolupament eficaç de medicaments i vacunes.

single factor responsible for emergence of new infections and for development of drug resistant strains, and preventing a development of effective drugs and vaccines.



Membres del grup
Research Team

- Andrei Korobeinikov (team leader)
- Anel Nurtay (PhD student)
- Nitin Lalwani (MSc student)
- Clàudia Toral Fernández (Internship student until 2015)

Col·laboradors
Collaborators

• Santiago F. Elena	Instituto de Biología Molecular y Celular de Plantas
• Lourdes Esteva	Universidad Nacional Autónoma de México
• Jordi Garcia Ojalvo	Universitat Pompeu Fabra
• Ellina Grigorieva	Texas Woman's University
• Tomas Kelly	University College Cork
• Evgenii Khailov	The Moscow State University
• Elena Lara	Institut de Ciències del Mar-CMIMA, CSIC
• Michael O'Callaghan	University College Cork
• Alexander Pimenov	Weierstrass Institute for Applied Analysis and Stochastics
• Dmitry Rachinskiy	The University of Texas at Dallas
• Elisabet Sa	Institut de Ciències del Mar-CMIMA, CSIC
• Josep Sardanyés	Universitat Pompeu Fabra
• Leonid Shaikhet	Donetsk State University of Management, Donetsk
• Elena Shchepakina	Samara State Airspace University, Samara
• Vladimir Sobolev	Samara State Airspace University, Samara
• Konstantin Starkov	Instituto Politécnico Nacional-CITEDI
• Yasuhiro Takeuchi	Shizuoka University
• Dolors Vaqué	Institut de Ciències del Mar-CMIMA, CSIC
• Cruz Vargas de León	Universidad Nacional Autónoma de México
• Graeme Wake	Massey University

Group Activity in 2015

During 2015, 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.

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 (Institut de Biologia Evolutiva, UPF, Barcelona), and with participation of Vladimir Sobolev and Elena Shchepakina (Samara State Airspace University, Russia) and Graeme Wake (Massey University). Anel Nurtay (a PhD student who joined the group in March of 2015) is also working in this direction.

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.

4. Immune response, its failure, and development of AIDS. In collaboration with Prof. Yasuhiro Takeuchi of Shizuoka University, Japan, and Prof. Leonid Shaikhet of the Donetsk State University of Management, Ukraine.

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

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 in credit and market risk such as the Value-at-Risk (VaR) and the Expected Shortfall. The accurate estimation of the individual risk

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.

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.

Una altra línia important de recerca del nostre grup és la valoració d'opcions. La valoració robusta i eficient de les opcions és un camp recent i interessant en matemàtica aplicada i computació científica. L'equació en derivades parcials (EDP) de valoració d'opcions més coneguda és, sens dubte, l'equació de Black-Scholes, que valora una opció europea sota una dinàmica de preus dels actius que segueix un moviment brownià geomètric. Si es volen considerar dinàmiques més realistes d'actius, aleshores cal recórrer a altres EDPs de valoració d'opcions, o fins i tot equacions integro-diferencials parcials. La valoració d'opcions es fa sovint sota l'enfocament del valor esperat del *pay-off* descomptat, i la seva connexió amb la solució d'EDPs és el teorema de Feynman-Kac. En molts casos d'interès, no tenim la funció de densitat de probabilitat condicionada per als preus dels actius disponibles, però sí que tenim la seva transformada de Fourier. L'aplicació de Fourier i de tècniques basades en ondícules per recuperar una funció de densitat a partir de la seva transformada de Fourier és objecte del nostre interès.

Another important research line of our group is option pricing. The robust and efficient valuation of options is an interesting recent field in applied mathematics and scientific computing. The best known option pricing partial differential equation (PDE) is without any doubt the Black-Scholes equation, pricing a European option under geometric Brownian motion asset price dynamics. When considering more realistic asset dynamics, other option pricing PDEs, or even partial integro-differential equations, will be encountered. Option pricing is often done by the discounted expected pay-off approach, and its connection with the solution of the option pricing PDEs is the Feynman-Kac theorem. In many cases of interest, we do not have the conditional probability density function for the asset prices available, but we do have its Fourier transform. The application of Fourier and wavelets-based techniques to recover a density function from its Fourier transform is subject of our interest.

Projectes vigents
Current Projects

- CRM Research Group in Collaborative Mathematics, AGAUR. 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)
- Stef Maree (MSc student, TU Delft)
- Carles Pérez (BSc student, UAB)
- Marc Lagunas (internship student until 2015)
- Jeremy Williams (internship student until 2015)
- Antonio Lozano (internship student until 2015)

Activitats relacionades

- Interdisciplinary Workshop on Quantitative Finance, June 25^{th} and 26^{th}, 2015.

Related Activities

- Quantitative Finance Seminar, thematic network CRM.

Col·laboradors
Collaborators

• Cornelis W. Oosterlee	Centrum voor Wiskunde en Informatica and Delft University
• Elisa Alòs	Universitat Pompeu Fabra
• Duy-Minh Dang	University of Queensland
• Argimiro Arratia	Universitat Politècnica de Catalunya

Group Activity in 2015

The group has incorporated two new members during 2015, Carles Pérez from the UAB and Stef Maree from TU Delft. Carles worked on option pricing with binomial trees and got his degree on Mathematics and Physics. Stef worked on Bermudan option pricing with Shannon wavelets in a joint project with the research group leaded by C.W. Oosterlee at the CWI in the Netherlands. Stef defended his MSc thesis at TU Delft by the end of August and submitted a paper for publication by the end of November. The PhD student Gemma Colldeforns has been working on market risk measurement with wavelets. She visited the CWI for seven weeks and undertook new research on pricing of spread options under the supervision of her PhD co-advisor C.W. Oosterlee. Luis Ortiz visited the University of Queensland for ten weeks to carry out a research project with Duy-Minh Dang on conditional Monte Carlo methods for high-dimensional option pricing problems. Gemma and Luis worked in a 4-months consultancy project for the Barcelona Graduate School of Economics. They developed and implemented Monte Carlo algorithms for pricing European options under stochastic volatility models.

The group received the visit of Dr. Marjon Ruijter from CWI who delivered a seminar on Fourier methods for backward stochastic differential equations. Group members organized an interdisciplinary workshop on Quantitative Finance gathering speakers from different fields of research like Mathematics, Physics and Economics. It is worth underlining the participation in this workshop of Jan De Spiegeleer from Jabre Capital Partners and KU Leuven.

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 terreny a tot Europa, sobretot des de la publicació del llibre, "Històries d'èxit a Europa en Matemàtica Industrial", patrocinat per la Fundació Europea de la Ciència. Els grups existents, com ara el Consorci Europeu de Matemàtiques per la Indústria (ECMI) han augmentat amb la creació de la UE-math-In i el EU COST Network MI-Net.

D'acord amb la filosofia de la matemàtica industrial, el grup del CRM ha treballat en una àmplia varietat de problemes pràctics i ha participat en activitats nacionals i internacionals. Els camps principals d'investigació en el grup han cobert:

- Nanomatemàtica. El nostre treball en aquest camp s'ha ampliat i ens ha portat a una col·laboració amb el Grup de nanopartícules inorgàniques de l'Institut Català de Nanotecnologia. Els nostres projectes abasten actualment canvis de fase a nanoescala (incloent nanopartícules i nanocables), el creixement de solucions de nanocristalls (amb ING), l'efecte Kirkendall, el flux de nanofluids per a la refrigeració i l'absorció directa de col·lectors solars. També tenim una col·laboració amb el departament de Física de la UAB sobre transferència de calor a escala nanomètrica o escales de temps extremadament curtes.

- Canvis de fase. Les transicions de fase es produeixen en una multitud de situacions naturals i industrials, com ara en la formació de gel, la formació de metall des de l'estat de fusió, la fabricació de discs d'ordinador, les cobertures de xocolata i molts altres. A més del nostre treball sobre els canvis de fase a nanoescala els membres del grup de Matemàtica Industrial han treballat en la teoria bàsica de la formulació matemàtica dels models de canvi de fase, en reduccions rigoroses de

Industrial Mathematics

Research Field

Industrial mathematics can be defined as the application of mathematics to real-world problems. The field appears to be gaining ground throughout Europe, particularly since the publication of the book, European Success Stories in Industrial Mathematics, sponsored by the European Science Foundation. Existing groups, such as the European Consortium for Mathematics in Industry have been augmented by the creation of EU-math-In and the EU COST Network MI-Net.

In keeping with the industrial mathematics philosophy, the group at CRM has worked on a wide variety of practical problems as well as participating in national and international activities. The primary research fields in the group have covered:

- *Nanomathematics. Our work in this field has expanded, leading to collaboration with the Inorganic Nanoparticles Group of the Institut Catalá de Nanotecnologia. Our projects currently cover phase change at the nanoscale (including nanoparticles and nanowires), growth from solution of nanocrystal (with ING), the Kirkendall effect, nanofluid flow for cooling and in Direct Absorption Solar Collectors. We also have a collaboration with the Physics department at UAB on heat transfer at the nanoscale or extremely short time-scale.*

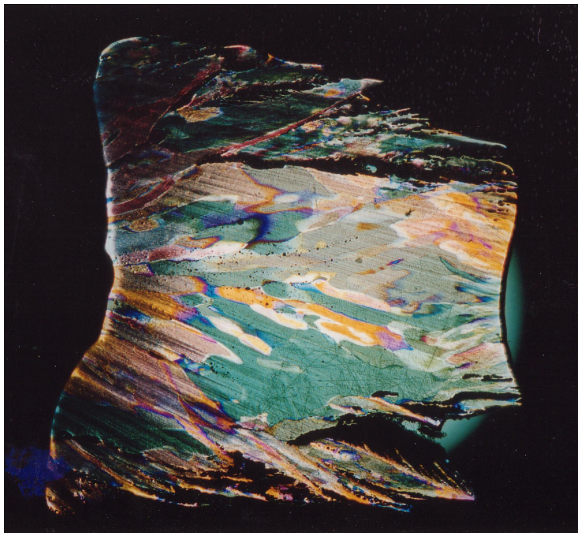
- *Phase change. Phase transitions occur in a multitude of natural and industrial situations such as in ice formation, metal formation from the molten state, computer disk manufacture, chocolate coating and many more. In addition to our work on phase change at the nanoscale IM group members have worked on the basic theory of the mathematical formulation of phase change models, rigorous reductions of the models, contact melting and vapour formation in cooling pipes.*

models, fusió de contacte i formació de vapor en tubs de refrigeració. Aquesta darrera col·laboració es realitza amb el Departament de Física de la UB.

□ Fluxos de capa prima. Els fluxos de capa prima poden incloure el moviment de lubricants, pintures, aigua corrent per una finestra, l'aire que suporta un disc dur d'ordinador en ràpida rotació o el moviment de la lava o una glacera. La modelació matemàtica dels fluxos de capa prima pot donar lloc a una rica varietat de comportaments i òbviament té moltes aplicacions pràctiques. Aquest treball implica fluids newtonians i no newtonians.

This latter is in collaboration with the Physics Department at UB.

□ *Thin film flows. Thin film flows can cover the motion of lubricants, paints, water running down a window, the air supporting a rapidly rotating computer hard drive or the motion of lava or a glacier. Mathematical modeling of thin film flows can lead to a rich variety of behaviour and obviously has many practical applications. This work involves both Newtonian and non-Newtonian fluids.*



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.

Membres del grup
Research Team

• Tim Myers	(team leader)
• Vincent Cregan	("la Caixa" post-doc, since 04/2014
• Helena Ribera	("la Caixa" PhD, since 09/2014)
• Marc Calvo	("la Caixa" PhD, since 09/2015, previously Masters student in IM group)
• Vicent Ribas	(Scientific Collaborator)
• Gary O'Keeffe	(PhD student, University of Limerick, TM joint supervisor)
• Adrià González	(Final year graduate student, UPC)
• Marc Marugán	(Final year graduate student, UAB)
• Beñat Irastorza	(Final year Graduate student, UPC)

• Carles Riera	(Final year Graduate student, UAB)
• Sergio González	(CRM Internship)
• Maria de Araceli Morales	(Final year graduate student, UPC, supervisors VR, TM)
• Gideon Fareo	(Lecturer, University of Witwatersrand, CRM Dev-Math program)

Activitats relacionades
Related Activities

• TM is the Short Term Scientific Mission Manage rand member of the Management Committee for the EU COST Action TD1409 Maths for Industry Network, MI-Net. He is also the Spanish Representative on the council for the European Consortium for Mathematics in Industry, an editor for Applied Mathematical Modelling and the RSME-Springer book series. He is a member of the scientific committee for the conferences NanoMath (Toulouse 2016), ECMI Conference (Santiago de Compostela 2016) and was the President of the organising committee for the 115th European Study Group with Industry (CRM 2016).

Col·laboradors
Collaborators

• Sarah Mitchell	University of Limerick
• Brian Wetton	University of British Columbia
• Gideon Fareo	University of the Witwatersrand
• Michelle MacDevette	University of Cape Town
• Francesc Font	University of Limerick

Group Activity in 2015

The group's research work on mathematics at the nanoscale is now leading to collaborations with both theoretical physics and experimental groups. Helena Ribera's project, involving nanoscale phase change and the Kirkendall effect is linked to the Inorganic Nanoparticles Group at the Institut Catala de Nanotecnologia. This connection led to the ING presenting a problem at the 115th European Study with Industry, held at the CRM in January 2016. The new PhD student, Marc Calvo, who joined the group in September is working on nanoscale heat transfer in collaboration with members of the Physics Department at UB. Vincent Cregan has worked on the use of nanofluids in Direct Absorption Solar Collectors and also in phase change energy storage materials. DASCs are also the subject of the PhD of Gary O'Keeffe.

Tim Myers gave keynote speeches at the 110th European Study Group with Industry, held in Ireland and also at the Industrial Mathematics Initiative, held in South Korea. He also gave talks at Yonsei University, Korean National Institute for Mathematical Sciences, African Institute for Mathematical Sciences, Institut de Ciència de Materials de Barcelona, Imperial College London, Universidad de Castilla-La Mancha, Real Sociedad Matemática meeting in Granada, Universidad Complutense de Madrid. He was also an invited expert at the South African Mathematics

in Industry Study Group, held in Cape Town. His EU activities required trips to the ECMI council meetings in Germany and the UK, and for the COST network to Belgium and the UK. The COST network has been particularly beneficial to the CRM, since 3 researchers will visit in 2016 funded by this grant. In July he visited the Vrije Universiteit in Amsterdam. There, as well as doing mathematics he worked on a proposal for a Marie Curie Post-doc, with Matt Hennessy of Imperial College. The project was successful and Matt will be joining the group in late 2016.

The groups work was published in papers in 3 first quartile journals, these dealt with phase change at the nanoscale and DASCs. Two papers also appeared in the Catalan Maths Society journal, one was a consequence of the Premi Albert Dou, awarded to Tim Myers in 2014.

Neurociència Computacional

Àmbit de recerca

La neurociència computacional és un subcamp de la neurociència en el qual els models computacionals s'usen per a entendre millor com funciona el sistema nerviós. Es tracta d'un camp molt vast, que disposa de molts tipos 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 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 el 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

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

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. Addicionalment, estem desenvolupant 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.

El Grup de Neurociència Computacional ha tingut sis investigadors a temps complert durant l'any 2015, incloent l'Investigador Principal, quatre estudiants de doctorat i un investigador postdoctoral. Els estudiants de doctorat han sigut: Marina Vegué (finançada per una beca de doctorat de la Fundació "la Caixa"), Bernat Rovira (finançat com a "investigador en formació", a través d'una subvenció per al projecte del Ministeri Espanyol d'Economia i Competitivitat), Genís Prat i Narani van Laarhoven (ambdós finançats a través d'un programa d'investigació en col·laboració amb la Fundació "la Caixa").

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. Additionally we are developing 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.

There were six full-time researchers in the Computational Neuroscience Group in 2015, including the PI, four PhD students and one post-doctoral researcher. The PhD students include: Marina Vegué (funded by a doctoral grant from the Caixa Foundation), Bernat Rovira (funded as a "researcher in training", through a project grant from the Spanish Ministry of Economics and Competitiveness), Genís Prat and Narani van Laarhoven (both funded through a collaborative research program of the Caixa Foundation).

Projectes vigents
Current Projects

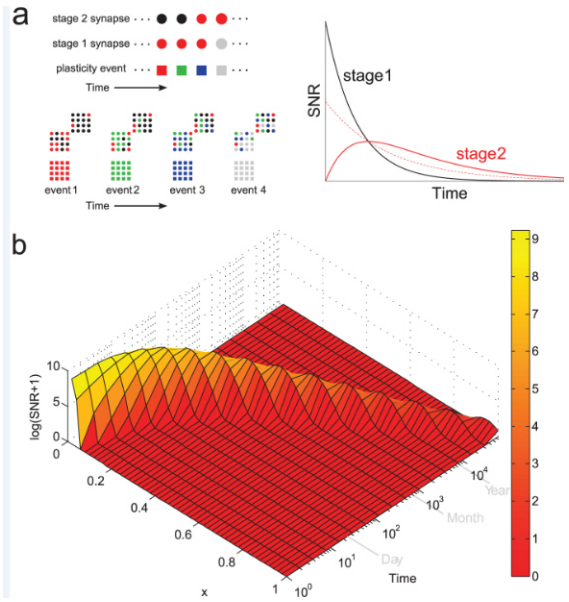
- BFU2012-33413. *Memory encoding and consolidation: a computational study*, 2013–2015. PI: Alex Roxin.

Membres del grup
Research Team

• Alex Roxin	(team leader)
• Panagiota Theodoni	(Postdoctoral researcher, FPI fellowship)
• Genís Prat	(PhD student, "la Caixa"-CRM, since 09/2014)
• Bernat Rovira	(PhD student, FPI fellowship)
• Narani van Laarhoven	(PhD student, "la Caixa"-CRM, since 11/2014)
• Marina Vegué	(PhD student, "la Caixa"-UPC)

Col·laboradors
Collaborators

• Albert Compte	IDIBAPS
• Ernest Montbrió	UPF
• Jaime de la Rocha	IDIBAPS
• Duane Nykamp	University of Minnesota



Group Activity in 2015

We continued to work on three parallel topics: 1- cortical networks and network dynamics, 2- memory formation and consolidation, 3- perceptual decision making. Specifically, Marina Vegué has analyzed different candidate network structures to explain the connectivity statistics seen in in-vitro slice experiments. Bernat Rovira has explored the stability of random patterns stored in attractor neural networks as a function of their age. Panagiota Theodoni has developed a model of spatial learning in rodents via spike-timing dependent synaptic plasticity in a network of place cells. Genís Prat has studied an attractor model for the dynamics underlying two-choice forced alternative decision making (collaboration with Jaime de la Rocha). We have also been actively collaborating with the group of Ernest Montbrió at the University Pompeu Fabra on mean-field models of neuronal networks, and with the group of Albert Compte at the Institut d'Investigacions Biomèdiques August Pi i Sunyer on the role of oscillations in cognition. Marina Vegué spent a three-month stay in the group of Nicolas Brunel at the University of Chicago and Alex Roxin spent six months visiting Nancy Kopell at Boston University.

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 dels reptes actuals de la humanitat estan en comprendre el comportament de sistemes complexos, com ara el clima, l'economia, la societat,

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 challenges come from trying to unravel the behaviour of these systems, such as the climate, the economy, the society, the brain, biological

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.

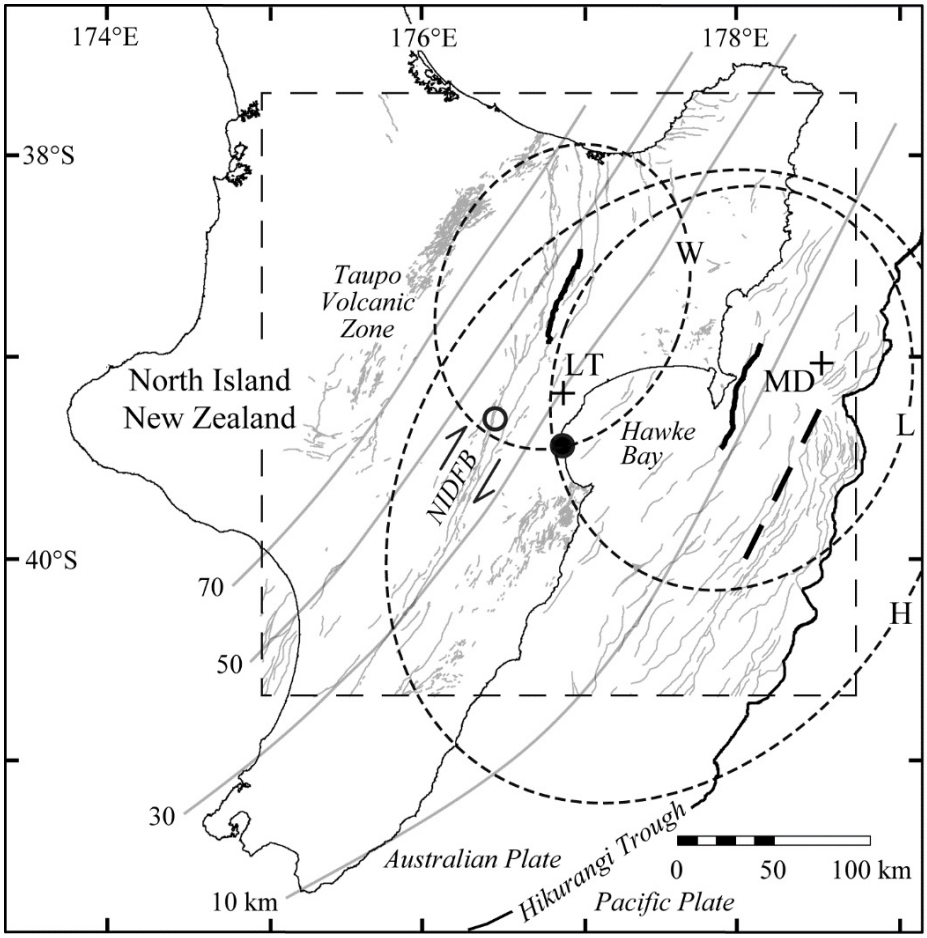
development, etc. Contrary to this, the hydrogen atom, the solar system or an ideal gas would be simple systems, despite the fact that in order to study them we need to use in-depth physics concepts and sophisticated mathematics. However, if everything that is complex is a complex system, what does the 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

- FIS2012-31324. *Scaling, complejidad y predictibilidad en fenómenos atmosféricos y formas de comunicación*, Ministerio de Economía y Competitividad, 2013–15. PI: Álvaro Corral.
- 2014SGR1307 AGAUR. *CRM research group in Collaborative*, Mathematics 2014–2016. PI: Álvaro Corral.



Membres del grup
Research Team

• Álvaro Corral	(team leader)
• Isabel Serra	(Postdoctoral res., "la Caixa"-CRM, since 09/2014)
• Francesc Font Clos	(PhD student, AGAUR-CRM grant)
• Isabel Moreno	(PhD student, "la Caixa"-CRM, since 09/2014)
• Rosalba García	(internship student)
• Irina Espejo	(internship student)
• Domènec Ruiz	(internship student)

Activitats relacionades
Related Activities

- IV Jornada Complexitat.cat, Tarragona (May 25, 2015)
- V GEFENOL Summer School on Statistical Physics of Complex and Small Systems, CRM (July 6^{th} to 17^{th}, 2015)

Col·laboradors
Collaborators

• Josep Lluís Arcos	IIIA -CSIC
• Gemma Boleda	Universitat Pompeu Fabra
• Anna Deluca	Max Planck Institute for the Physics of Complex Systems
• Albert Díaz-Guilera	Universitat de Barcelona
• Ramon Ferrer i Cancho	Universitat Politècnica de Catalunya

• Basil Gomez	University of Hawai'i
• Nicholas R. Moloney	London Mathematical Laboratory
• Gunnar Pruessner	Imperial College London
• Francesc Sagués	Universitat de Barcelona
• Joan Serrà	Telefónica I+D
• M. Ángeles Serrano	Universitat de Barcelona
• Eduard Vives	Universitat de Barcelona

Group Activity in 2015

During 2015 the group achieved several milestones. Francesc Font Clos got his PhD degree very brilliantly, and then he joined the Institute for Scientific Information Foundation in Turin as a postdoc. Also, Rosalba García-Millán and Domènec Ruiz defended with great success their "Treball de Fi de Grau" of the double Bachelor Degree in Mathematics and Physics; subsequently both of them enrolled in Master studies abroad. The group also organized during two intensive weeks the V GEFENOL Summer School on Statistical Physics of Complex and Small Systems, with courses from A. Hernández-Machado (UB), I. Pagonabarraga (UB), S. Thurner (Medical University of Vienna), G. Pruessner (Imperial College), A.C.C. Coolen (King's College), and A. Díaz-Guilera (UB). Other guests that have contributed to the CRM Colloquium or the CRM CAMP Seminars are R. Pastor-Satorras (UPC), L. Vega (MATGAS), D. Reguera (UB) and N.R. Moloney (London Mathematical Lab).

The main research of the group has focused on the theory of branching processes, quantitative linguistics, quantitative musicology, metabolic networks and statistical seismology. This has led to the publication of nine articles in ISI-indexed journals by the members of the group, including Physical Review Letters, Geology, Journal of the Royal Society Interface, New Journal of Physics and PLoS ONE, and to two invited lectures at international events. The group has continued to do consulting projects of the CRM Technology Transfer Unit, working for Ferrovial and Banc de Sabadell.

2.2. Personal investigador / CRM 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 2.3).

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 2.3).

Tomás Alarcón

During 2015, the main activity has continued to focus 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 2015, four 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, Roberto de la Cruz, whose PhD is on stochastic multiscale models of tumour growth, and, Núria Folguera-Blasco, who is doing her PhD on models of reprogramming of somatic cells.

As far as research output is concerned, I have published 7 papers in peer-reviewed journals during 2015. All of these were published in ISI journals of top quality.

In October 2015, I was appointed to an ICREA Research Professorship at the Centre de Recerca Matemàtica.

□ Publications

Articles

- P. Guerrero, T. Alarcón, *Stochastic multiscale models of cell population dynamics: Asymptotic and numerical methods*, Math. Model. Nat. Phen. **10**, 64–93 (2015).
- F. Spill, P. Guerrero, T. Alarcón, P.K. Maini, H.M. Byrne, *Mesoscopic and continuum modelling of angiogenesis*, J. Math. Biol. **70**, 485–532 (2015).
- D. Sánchez-Taltavull, T. Alarcón, *Stochastic modelling of viral blips in HIV-1-infected patients: effects of inhomogeneous density fluctuations*, J. Theor. Biol. **371**, 79–89 (2015).
- C.B. Picallo, R.A. Barrio, C. Varea, T. Alarcón, A. Hernández-Machado, *Phase-field modelling of the dynamics of Z-ring formation in liposomes: Onset of constriction and coarsening*, Eur. Phys. J. E. **38**, 61 (2015).
- F. Spill, P. Guerrero, T. Alarcón, P.K. Maini, H.M. Byrne, *Hybrid approaches for multiple-species stochastic reaction-diffusion models*, J. Comp. Phys. **299**, 429–445 (2015).
- R. de la Cruz, P. Guerrero, F. Spill, T. Alarcón, *The effects of intrinsic noise on the behaviour of bistable cell regulatory systems under quasi-steady state conditions*, J. Chem. Phys **143**, 074105 (2015).
- S. Fernández-Arroyo, E. Cuyas, J. Bosch-Barrera, T. Alarcón, J. Joven, J.A. Menéndez, *Activation of the methylation cycle in cells reprogrammed into a stem cell-like state*, Oncoscience **2**, 958–96 (2015).

Patents

- I. Rodríguez-Villarreal, T. Alarcón, J. Colomer, A. Hernández-Machado, P. Miribel. Method apparatus for measuring viscosity of Newtonian and Non-Newtonian fluids. Submitted. Patent application number: 15382248.1-1553, (2015).

Research projects

- *Mathematical modelling of biological populations with complex structure*, MICINN, MTM2011-29342. From 2012 to 2014. Extended for a further year until the end of 2015. Principal investigator: Tomás Alarcón.
- *CRM research group in Collaborative Mathematics,* 2014SGR1307. From 2014 to 2016. Principal investigator: Álvaro Corral.
- *Kidney integration software: developing a new tool for diagnostic and decision making treatments for kidney tumour,* EUIN2013-51201. From 2014 to 2016. Principal investigator: Anna Messeguer, Vall d'Hebron Hospital Research Institute.

Activity in research training

Supervision of research students

PhD supervision

- 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).
- Nuria Folguera-Blasco. Funded by Obra Social "la Caixa" through the CRM programme in Collaborative Mathematics. Subject: *Stochastic modelling of cellular reprogramming*. November 2014 – Present.

Postdoc supervision

- Juan Calvo. Funded by Obra Social "la Caixa" through the CRM programme in Collaborative Mathematics. Subject: *Hybrid multi-scale modelling of tumour growth*. April 2015 – Present.
- Ivón Rodríguez-Villareal. Funded by the Centre de Recerca Matemàtica. Subject: *Microrheology of biofluids*. Co-supervised by Aurora Hernández Machado (School of Physics, University of Barcelona). March 2013 – Present.

□ Teaching activity

• *Module on Asymptotic and Numerical Methods* (10 lectures) in the Advanced Stochastic Methods course with the MSc on Modelling in Science and Engineering, Universitat Autònoma de Barcelona, Course 2015-2016.

□ Scientific activities

Organisation

• Member of the Organising Committee (jointly with Álvaro Corral, CRM, and Francesc Font, CRM) of the Fifth GEFENOL *Summer School on Statistical Physics and Physics and Small and Complex Systems*. CRM, July 2015.
• Member of the Scientific Committee of the Barcelona Graduate School of Mathematics.
• Member of the Scientific Committee of Catalan Mathematical Society.

Participation

Invited lectures in conferences

• *Current challenges in Mathematical Biology*. Invited talk at the IEMath (Spanish Institute for Mathematics) Presentation Meeting, February 2015.
• *Evolutionary dynamics of systems with genotype-phenotype map*. Invited talk at the mini-symposium on "Molecular Evolution and Fitness Landscapes" within the conference "Modelling Biological Evolution 2015" Leicester, UK, April 2015.
• *Stochastic multi-scale modelling of cell populations*. Seminar at the Angiogenesis & Vascular Tumour Growth Working Group, Mathematical Institute, University of Oxford, UK, May 2015.
• *Mathematical modelling of drug resistance*. Advanced Topics Seminar, MSc on Modelling in Science and Engineering, Universitat Autònoma de Barcelona, Spain, October 2015.
• *Stochastic multi-scale modelling of tumour growth*. Current Trends in Mathematics Undergraduate Seminar, Universitat Autònoma de Barcelona, Spain, October 2015.
• *Gene regulatory systems under epigenetic regulation: robustness, noise-enabled bifurcations, and cellular reprogramming*. Seminar, Department of Applied Mathematics, Universidad de Granada, Spain, December 2015.

Álvaro Corral

During 2015, the research activity of A. Corral has been dispersed accross several research lines, including: predictability and scaling of rain time series, jointly with A. Deluca and N.R. Moloney; the theory of branching processes from the point of view of statistical physics, together with F. Font Clos and R. García Millán; quantitative linguistics, with F. Font Clos and I. Moreno Sánchez; statistical properties of musical pieces, together with I. Moreno Sánchez; and statistical tools for testing universality in critical exponents, with A. Deluca and P. Puig. A. Corral has continued his work in the Scientific Committees of complexitat.cat and the GEFENOL Summer School. He has also devoted an special effort to outreach activities, with two papers in the journal of the Societat Catalana de Física, and appearances in newspapers and radio programs.

□ Publications

Articles

- B. Gómez, A. Corral, A.R. Orpin, M.J. Page, H. Pouderoux, P. Upton, *Lake Tutira paleoseismic record confirms random, moderate to major and/or great Hawke's Bay (New Zealand) earthquakes*, Geology **43(2)**, 103–106 (2015).
- R. García Millán, F. Font Clos, A. Corral, *Finite-size scaling of survival probability in branching processes*, Phys. Rev. E **91**, 042122 (2015).
- A. Corral, *Scaling in the timing of extreme events*, Chaos, Solitons, and Fractals **74**, 99–112 (2015).
- A. Deluca, N.R. Moloney, A. Corral, *Data-driven prediction of thresholded time series of rainfall and self-organized criticality models*, Phys. Rev. E **9**, 052808 (2015).
- F. Font Clos, A. Corral, *Log-Log Convexity of Type-Token Growth in Zipf's Systems*, Physical Review Letters **114**, 238701 (2015).
- A. Corral, G. Boleda, R. Ferrer i Cancho, *Zipf's Law for Word Frequencies: Word Forms versus Lemmas in Long Texts*, PLoS ONE **10(7)**, e0129031 (2015).
- A. Corral, A. Díaz Guilera, *La cerca i la recerca de la complexitat a Catalunya: complexitat.cat*, Revista de Física **5(2)**, 4–10 (2015).
- A. Corral, C. Masoller, A. Turiel, *Desastres naturals, multifractals i xarxes climàtiques: tres exemples de complexitat a geociència*, Revista de Física **5(2)**, 11–16 (2015).

Preprints

- J. Serrà, I. Serra, A. Corral, J.L. Arcos, *Ranking and significance of variable-length similarity-based time series motifs*, arXiv:1503.01883.
- I. Serra, A. Corral, *Deviation from power law of the global earthquake seismic moment distribution*, arXiv:1504.00378.
- A. Deluca, P. Puig, A. Corral, *Testing Universality in Critical Exponents: the Case of Rainfall*, arXiv:1508.06516.
- I. Moreno Sánchez, F. Font Clos, A. Corral, *Large-scale analysis of Zipf's law in English texts*, arXiv:1509.04486.

Research projects

• *Scaling, complejidad y predictibilidad en fenómenos atmosféricos y formas de comunicación,* Ministerio de Economía y Competitividad, FIS2012-31324. From 2013 to 2015. Principal investigator: Álvaro Corral.
• *Grup de Recerca en Matemàtica Col·laborativa del CRM,* Generalitat de Catalunya, SGR-01307. From 2014 to 2016. Principal investigator: Álvaro Corral.

Activity in research training

Supervision of research students

Undergraduate project supervision

• Rosalba García Millán, double degree in Mathematics and Physics, UAB, July 2015.
• Domènec Ruiz Balet, double degree in Mathematics and Physics, UAB, July 2015.

PhD supervision

• Francesc Font Clos, PhD awarded June 2015 (Generalitat de Catalunya FI grant).
• Isabel Moreno Sánchez, PhD student (CRM, Projecte Fundació "la Caixa").

Scientific activities

Organisation

• Chairman of the scientific committee of the Catalan Network on Complex Systems complexitat.cat, organizing the Jornada complexitat.cat in URV, Tarragona, May 2015.
• Member of the scientific committee of the GEFENOL (Grupo Especializado en Física Estadística y Nolineal) Summer School.
• Member of the organizing committee ot the 5th GEFENOL Summer School on Statistical Physics of Complex and Small Systems, CRM, July 2015.

Participation

Communications in conferences

• A. Corral, *Power Laws or not in Zipf-like Systems, Criticality in Biology: a Critical Assessment*, BIOCRIT, MPIPKS, Dresden, Germany, April 2015.
• A. Corral and I. Serra, *Performance of the Clauset-Shalizi-Newman Method for Power-law Fitting and Comparison with other Methods*, International Conference on Risk Analysis, ICRA 6 / RISK 2015, Barcelona, May 2015
• I. Serra and A. Corral, *Statistical Tests for the Tail of the Seismic-moment Distribution of Global Shallow Earthquakes*, International Conference on Risk Analysis, ICRA 6 / RISK 2015, Barcelona, May 2015.

• I. Serra and A. Corra, *Statistical Tests for the Tail of the Seismic-moment Distribution of Global Shallow Earthquakes* 9th International Workshop on Statistical Seismology, StatSei9, Postdam, Germany, June 2015.
• A. Corral, *Power Laws or not Power Laws in Zipf-like Systems*, Granada Seminar, La Herradura, Spain, June 2015.
• A. Corral, *Power Laws and Criticality*, Invited Course, International Summer School: Large Fluctuations and Extreme Events, Dresden, Germany, October 2015.

□ Other activities

• Member of the evaluation committee of the PhD thesis of Giulio Tirabassi, PhD in physics, UPC, June 2015.
• Referee of the journals Physical Review E (4 reviews), Proceedings of the National Academy of Sciences, Geophysical Journal International, Physica A (2), Journal of Statistical Physics.

Andrei Korobeinikov

During 2015, I continued my research in Mathematical Medicine and Biology, working in the following research directions: (i) The global analysis of mathematical models originated in Medicine and Biology, and the persistence and stability of biological systems. In particular, I was interested in ecological systems and host-microparasite systems; the latter include the models for the spread of a pathogen within a population, virus dynamics models and models of immune response. To a large extend, these research were a further development of my earlier advance in application of the Direct Lyapunov method to the problems in Mathematical Biology. Working with collaborators, I manage to establish global properties for a number of models in host-parasite dynamics. (ii) The second direction of my research, and the one which I am currently most interested in, was mathematical modelling of biological evolution, and of pathogen evolution in particular. Pathogen evolution is probably the most significant single factor responsible for the emergence of novel pathogens and for a rise of drug resistance; collapse of immune system and the development of AIDS is also probably a result of viral evolution within an infected host. In this direction framework I also studied mechanisms of adaptation, such as memory, to biological system dynamics. (iii) The third direction of my research in 2015 was the optimal control by biological processes. In particularly, I work on the optimal controls for antiretroviral therapy (HIV treatment) and the optimal controls for the the spread of an infection in a population. In collaboration with Prof. E. Grigorieva and Prof. E. Khilov, we developed a mathematical technique which enabled us to analyze the controls with singularities (so-called "bang-bang controls") and reduce a problem of optimal control to a problem of the finite-dimensional optimization (the mathematical methods for the latter problems are well developed).

□ Publications

Articles

• E.V. Grigorieva, E.N. Khailov, A. Korobeinikov, *Optimal control for a SIR epidemic model with nonlinear incidence rate*, Math. Model. Nat. Phenom., (accepted 21/02/2016).

• A. Korobeinikov, E. Shchepakina, V. Sobolev, *Paradox of enrichment and system order reduction: bacteriophages dynamics as case study*, Math. Med. Biol., (in print), 11 p., http://imammb.oxfordjournals.org/cgi/reprint/dqv025?ijkey=LqoHzdKoJBjgz0B&keytype=refdoi:10.1093/imammb/dqv025.

• A.A. Archibasov, A. Korobeinikov, V.A. Sobolev, *Limits in a singularly perturbed partial integro-differential system*, Differential equations, (accepted 16/06/2015).

• E. Groarke , L. O'Brien , M. Kiely , S. Joyce , J. Gleeson, A Korobeinikov, C. Fell, *et al.*, *Streamlining the management of blood group RH negative bloodstock: a single centre irish experience*, Haematologica **100** (2015), 138–138.

• L. Shaikhet, A. Korobeinikov, *Stability of a stochastic model for HIV-1 dynamics within a host*, Applicable Analysis, (in print) (2015), DOI:10.1080/00036811.2015.1058363.

• A. Korobeinikov, A. Archibasov, V. Sobolev, *Order reduction for an RNA virus evolution model*, Math. Biosci. Eng. **12 (5)**, 1007–1016 (2015). doi:10.3934/mbe.2015.12.1007, http://www.aimsciences.org/journals/pdfs.jsp?paperID=11304&mode=full

• A. Pimenov, T.C. Kelly, A. Korobeinikov, M.J.A. O'Callaghan, D. Rachinskii, *Adaptive behaviour and multiple equilibrium states in a predator-prey model*, Theoretical Population Biology **101**, 24–30 (2015), doi:10.1016/j.tpb.2015.02.004 (Cited by 2).

• A.A. Archibasov, A. Korobeinikov, V.A. Sobolev, *Asymptotic expansions of solutions for a singularly perturbed model of viral evolution*, Computational Mathematics and Mathematical Physics **55 (2)**, 240–250 (2015), DOI:10.1134/S0965542515020037.

Books or book chapters

• M. Corbera, J.M. Cors, J. Llibre, A. Korobeinikov (Editors), *Extended Abstracts Spring 2014. Hamiltonian Systems and Celestial Mechanics Systems. Virus Dynamics and Evolution*, in Trends in Mathematics; Research Perspectives, CRM Barcelona, vol. 4 (978-3-319-22129-1).

Conference proceedings

• E.V. Grigorieva, E.N. Khailov, A. Korobeinikov, *Optimal control for an epidemic in populations of varying size* in Proc. of the 10th AIMS Conference on Dynamical Systems, Differential Equations and Applications, Madrid, July 7–11, 2014. AIMS Proceedings, 549–561, (2015), doi:10.3934/proc.2015.0549, https://aimsciences.org/journals/pdfs.jsp?paperID=11916&mode=full.

• J.C. Cantero-Guardeño, V. Sobolev, A. Korobeinikov, *The spread of two viral strains on a plant leaf,* in "Virus Dynamics and Evolution" (Proc. of Workshop). Research Perspectives CRM Barcelona, Spring 2014, vol. 4, in Trends in Mathematics, Springer-Birkhäuser, Cham, pp. 95–100, (2015), doi10.1007/978-3-319-22129-8_17.

• N. van Laarhoven, A. Korobeinikov, *Within-host viral evolution model with cross-immunity* in "Virus Dynamics and Evolution" (Proc. of Workshop. Research Perspectives CRM Barcelona, Spring 2014, vol. 4, in Trends in Mathematics, Springer-Birkhäuser, Cham, pp. 119–124 (2015), doi10.1007/978-3-319-22129-8_21.

□ Research projects

• *Ramón y Cajal Fellowship,* MICINN. From 2012 to 2017. Principal investigator: A. Korobeinikov.

• *Análisis de sistemas con dinámica compleja en las áreas de medicina matemática y física utilizando los métodos de localización de conjuntos compactos invariantes,* CONACYT (México), grant N 219614. From 2014 to 2017. Principal investigator: Konstantin Starkov.

• *Grup de recerca en matemàtica col·laborativa del CRM (CRM research group on collaborative mathematics),* AGAUR, Generalitat de Catalunya, grant 2014SGR1307. From 2014 to 2016. Principal investigator: Álvaro Corral.

• *Mathematical modelling of biological populations with complex structure,* MICINN grant MTM2011-29342. From 2012 to 2015. Principal investigator: Tomás Alarcón.

• *Recerca Matemàtica Col·laborativa (Interdisciplinary Research in Mathematics)*, "la Caixa" Foundation project, for five years (Joaquim Bruna).

□ Activity in research training

• Clàudia Toral Fernández (Final Year BSc honour project, UAB, July 2015): *The spread of two viral types on a leaf.*

• Nitin Lalwani (MSc thesis, UPC, 2015): *Mathematical modelling of plant virus*.

• Anel Nurtay (PhD student, from March 2015, CRM & Universitat Autònoma de Barcelona): *Modelling of biological evolution: development of specialization in biological species*.

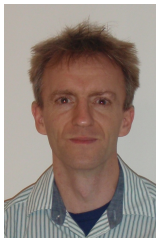
□ Scientific activities

Scientific activities organised

• 2nd International Conference on Mathematics and Computers in Sciences and Industry (MCSI 2015), Sliema, Malta, August 17^{th} to 19^{th}, 2015, www.mcsi-conf.org.

- International Conference on Risk Analysis ICRA 6 / RISK 2015, Barcelona, May 26^{th} to 29^{th}, 2015, `http://www.uoc.edu/portal/en/symposia/icra6/committees/index.html`.
- The 2015 International Conference on Biology and Biomedical Engineering Vienna, Austria, March 15^{th} to 17^{th}, 2015, `http://www.inase.org/conferences/2015/vienna/bbe.htm#tpc`.
- The 2015 International Conference on Pure Mathematics - Applied Mathematics Vienna, Austria, March 15^{th} to 17^{th}, 2015, `http://www.inase.org/conferences/2015/vienna/pm-am.htm`.
- The 2015 International Conference on Biology and Biomedicine Barcelona, Spain, April 7^{th} to 9^{th}, 2015 `http://www.inase.org/conferences/2015/barcelona/bio.htm`.
- The 2015 International Conference on Pure Mathematics, Applied Mathematics and Computational Methods, Zakynthos Island, Greece, July 16^{th} to 20^{th}, 2015 `http://www.inase.org/conferences/2015/zakynthos/pmamcm.htm`.
- Applied Mathematics, Computational Science & Engineering (AMCSE 2015) Agios Nikolaos, Crete, Greece, October 17^{th} to 19^{th}, 2015, `http://www.amcse.org/index.html`.

Tim Myers



My activities are currently split into three main sections: Researchs, Teaching and supervisions, External activities (obviously a very loose term).

My research is become increasingly focussed on the nanoscale. I have worked on developing rigorous mathematical models for nanoscale phase change and nanofluid flow. Together with PhD, Masters and Undergraduate students I have worked on a variety of related topics: Nanoscale heat flow, Nanocrystal growth, Phase change of nanofluids, Kirkendall effect, Nanofluid based direct absorption solar cells, etc. Much of this work is guided by the experimental work carried out by the Inorganic Nanoparticles group and the Statistical Physics group at UAB.

I continue to teach at the Universitat Politècnica de Catalunya, taking part in the course *Models Matematics de la Tecnologia*. I have supervised undergraduate students in their final year projects, both from UAB and UPC as well as Masters students from UPC. I also supervised 2 PhDs at the CRM and joint supervisor of a student at the University of Limerick (main supervisor, Dr Sarah Mitchell).

My external activities include being the Short Term Scientific Manager and member of the Management Committee for the EU COST Action TD1409, Mathematics for Industry Network and a member of the council for the European Consortium for Mathematics in Industry. I have editorial duties with the Elsevier journal, Applied Mathematical Modelling and with the RSME Springer book series. I have carried out too many reviews, for example for Agencia Nacional de Evaluación y Prospectiva, Generalitat de Catalunya Tecnio programme, King Abdul Aziz Highly Cited program, Belgian Research Foundation FWO as well as a UK Phd and reviews for a multitude of journal.

Publications

Articles

- V. Cregan, T.G. Myers, *Modelling the efficiency of a nanofluid direct absorption solar collector*, International Journal of Heat and Mass Transfer **90**, 505–514 (2015).
- T.G. Myers, F. Font Martínez, *On the one-phase reduction of the Stefan problem with a variable phase change temperature*, International Communications in Heat and Mass Transfer **61**, 37–41 (2015).
- F. Font, T.G. Myers, S.L. Mitchell, *A mathematical model for nanoparticle melting with density change*, Microfluidics and Nanofluidics **18 (2)**, 233-243 (2015).
- T.G. Myers, F. Font Martínez, V. Cregan, M.M. MacDevette, *Nano-matemàtiques: modelització matemàtica a la nanoescala*, Butlletí de la Societat Catalana de Matemàtiques **29(2)**, 115–134 (2015).
- T.G. Myers, S.L. Mitchell, *Una anàlisi matemàtica del moviment d'una pilota de futbol durant el vol*, Butlletí de la Societat Catalana de Matemàtiques **30(2)**, 167–191 (2015).

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.

Activity in research training

Supervision of research students

Undergraduate project supervision

- Carles Riera, UAB, *The hyperbolic heat equation*, September 2014 – July 2015.
- Sergio González, UAB, *Modelling flow enhancement in carbon nanotubes*, September 2014 – February 2015.
- Benat Irastorza, UPC, *Heat transfer and phase change at the nanoscale*, December 2014 – July 2015.
- Maria de Araceli Morales, UPC, *Image classification for early detection of lung cancer*, December 2014 – September 2015 (Main supervisor Vicent Ribas).
- Adrià González, UPC, *One-phase reduction of Stefan problems*, September 2015 – .
- Marc Marugán, UAB, *Nanoscale heat transfer,* September 2015 – .
- Gideon Fareo (Lecturer, U. Witwatersrand, CRM Dev-Math program).

Master's project supervision

- Marc Calvo, *Nanoparticle melting* UAB, October 2014 – September 2015.

PhD supervision

- Helena Ribera, PhD project: *Mathematical modelling of nanoparticle evolution*, September 2014 – .
- 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 – .

Postdoc supervision

• Vincent Cregan, "la Caixa" Post-doc, *Nanoparticle evolution*, September 14 – .

□ Teaching activity

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

□ Scientific activities

Organisation

• Short Term Scientific Manager & member of Management committee EU COST Action, TD1409 Mathematics for industry network (MI-NET), see `http://www.cost.eu/COST_Actions/TDP/Actions/TD1409`.
• Council member of the *European Consortium for Mathematics in Industry*, see `http://www.ecmi-indmath.org/`.
• Scientific committee *Nanomath* 2016, Toulouse 2016, see `http://nanomath2016.sciencesconf.org/`.
• Scientific committee *European Consortium for Mathematics in Industry Conference*, Santiago de Compostela 2016.
• President for 115th *European Study Group with Industry*, Barcelona 2016.
• Organiser of *An introduction to* seminar series, Faculty of Math. & Stats., Universitat Politècnica de Catalunya, where experts in a field give an introductory lecture to a general audience.

Participation

Invited lectures in conferences

• T.G. Myers, *Continuum mathematics at the nanoscale*, Industrial Mathematics Initiative, Korea, Advanced Institute for Science and Technology, November 2015.
• T.G. Myers, *Continuum mathematics at the nanoscale*, 110th European Study Group with Industry, University of Limerick, June 2015.
• T.G. Myers, Invited international expert, South African Mathematics in Industry Study Group, African Institute for the Mathematical Sciences, Cape Town, South Africa, January 2015.

□ Other activities

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

- Member of Editorial Board, Mathematics in Industry Case Studies.
- PhD examiner, School of Mechanical Engineering, University of Leeds.
- Evaluator for Tecniospring Fellowships, Generalitat de Catalunya.
- Evaluator for King Abdul Aziz University, HiCi Distinguished Professor Visiting Programme.
- Evaluator for Agencia Nacional de Evaluación y Prospectiva.
- Evaluator for Belgian Research Foundation FWO.
- Research Stay: July (4 weeks), Department of Mathematics, Vrije Universiteit, Netherlands.
- Referee for Applied Mathematical Modelling; Cold Region Science and Technology; International Journal of Thermal Science; JIMA Journal of Applied Mathematics, etc.

Luis Ortiz

During 2015, my research activity has been focused on the development of new efficient numerical methods to price financial options as well as on the enhancement of risk measurement techniques. Within the option pricing framework, the point of departure is the discounted expected pay-off pricing formula, and my methods belong to the class of numerical integration methods. The Fourier transform of the density that we encounter in these kind of problems is typically known for most of the interesting processes in finance, and we recover the density by means of wavelets. Three projects were undertaken on this field, namely high-dimensional models with Duy-Minh Dang, Bermudan option pricing with Cornelis W. Oosterlee and Asian option pricing with Elisa Alòs.

Regarding the first, I carried out a ten-weeks research stay at the University of Queensland. The robustness, accuracy and speed during the pricing of options under high-dimensional models dynamics are important issues that make this topic a very challenging field. I worked on market risk measurement with stochastic liquidity horizons with Gemma Colldeforns as well as on the pricing of spread options.

I served as a reviewer for well known international journals on quantitative finance an I was appointed a member of the Editorial Board of the Journal of Computational Finance.

Regarding research dissemination, I delivered several seminars at international level and organized an international and interdisciplinary workshop on quantitative finance. My teaching activity within this year comprises a course on quantitative risk management for undergraduate and master students in a summer school at the CRM and a course on computational risk management for master students at the CRM.

□ Publications

Articles

- L. Ortiz-Gracia, *Efficient wavelets-based valuation of synthetic CDO tranches*, to appear in Journal of Computational and Applied Mathematics (2015).
- L. Ortiz-Gracia, C.W. Oosterlee, (2015). *A highly efficient Shannon wavelet inverse Fourier technique for pricing European options*, to appear in SIAM Journal on Scientific Computing (2015).

Preprints

- S.C. Maree, L. Ortiz-Gracia, C.W. Oosterlee, *Pricing early-exercise and discrete barrier options by Shannon wavelet expansions*, submitted for publication (2015).

Books or book chapters

- S.C. Maree, L. Ortiz-Gracia, C.W. Oosterlee, *Fourier and wavelets option pricing methods* in High-Performance Computing in Finance: Problems, Methods and Solutions. To appear (2015).

□ Research projects

- *Grup de Recerca en Matemàtica Col·laborativa del CRM*, Generalitat de Catalunya, SGR-01307. From 2014 to 2016 P.I.: Álvaro Corral, Centre de Recerca Matemàtica.
- *Stochastic Finance*, Ministerio de Economía y Competitividad (MINECO). From 2014 to 2016. P.I.: José Manuel Corcuera Valverde, Universitat de Barcelona.

□ Activity in research training

Supervision of research students

PhD supervision

- Gemma Colldeforns (Universitat Autònoma de Barcelona), starting date October 1st, 2014, in co-direction with Cornelis W. Oosterlee. PhD project: *Wavelets-based methods to compute solutions of BSDEs arising in Finance*.

MSc supervision

- Stef Maree (TU Delft, Delft, the Netherlands). Project: *Numerical pricing of Bermudan options with Shannon wavelet expansions*, February 2015 – July 2015.

BSc supervision

- Carles Pérez (Universitat Autònoma de Barcelona). Project: *Pricing options: from binomial trees to Black-Scholes formula*, September 2014 – July 2015.

□ Teaching activity

- Graduate level: First term 2015–2016: *Computational Risk Management*, Master of Mathematics in Finance, Universitat Autònoma de Barcelona.
- Undergraduate level:Third term 2014–2015: *Matemàtiques III*, Degree in Economics, Universitat Pompeu Fabra.

Lectures and short courses

- October 2014: *Scientific Computing in Financial Risks*, summer school on Financial Mathematics, CRM.

□ Scientific activities

Organisation

- Organizer of the *Interdisciplinary Workshop on Quantitative Finance*, CRM, June 25^{th} and 26^{th}, 2015.
- Coordinator of the *Seminar Cycle on Quantitative Finance* at Centre de Recerca Matemàtica, Barcelona, Spain.

Seminars

- L. Ortiz-Gracia. *Problems and Wavelets-Based Solutions in Computational Finance*. Colloquium of the Mathematics Department, School of Mathematics and Physics, University of Queensland, Australia, November 2^{nd}, 2015.
- L. Ortiz-Gracia. *A New Look to the Delta-Gamma Approach*, Riskcenter, Faculty of Economics, University of Barcelona, March 18^{th}, 2015.

Research stays

- University of Queensland, Brisbane, Australia, September 2015 (10 weeks).

Courses attended

- *Conic Finance Explained and Applied*. Advanced course delivered by Wim Schoutens at Riskcenter, University of Barcelona, July 15^{th}, 2015.

□ Technology transfer

- Scientific project for the Barcelona Graduate School of Economics on the implementation of Monte Carlo methods for the traditional stochastic volatility models, models with fractional Brownian noise and models with jumps.

Alex Roxin

My research group has been focused on three main problems.

1. The first is to understand the detailed statistical structure of cortical networks and the second is to investigate the neuronal basis of memory consolidation. Regarding the first, it is known from electrophysioligical experiments recording from several neurons simultaneously in cortical tissue, that the patterns of connectivity are inconsistent with the underlying network being random in the Erdös-Renyi sense. That is, the probability of connection between any two neurons, called the sparseness, is not a sufficient statistic to describe the types of connectivity patterns seen in real data. Therefore we have been exploring other possible types of networks which can come closer to matching the data. Some candidate models are: clustered networks, spatially in homogeneous networks and networks with a large degree of heterogeneity in the number of incoming and outgoing connections. This work has been carried out by my PhD student Marina Vegué.

2. Our work on memory consolidation has involved two different yet related projects. The first is to encode patterns of activity in a neuronal network by ensuring that they are attracting fixed points of the dynamics. This follows the classical work of John Hop field and others. In our case, we are attempting to modify the network models to make them more biologically plausible, e.g., by separating neurons into excitatory and inhibitory classes. We have also gone beyond the classical calculation

of memory capacity to consider the basins of attraction of the stable fixed points, a crucial property for recall, or for re-activition during memory consolidation. The second is more closely related with electrophysiological data from rodents involved in spatial navigation and exploration. It is well established that in the hippocampus of the rodent, some neurons, so-called place cells, are active when the animal traverses a particular spatial location in a given environment. We consider a network of place cells which learn to encode the memory of a given environment via realistic spike-timing dependent synaptic plasticity rules. Specifically, place cells which encode for nearby locations become strongly coupled, while neurons which encode for far-away locations are weakly coupled and interact mainly via inhibitory inter-neurons. In this way a spatially structured network emerges which can support an active bump of activity, indicating the memory of a position in a specific environment. The work on these two projects is being carried out by my PhD student Bernat Rovira and postdoc Panagiota Theodoni respectively.

3. In collaboration with the group of Jaime de la Rocha at IDIBAPS, Genís Prat has been studying the role of stimulus fluctuations in perceptual decision-making tasks. Specifically, he has discovered that increasing the level of stimulus noise in attractor models can in some cases improve performance; this happens when an incorrect decision is first made and then fluctuations generate a change-of-mind. He is now testing this finding by running psychophysics experiments with human subjects.

Publications

Articles

- J.P. Ramírez-Mahaluf, A. Roxin, H.S. Mayberg, A. Compte, *A computational model of major depression: the role of glutamate dysfunction on cingulo-frontal network dynamics*. Cerebral Cortex, 1–20, (2015).doi:10.1093/bhv249.
- Ernest Montbrió, Diego Pazó and Alex Roxin, *Macroscopic description for networks of spiking neurons*. Phys. Rev. X **5**, 021028, (2015).
- K. Wimmer, A. Compte, A. Roxin, D. Peixoto, A. Renart, J. de la Rocha, *Sensory integration dynamics in a hierarchical network explains choice probabilities in cortical area MT*. Nat. Comm. **6**, 6177, (2015), doi:10.1038/ncomms717.

Research projects

- *Codificación y consolidación de la memoria: un estudio computacional,* MINECO BFU2012-33413. From January 2013 to December 2015. Principal investigator: Alex Roxin.
- *Network Dynamics,* SGR Grup Emergent 2014SGR 1265. From 2014 to 2017. Principal investigator: Albert Compte.

Activity in research training

- Panagiota Theodoni, Post-doctoral researcher (CRM).
- Bernat Rovira, PhD student (CRM).
- Genís Prat, PhD student (CRM-IDIBAPS).
- Narani van Laarhoven, PhD student (CRM-IDIBAPS).
- Marina Vegué, PhD student (CRM).

□ Scientific activities

Participation in scientific activities

Invited lectures in conferences

- A. Roxin. Contributed Talk: *The encoding of episodic memory via spike-timing-dependent plasticity: a computational model* international conference on system level approaches to neural engineering (NETT). Barcelona, September 2015.
- A. Roxin, P. Theodoni. Poster: *The encoding of episodic memory via spike-timing-dependent plasticity: a computational model*. Society for Neuroscience Annual Meeting. Chicago, October 2015.
- A. Roxin, Marina Vegué. Poster: *Different models of network connectivity can explain "non-random" features of cortical microcircuits*. Society for Neuroscience Annual Meeting. Chicago, October 2015.
- A. Roxin, G. Prat. Poster: *Dynamics of evidence integration in canonical models of preceptual decision making*. Society for Neuroscience Annual Meeting. Chicago, October 2015.
- A. Roxin, Panagiota Theodoni. Poster: *The encoding of episodic memory via spike-timing-dependent plasticity: a computational model*. Neural Coding, Computational and Dynamics (NCCD) Conference. Bilbao, September 2015.
- A. Roxin, G. Prat. Poster: *Dynamics of evidence integration in canonical models of perceptual decision making*. Neural Coding, Computational and Dynamics (NCCD) Conference. Bilbao, September 2015.
- A. Roxin, Marina Vegué. Poster: *Different models of network connectivity can explain "non-random" features of cortical microcircuits*. Neural Coding, Computational and Dynamics (NCCD) Conference. Bilbao, September 2015.
- A. Roxin, P. Theodoni. Contributed Talk: *The encoding of episodic memory via spike-timing-dependent plasticity: a computational model*. BARCSYN, June, 2015.

Sergey Tikhonov

During 2015, my research activities include the following topics. I continue investigating, with Andrey Bondarenko and Dmitry Gorbachev, sharp Remez inequalities. Jointly with Feng Dai and Han Feng (both from the University of Alberta), I have finished the project on the sharp reverse Hölder inequality for spherical harmonics on the unit sphere. Together with Amiran Gogatishvili, Mirek Opic, and Walter Trebels we have been investigating sharp Ulyanov-type inequalities between different function spaces.

Jointly with Yury Kolomoitsev, I studied sharp (L_p, L_q) inequalities for smoothness characteristics in the case of $0 < p < 1$. 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.

Besides, I have served as a supervisor for four PhD students: Néstor Costa, Alberto Debernardi, Ainur Jumambaeva, and Askhat Mukanov. Néstor 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 moduli of smoothness of the generalized Liouville derivatives. Askhat Mukanov investigated different types of convergence of trigonometric series.

I have been an editor of two books published in the series Advanced Courses in Mathematics CRM Barcelona, Birkhäuser. I have served as an editor of the following journals: Journal of Mathematical Analysis and Applications, Abstract and Applied Analysis, Bulletin of Mathematical Analysis and Applications, and The Scientific World Journal.

I was a co-organizer of the Session "Fourier analysis and approximation theory" at the 10th International ISAAC congress and of the Banff-CMO workshop "Applied Functional Analysis", Oaxaca, México.

I have given several talks in different conferences including Sweden (April), Mexico (Juny), and USA (July). Moreover, I have presented my research in Colloquium talks in Delft University of Technology, The Netherlands, Universität Trier, Germany, and Florida International University, USA. Besides, I have given talks in the Barcelona Analysis Seminar, Jena's seminar "Function spaces", and GAMA Seminar in Madrid.

□ Publications

Articles

- P. Glazyrina, S. Tikhonov, *Jacobi weights, fractional integration, and sharp Ulyanov inequalities*, J. Approx. Theory **195**, 122–140, (2015).
- E. Nursultanov, M. Ruzhansky, S. Tikhonov, *Nikolskii inequality and functional classes on compact Lie groups*, Functional Analysis and Its Applications **49(3)**, 226–229, (2015), (arXiv:1507.07111).
- E. Nursultanov, S. Tikhonov, *Weighted norm inequalities for Riesz potential in the Lorentz spaces*, Potent. Analysis. **42(2)**, 435–456, (2015), (arXiv:1307.0206).
- A. Bondarenko, S. Tikhonov, *Bernstein inequalities with nondoubling weights*. To appear in J. Eur. Math. Soc., arXiv:1308.5818.
- F. Dai, S. Tikhonov, *Weighted fractional Bernstein's inequalities and their applications*. To appear in J. d'Analyse Math., arXiv:1307.0207.
- L. De Carli, D. Gorbachev, S. Tikhonov, *Pitt inequalities and restriction theorems for the Fourier transform*. To appear in Revista Matem. Iberoamericana (2015), arXiv:1509.01210.
- D. Gorbachev, V. Ivanov, S. Tikhonov, *Pitt's inequalities and uncertainty principle for generalized Fourier transform*. To appear in International Mathematics Research Notices, arXiv:1507.06445.
- E. Nursultanov, M. Ruzhansky, S. Tikhonov, *Nikolskii inequality and Besov, Triebel-Lizorkin, Wiener and Beurling spaces on compact homogeneous manifolds*. To appear in Annali della Scuola Normale Superiore di Pisa, Classe di Scienze, arXiv:1403.3430.
- M. Ruzhansky, S. Tikhonov, *Methods of Fourier analysis and approximation theory*, in Applied and Numerical Harmonic Analysis, Birkhäuser 1–18 (2016).

• F. Dai, H. Feng, S. Tikhonov, *Reverse Hölder's inequality for spherical harmonics*, Proc. Amer. Math. Soc. **144(3)**, 1041–1051, (2016), `arXiv:1408.1877`.

• D. Gorbachev, V. Ivanov, S. Tikhonov, *Sharp Pitt inequality and logarithmic uncertainty principle for Dunkl transform in* L^2, J. Approx. Theory **202**, 109–118, (2016), `arXiv:1505.02958`.

Books or book chapters

• M. Ruzhansky, S. Tikhonov, *Methods of Fourier Analysis and Approximation Theory*. Applied and Numerical Harmonic Analysis, 226 pp. Springer Basel (Birkhäuser) (2016), ISBN: 978-3-319-27466-9.

• F. Dai, Y. Xu, S. Tikhonov, *Analysis on* h*-harmonics and Dunkl transforms*. Advanced Courses in Mathematics CRM Barcelona. Springer Basel (Birkhäuser) (2015).

• V. Temlyakov, S. Tikhonov, *Sparser approximation with bases*. Advanced Courses in Mathematics CRM Barcelona. Springer Basel (Birkhäuser) (2015).

□ Research projects

• *Methods of constructive approximation and Fourier analysis*. Ministerio de Ciencia e Innovación MTM2014-59174-P. From 2015 to 2017. P.I.: Sergey Tikhonov.

• *Optimal methods of digital signal compression and recovery*. Grant of Ministry of Education and Science of the Republic of Kazakhstan. From 2015 to 2017.

• *Grup de teoria de funcions de la UAB/UB*, 2014SGR-289. Grups de recerca (SGR-DGR), the Generalitat de Catalunya. From 2014 to 2016.

□ Activity in research training

Supervision of research students

PhD supervision

• Néstor Costa (doctorate student at the CRM, supported by CRM).

• Alberto Debernardi (doctorate student at the CRM and UAB, supported by CRM).

• Ainur Jumabayeva (doctorate student at the CRM and UAB, partially supported by CRM).

• Askhat Mukanov (doctorate student at the CRM and UAB, partially supported by CRM).

□ Scientific activities

Participation

Invited lectures in conferences

• S. Tikhonov. Conference in Analysis in Honor of Yoram Sagher, Florida Atlantic University, USA. July 2015.

• S. Tikhonov. *Weighted Bernstein inequalities*. CMO-BIRS 2015, Applied Functional Analysis, Oaxaca, Mexico. July 2015.

• S. Tikhonov. Workshop on Function Spaces, Harmonic Analysis, and Related Topics, Karlstad University, Spain. April 2015.

Colloquium talks

• S. Tikhonov. Delft University of Technology, The Netherlands.
• S. Tikhonov. Universität Trier, Germany.
• S. Tikhonov. Florida International University, USA.

Seminars

• S. Tikhonov. *Function spaces*, Mathematical Institute, Jena, Germany, December 2015.
• S. Tikhonov. *Function spaces*, Mathematical Institute, Jena, Germany, October 2015.
• S. Tikhonov. *GAMA Seminar* Universidad Carlos III de Madrid, May 2015.
• *Barcelona Analysis Seminar*, Barcelona, March 2015.
• S. Tikhonov. *Inequalities for moduli of smothness* Approximation Theory Seminar, Steklov Mathematical Institute, Moscow, Russia, October 2014.

Research stays

• 12/15: Research in Pairs Program, Mathematisches Forschungsinstitut Oberwolfach, Germany.
• 09/15: Invited Researcher, Institute of Mathematics of Acad. of Sciences, Prague, Czech Republic.

□ Other activities

• Humboldt Research Fellowship for Experienced Researchers (granted by the Alexander von Humboldt Foundation).
• Member of Editorial board:

  · Analysis Mathematica;

  · Journal of Mathematical Analysis and Applications;

  · Abstract and Applied Analysis, Bulletin of Mathematical Analysis and Applications;

  · The Scientific World Journal.

• Managerial Activities:

  · Co-organizer of the Session *Fourier analysis and approximation theory* at the 10th International ISAAC congress (International Society for Analysis, Applications and Computations), Macao, China, August 3^{rd} to 8^{th}, 2015

  · Co-organizer of the Banff-CMO Workshop *Applied Functional Analysis*, Oaxaca, Mexico, June 28^{th} to July 3^{rd}, 2015

Anthony Blanc

This is a report on my stay at the Centre de Recerca Matemàtica, CRM, Barcelona as a postdoctoral fellow of the European Post-Doctoral Institute for Mathematical Sciences (EPDI) from November 1^{st}, 2014 to June 30^{th}, 2015.

During my seven months stay at the CRM, I have worked on several directions around my research project in *categorical geometry*, and have benefited from many interactions with several mathematicians of the Barcelona area and within the special program IRTATCA at the CRM. Let me recall briefly the setting of my research, and then enumerate the activities I took part in during my stay.

□ Publications

Preprints

- A. Blanc, *Invariants topologiques des Espaces non commutatifs*. arXivpreprintarXiv:1307.6430 (2013), PhD thesis in french, Université Montpellier.
- A. Blanc, *Topological K-theory of complex noncommutative spaces*. arXivpreprintarXiv:1211.7360. To appear in Composition Mathematica (2013).
- B. Keller, *On differential graded categories*. International Congress of Mathematicians. Vol. II, Eur. Math. Soc., Zürich, 2006, 151–190.
- L. Katzarkov, M. Kontsevich, and T. Pantev, *Hodge theoretic aspects of mirror symmetry*. Arxiv preprint arxiv:0806.0107 (2008).
- M. Kontsevich, *Homological algebra of mirror symmetry*. arXiv preprint alg-geom/9411018 (1994).
- B. Töen, *Derived algebraic geometry and deformation quantization*. arXivpreprintarXiv:1403.6995 (2014).
- C. Voisin, *The Griffiths group of a general Calabi-Yau threefold is not finitely generated*. Duke Mathematical Journal **102**(1) (2000), 151.

□ Activity in research training

Supervision of research students

Undergraduate project supervision

- (with Carles Casacuberta) Thesis of Roderic Guigó Corominas.

Participation

Communications in conferences

- A. Blanc, *Lattice conjecture: statement and examples*. Algebraic Topology Seminar, Universitat Autònoma de Barcelona, December 2014.

• A. Blanc, *Lectures on dg-categories: from homotopy theory to Hodge theory*. Mini-course at the Institut de Matemàtica de la Universitat de Barcelona, January 2015. Poster visible at `http://www.crm.cat/en/Activities/Documents/Curs_Blanc_2015%20(2).pdf`.
• A. Blanc, *Deformation theory of dg-categories*. Workshop: Brave New Algebra: opening perspectives, April 2015.

Invited lectures in conferences

• Advanced Course on Reemerging Methods in Commutative Algebra and Representation Theory. February 9^{th} to 13^{th}, 2015.
• Advanced Course on Building Bridges between Algebra and Topology. April 13^{th} to 17^{th}, 2015.
• Workshop on Brave New Algebra: opening perspectives. April 20^{th} to 24^{th}, 2015.
• Conference on Opening Perspectives in Algebra, Representations and Topology. May 25^{th} to 29^{th}, 2015.

□ Other activities

• In November and December 2014, together with Abdó Roig Maranges (PhD student and assistant professor at the Universitat Politècnica de Catalunya) we organized a weekly seminar *The Griffiths Group Seminar* at the CRM.
• I organized the Weekly Seminar outside of the conference weeks, where visitors within the program were invited to give talks on their subjects of interests. Activity visible at `http://www.crm.cat/en/Activities/Curs_2014-2015/Pages/IRTATCA-Weekly-Seminar.aspx`.

Juan Calvo

The main goal of the project under which Juan Calvo was recruited is to produce a multiscale model for kidney cancer and angiogenesis. This involves the theoretical formulation of such a model, a careful mathematical analysis of it, its implementation as a computational tool and its calibration against relevant data coming from image analysis and blood analysis bio-markers. Fundamentals steps have been carried during the aforementioned period towards a computational implementation of a multiscale model for the proliferation of kidney tumors, laying also the foundations of the required framework for performing calibration against data, while some stages of the theoretical analysis of the model have been performed along our advancements on the previous points.

□ Publications

Articles

• J. Calvo, J. Campos, V. Caselles, O. Sánchez, and J. Soler, *Flux saturated porous media equations and applications*. EMS Surveys in Mathematical Sciences **2**(1), 131–218 (2015).

• J. Calvo, *Analysis of a class of diffusion equations with a saturation mechanism*. SIAM J. Math. Anal. **47**(4), 2917–2951 (2015).
• J. Calvo, J. Campos, V. Caselles, O. Sánchez, and J. Soler, *Pattern formation in a flux limited reaction-diffusion equation of porous media type*. To appear in Inventiones Mathematicae (already available online in the journal webpage) (2016).

Preprints

• J. Calvo, M. Novaga, and G. Orlandi, *Parabolic equations in time dependent domains*. CRM preprint 1204 (May 2015).

Books or book chapters

• O. Sánchez, J. Calvo, C. Ibañez, I. Guerrero, and J. Soler, *Modeling Hedgehog signaling through flux-saturated mechanisms*. In "Hedhehog Signaling Protocols"", Methods in Molecular Biology 1322, Springer. Natalia A. Riobo (Ed) 2015, pp 19–33.

□ Activity in research training

Supervision of research students

Undergraduate project supervision

• (with Andrei Korobeinikov) Co-mentorship of Silvia Pagliarini (ongoing Master Thesis).

□ Scientific activities

Scientific activities organised

• Member of the Organizing & Scientific Committee of the *Summer School on nonlinear pde's and applications to image analysis*. Centre de Recerca Matemàtica, Bellaterra, Barcelona, July 20^{th} to 24^{th}, 2015.

Participation in scientific activities

Invited lectures in conferences

• J. Calvo, *Parabolic equations on non-cylindrical domains*. Espalia (3rd Edition), Roma, June 17^{th} to 19^{th}, 2015.

Communications in conferences

• J. Calvo, *The smoothing effect of the one-dimensional relativistic heat equation*. JISD 2015: 13th Workshop on interactions between dynamical systems and partial differential equations, Barcelona, June 1^{st} to 5^{th}, 2015.

Seminars

• J. Calvo, *Mathematical modelization in neurodegenerative diseases*. Dipartimento di Informatica, University of Verona, November 13^{th}, 2015.

• J. Calvo, *Singular traveling waves and non-linear reaction-diffusion equations*. Dipartimento di Matematica, University of Padova, November 11^{th}, 2015.

Research stays

• January 18^{th} to 22^{nd}, 2016, Laboratoire Jacques-Louis Lions, Université Pierre et Marie Curie.
• November 12^{th} and 13^{th}, 2015, Dipartimento di Informatica, University of Verona, Verona.
• November 3^{rd} to December 4^{th}, 2015, Departamento de Matemática Aplicada, Universidad de Granada.
• European Study Group with Industry: ESGI 2016. Barcelona (Centre de Recerca Matemàtica), January 25^{th} to 29^{th}, 2015.
• First BGSMath Junior Meeting. Universitat de Barcelona, December 11^{th}, 2015.
• Advanced Course on Geometric Analysis. Barcelona (Centre de Recerca Matemàtica), September 14^{th} to 18^{th}, 2015.
• Introduction to Python. Barcelona (Centre de Recerca Matemàtica), September 8^{th} to 10^{th}, 2015.
• V Summer School on Statistical Physics of Complex and Small Systems. Barcelona (Centre de Recerca Matemàtica), July 6^{th} to 17^{th}, 2015.
• Biomat 2015, Emergence and self-organization in social and biological systems. Participación: asistente. Granada, May 27^{th} to 29^{th}, 2015.
• IV Jornada Complexitat.cat. Tarragona, May 25^{th}, 2015.

Vincent Cregan

In 2015 the main focus of my research was in the areas of nanoscience and phase change phenomena. I was involved in several projects with members of the Industrial Mathematics Research Group (IMRG) and our external collaborators.

In the first project, with the Inorganic Nanoparticles Group (ING) in the Catalan Institute of Nanoscience and Nanotechnology, the aim was to construct a model for a method to synthesise monodisperse nanoparticles from solution. The ability to produce nanoparticles in a predefined size range is critical for many applications. I used various modelling techniques including perturbation theory and numerics to describe different aspects of the ING's synthesis method. Specifically, I concentrated on the mechanisms of size focusing and Ostwald ripening. The results thus far have shown good agreement with experimental data.

Secondly, I have been developing a theoretical description of the boiling crisis phenomenon. This process is observed in high temperature applications where phase change occurs, and can lead to an undesirable decrease in the heat transfer coefficient. The resulting model consists of elements from fluid flow, heat transfer and phase change. In addition to other IMRG members, I have been collaborating with Professor Brian Wetton (University of British Columbia) and Dr. Adewunmi Fareo (University of the Witwatersrand) on this project. We have been using a mixture of analytical methods and numerical techniques to generate results.

I extended the previous research of my supervisor, Professor Tim Myers, on the topics of phase change materials (PCMs) and contact melting. PCMs absorb and release thermal energy during a phase change, and are used in numerous applications (e.g., air conditioning units, solar water-heating systems, smart textiles, etc.). The new, novel aspect of my research was to use the heat balance integral method to demonstrate how temperature-dependent thermal conductivity and viscosity affect the melting process.

In addition to the discussed projects, I have also been involved with several other activities. I began work with members of the IMRG group on a project to clarify the heat transfer properties of nanofluids. After publishing a paper in the International Journal of Heat and Mass Transfer on my research pertaining to nanofluid-based direct absorption collectors, I started helping Gary O'Keefe, a PhD student from the University of Limerick. Gary is extending my previous analysis of planar collectors to consider parabolic collectors.

□ Publications

Articles

- V. Cregan and T.G. Myers, *Modelling the efficiency of a nanofluid direct absorption solar collector*. International Journal of Heat and Mass Transfer **90**, 505–514 (2015).

Preprints

- V. Cregan, T.G. Myers, S.L. Mitchell, H. Ribera Ponsa, and M. Calvo Schwarzwälder, *Nanoparticle evolution via the precipitation method*. (In preparation).
- V. Cregan, J. Williams, and T.G. Myers, *Contact melting of a phase change material with linear temperature-dependent thermal conductivity and viscosity*. (To be submitted).
- T.G. Myers, H. Ribera Ponsa, and V. Cregan, *Does mathematics contribute to the nanoflid debate?*. (In preparation).

Scientific reports

- G. Hocking, D.A. Burton, V. Cregan, and F. Font, *Stress effects of silica particles in a semiconductor package molding compound*. Proceedings of the Study Group Mathematics with Industry 110 (Limerick). 2015.

Other

- V. Cregan, *Modelling the efficiency of a nanofluid-based direct absorption collecto*. European Consortium for Mathematics in Industry Blog. June 2015.

□ Scientific activities

Participation in scientific activities

Invited lectures in conferences

- V. Cregan, Invited talk at the 110^{th} European Stud Group with Industry. University of Limerick, June 28^{th} to July 3^{rd}, 2015.

Adewunmi Gideon Fareo

I visited CRM for the period September 2014 – July 2015, under the DevMath Programme.

Boiling is a phase change process in which there is a formation of vapour bubbles either at a heating surface or in a superheated liquid layer next to the surface. These vapour bubbles form at nucleation sites, the number and location of which depend on the surface roughness of the heating surface, fluid properties and operating conditions. Film boiling, on the other hand, is a phenomena which occurs at a boiling stage, and in which a continuous layer of vapour covers the heating surface thereby keeping the liquid from making contact with the heating surface. Since water vapour conducts heat more poorly than does liquid water, the transfer of energy from the heating surface is diminished. This insulating property of vapour reduces the heat transfer coefficient in between the heating surface and the fluid medium.

In industrial processes, film boiling is encountered in various practices which include metallurgical, chemical and power engineering, as well as in nuclear power plants where water-based coolants are used. In general the formation of a vapour layer reduces heat transfer to the liquid, resulting in higher temperatures at the boundaries and possible overheating and melting of the cooling pipes. In the case of nuclear power plants, the vapour layer that forms does not absorb neutrons as well as liquid water does, even though neutron absorption is a major factor in achieving the much desired slowing down of nuclear reactions. Film boiling was a contributing factor in the Chernobyl nuclear disaster.

The problem of heat transfer in film boiling has formed the object of much theoretical research. Because the physics of boiling is highly complex, in that it involves the continuous coupled interaction between the fluid and heat variables, so far there has been no comprehensive theoretical framework developed that accurately predicts the boiling heat transfer coefficient.

In our research project, we have considered the problem of advective flow of water in a two-dimensional channel, whose boundaries are heated by a prescribed flux. The models describing the fluid and heat flow consisted of the lubrication equations, the heat equation with advection and the Stefan condition for conservation of energy at the fluid-vapour interface. Our ultimate goal in this initial project was to derive simple analytical expressions for the heat transfer coefficient, before and after film boiling. In later work we hope to extend the analysis in order to fully model the film boiling process and so determine the key factors. In this way we hope to be able to provide recommendations for industrial practitioners on ways to tackle vapour film formation.

Henri Martikainen

I visited CRM for the period September 14^{th} to October 2^{nd}, 2015. My main contact was Dr. Mihalis Mourgoglou. I also discussed and worked with Dr. Jonas Azzam and Professor Xavier Tolsa. This was a pure research visit.

We worked on a new, novel approach to general local Tb theorems. These are theorems, which characterize the boundedness of singular integral operators using very weak testing conditions. There is a big open problem by S. Hofmann on this area, and we made significant progress on this. Two preprints, which have been submitted to journals, came out of this research visit.

Publications

Preprints

- H. Martikainen, M. Mourgoglou, and X. Tolsa, *Improved Cotlar's inequality in the context of local Tb theorems*. Preprint, `http://arxiv.org/abs/1512.02950`, (2015).
- H. Martikainen, M. Mourgoglou, and E. Vuorinen, *A new approach to non-homogeneous local Tb theorems: Square functions and weak (1,1) testing with measures*. Preprint, `http://arxiv.org/abs/1511.00528`, (2015).

Activity in research training

- Preprint 2 is part of the upcoming PhD thesis of E. Vuorinen, University of Helsinki.

Santiago Molina

During 2015 I have been working on p-adic L functions attached to automorphic forms, Hida families of automorphic forms and Stark-Heegner-Darmon points on modular abelian varieties. I have submitted a paper where I study the exceptional zero phenomenon of the anticyclotomic (definite and indefinite) p-adic L-function attached to a Hilbert automorphic form. I have started a joint work with X. Guitart and M. Mardeu on Stark-Heegner-Darmon points. I have started a joint work with X. Guitart and V. Rotger on p-adic L-functions attached to triples of automorphic forms and I have started a joint work with L. Gehrmann on higher weight anticyclotomic p-adic L-functions. Moreover, I have organized a seminar on *Perfectoid spaces and modular curves at infinite level* at the IMUB.

Publications

Preprints

- S. Molina, *Anticyclotomic p-adic L-functions and the exceptional zero phenomenon*. Submitted

Diffusion activity

- I was invited to give a talk at the Number Theory Seminar of the University of Warwick on October 5^{th}, 2015. Title: *Anti-cyclotomic p-adic L-functions and the exceptional zero phenomenon*.

Teaching activity

Lectures and short courses

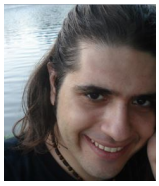
- S Molina, *Perfectoid spaces and modular curves at infinite level*.

Scientific activities

Seminars

- S Molina, *Perfectoid spaces and modular curves at infinite level*.

Mihalis Mourgoglou



I was a visitor of the CRM as a postdoctoral fellow of the European Post-Doctoral Institute for Mathematical Sciences (EPDI) from September 1^{st}, 2014 to August 31^{st}, 2015. I also held an office at CRM for the period of September to December, 2015. During this period I collaborated with professor X. Tolsa and his postdoctoral student Dr. J. Azzam producing several results using techniques of Geometric Measure Theory and Harmonic Analysis. Mainly we investigated the connection between the behavior of the harmonic measure defined in a very "rough" domain and the geometry of the domain itself answering important questions that remained open for quite a while. Moreover, I explored boundedness criteria of square functions and singular integral operators with non-doubling measures which find applications to the aforementioned problems for harmonic measure, while I exploited the geometry of the domain to show boundedness of such square functions and arise in the study of elliptic PDEs.

Publications

Preprints

- H. Martikainen, M. Mourgoglou, and X. Tolsa, *Improved Cotlar's inequality in the context of local Tb theorems*. Preprint, arXiv:1512.02950 (2015).
- H. Martikainen, M. Mourgoglou, and E. Vuorinen, *A new approach to non-homogeneous local Tb theorems: Square functions and weak (1; 1) testing with measures*. Preprint, arXiv:1511.00528, (2015), submitted.
- M. Mourgoglou and X. Tolsa, *Harmonic measure and Riesz transform in uniform and general domains*. Preprint, arXiv:1509.08386 (2015), submited.
- J. Azzam, S. Hofmann, J.M. Martell, S. Mayboroda, M. Mourgoglou, X. Tolsa, and A. Volberg, *Rectifiability of harmonic measure*. Preprint, arXiv:1509.06294 (2015), submitted.
- J. Azzam and M. Mourgoglou, *Tangent measures and absolute continuity of harmonic measure*. Preprint, arXiv:1507.00926 (2015), submitted.
- M. Mourgoglou, *Uniform domains with rectifiable boundaries and harmonic measure*. Preprint, arXiv:1505.06167 (2015), submitted.
- J. Azzam, M. Mourgoglou, and X. Tolsa, *Rectifiability of harmonic measure in domains with porous boundaries*. Preprint, arXiv:1505.06088 (2015).
- J. Azzam, M. Mourgoglou and X. Tolsa, *Singular sets for harmonic measure on locally flat domains with locally finite surface measure*. arXiv:1501.07585 (2015) submitted.
- J. Azzam and M. Mourgoglou, *A characterization of 1-rectifiable doubling measures with connected supports*. To appear in Analysis & PDE, arXiv:1501.02220 (2015).
- H. Martikainen and M. Mourgoglou, *Note about square function estimates and uniformly rectifiable measures*. To appear in Proc. Amer. Math. Soc. arXiv:1501.01274 (2015).

□ Scientific activities

Participation

Invited lectures in conferences

- M. Mourgoglou,, Invited talk at the Analysis Seminar, University of Helsinki, November 18^{th}, 2015.

Research stays

- November 10^{th} to 21^{st}, 2015, University of Helsinki (invited by T. Hytönen and H. Martikainen).

Invited lectures in conferences

- Workshop on *Harmonic Analysis, Partial Differential Equations and Geometric Measure Theory*, ICMAT, Madrid, Spain, January 12^{th} to 16^{th}, 2015.
- Conference *Frontiers of Singular Integrals*, Helsinki, Finland, June 2^{nd} to 5^{th}, 2015.
- Conference *Geometric Measure Theory, Optimal Mass Transportation and PDEs*, Sant Feliu de Guíxols, Spain, June 15^{th} to 19^{th}, 2015.

Isabel Serra

During 2015, I was postdoctoral researcher in Complex System Group of the CRM as a member of the mathematic research collaborative programme of "la Caixa" Foundation.

My research activities on my fundamental knowledge was divided on the methodological development in order to improve the use of Extreme Value Theory (EVT) with real data and the theoretical development of EVT. 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 Preprints. The second was in collaboration with Department of Mathematics of UAB, see Articles.

The transfer research activities were developed with Artificial Intelligence Research Institute (IIIA-CSIC) and with the Institute of Photonic Sciences, Mediterranean Technology Park (ICFO). My role in the IIIA-CSIC project was to model a distance in order to characterize ranking of motif in time series, the techniques was based on to consider beta distribution as model for light tails, see my Preprints. The ICFO collaboration was characterized for analyzing cerebral blood flow dynamics during individual obstructive sleep apnea events measured by hybrid diffuse optics, see my Conference proceedings.

I did some commercial transfer activities derived from exploiting my fruitfully research on EVT in the frame of finance, which was joining work with a finance company (confidential) and Applied Statistics Service (SEA). Moreover, in December a project with Ferrovial Servicios was started.

My public engagement activity is concentrated in to take part in several conferences and teach in several Master studies. Moreover, I was supervising several Final Degree project on risk analysis of Spanish continuous market portfolios. Several times I was member of Master Thesis committee and in January I was a member of a Thesis committee.

Finally, I participated as a member of the organizing committees of some research activities and I was guest editor for Maphre Foundation Editions.

□ Publications

Articles

• J. del Castillo and I. Serra, *Likelihood Inference for Generalized Pareto Distribution*. Computational Statistics & Data Analysis, **83**, 116–128 (2015).

Preprints

• J. Serrà, I. Serra, A. Corral, and J.-Ll. Arcos, *Ranking and significance of variable-length similarity-based time series motifs*.
• I. Serra and A. Corral, *Deviation from power law of the global seismic moment distribution*.

Books or book chapters

• A. Cabaña and I. Serra, *An approach to solve the weakness of block maxima method* in Current topics on Risk Analysis: ICRA6 and RISK 2015 Conference. M. Guillén *et al.* (eds.). Fundación Mapfre, C/205, 179–185.
• A. Corral and I. Serra, *Performance of the Clauset-Shalizi-Newman method for power-law fitting and comparison with other methods* in Current topics on Risk Analysis: ICRA6 and RISK 2015 Conference. M. Guillén *et al.* (eds.). Fundación Mapfre, C/205, 245–249.
• I. Serra and A. Corral, *Statistical tests for the tail of the seismic-moment distribution of global shallow earthquakes* in Current topics on Risk Analysis: ICRA6 and RISK 2015 Conference. M. Guillén *et al.* (eds.). Fundación Mapfre, C/205, 703–710.
• P. Rochet and I. Serra, *A test on separate families of hypotheses: distinguish between uniform and exponential distributions* in Current topics on Risk Analysis: ICRA6 and RISK 2015 Conference. M. Guillén *et al.* (eds.). Fundación Mapfre, C/205, 671–676.
• I. Blanco, P. Zirak, C. Gregori, R. Marín-Bueno, M. Sestelo, I. Serra, J. Martí-Fàbregas, T. Durduran, R. Delgado-Mederos, *Monitoring cerebral hemodynamics during early hours after stroke measured by hybrid diffuse optics*. Brain 2015 Proceedings (Vancouver).

□ Research projects

• *Grup de Recerca en Matemàtica Col·laborativa del CRM*. AGAUR, Generalitat de Catalunya, grant 2014SGR-01307. From 2014 to 2016. IP: Álvaro Corral (CRM)
• *Procesos estocásticos aplicados*. MICINN grant MTM2012-31118. IP: Pere Puig Casado (UAB). From 2013 to 2015

□ Teaching activity

Lectures and short courses

• *Random walk model by finance data*. UAB-CRM. Màster de Matemàtiques per als Instruments Financers (MMIF). January 2015 (30h.)
• *Temporal estimation of temporal rate*. UB-UPC. Master's degree in Statistics and Operations Research (MESIO). February 2015 (30h.)

• *Volatility models*. UB. Máster universitario en ciencias actuariales y financieras (MCCAF). May 2015 (30h.)
• *La predicció de la Borsa i el passeig aleatori*. CRM. Introducció a la matemàtica financera. September 2015 (2h.)

□ Scientific activities

Organisation

• Member of the organising committee of *6th International Conference in Risk Analysis*. May 2015.
• Member of the organising committee of *Barcelona Risk Analytics Young Research Workshop*. November 2015.
• Member of the organising committee of *First BGSMath Junior meeting*. December 2015.

Participation

Invited lectures in conferences

• I. Serra, *Christma's conference 2015* by Societat Catalana d'Estadística (SCE)
• I. Serra, *Teoría de valores extremos en la modelización estadística del riesgo*. Invited talk at the Congreso de Jóvenes Investigadores RSME 2015 (Murcia).
• I. Serra and P. Rochet, *On how to distinguish between tail distribution with right-truncated or with exponential decay*. Invited talk at the 8th International Conferences of the ERCM WG on Computational and Methodological Statistics (Londres).
• I. Serra and A. Corral, *On optimal threshold estimation in extreme value analysis*. Invited talk at the International Conference of Numerical Analysis and Applied Mathematics 2015 (Rodos).

Communications in conferences

• I. Serra, and A. Corral, *Statistical tests for the tail of the seismic-moment distribution of global shallow earthquakes*, 9th International Workshop on Statistical Seismology (Postdam).
• I. Serra and A. Corral, *Statistical tests for the tail of the seismic-moment distribution of global shallow earthquakes*, 6th International Conference in Risk Analysis. Risk 2015 (Barcelona).
• I. Serra, *On high-quantiles (VaR) estimator*, Interdisciplinary Workshop on Quantitative Finance 2015 (Barcelona).

Seminars

• I. Serra, *Statistical models for tails and applications*. CAMP seminar

Courses attended

• *Interdisciplinary Workshop on Quantitative Finance*, June 25^{th} and 26^{th}, 2015.
• *V Summer School on Statistical Physics of Complex and Small Systems*, July 6^{th} to 17^{th}, 2015
• *Competing risks: Concepts, methods and software*, October 14^{th} to 16^{th}, 2015.

Panagliota Theodoni

During 2015 I was a CRM postdoctoral researcher in the Computational Neuroscience Group of Alex Roxin. My postodoctoral position was funded by the BFU2012-33413 grant from the Spanish Ministry of Economics and Competitiveness.

Our research focused on how memories are formed and represented in the brain. Memories are thought to be encoded in particular patterns of synaptic weights in neuronal networks and to occur during learning through synaptic plasticity. We studied how the exploratory behavior of an animal, e.g., a rodent, in a novel environment shapes the network connectivity in a computational model of area CA3 of the hippocampus and forms a novel episodic memory. Furthermore, we explored the memory capacity of the network, and we planned to test our model predictions by analyzing corresponding experimental data.

The results of this study have been presented in several conferences; as a talk at the Barcelona Computational and Systems Neuroscience Conference (BARCCSYN), in Barcelona, Spain (June 2015), as a poster at the Neural Coding, Computation and Dynamics Conference (NCCD), in Bilbao, Spain (September 2015) and as a poster at the Society for Neuroscience Annual Meeting (SFN), in Chicago, Illinois, USA (October 2015).

□ Scientific activities

Participation

Communications in conferences

- P. Theodoni, Talk at the *Barcelona Computational and Systems Neuroscience Conference* (BARCCSYN), Barcelona, June 2015.
- P. Theodoni, Poster at the *Neural Coding, Computation and Dynamics Conference* (NCCD), Bilbao, September 2015.
- P. Theodoni, Poster at the *Society for Neuroscience Annual Meeting* (SFN), Chicago, Illinois, October 2015.

2.2.3. Col·laboradors Científics

Durant l'any 2015, tres investigadors pertanyents a altres institucions han format part de la comunitat del CRM com a Col·laboradors Científics: Aurora Hernández-Machado i Claudia Trejo, de la Universitat de Barcelona, que participen en el Laboratori de Microreologia de Biofluids del CRM (vegeu Secció 2.3) i col·laboren amb els grups de Biologia Matemàtica i Computacional i Matemàtica Industrial; i Vicent Ribas, de l'empresa Sabirmedical, que col·labora amb el grup de Matemàtica Industrial.

2.2.3. Scientific Collaborators

During the year 2015, three researchers belonging to external institutions have been joining the CRM community as Scientific Collaborators: Aurora Hernández-Machado and Claudia Trejo, from Universitat de Barcelona, who are part of the team of the CRM Lab for Microrheology of Biofluids (see Section 2.3) and collaborate with the Mathematical and Computational Biology and the Industrial Mathematics groups; and Vicent Ribas, from the company Sabirmedical, who collaborates with the Industrial Mathematics groups.

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 participated in the analysis of existing credit risk rating methodologies. He also assisted in the preparation of the application for funding to PRODUCT 2014 Assigned to the Development of Prototype and the Valorization and Transfer of Research Results, generated by research groups in Catalonia.

Néstor Costa

2007–2013 Physics Degree, Mention in Applied physics. Universitat de Barcelona

Aurora Hernández-Machado

Aurora Hernández-Machado is a Full Professor of Condensed Matter Physics at the Universitat de Barcelona, who leads the group on *Dynamics of interfaces in nanotechnology, fluidics and biophysics*. Jointly with Tomás Alarcón, she is in charge of the CRM lab for Microrheology of Biofluids. The activity of her group can be followed from `http://www.nanobarnafluidics.com/`.

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 2015. 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

2.2.5. CRM PhD Students

Next we present the postgraduate students of the CRM research groups and their activity along the year 2015. 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

Universitat Politècnica de Catalunya. A l'apartat 2.6.1. es detalla la procedència de cadascuna de les beques.

based at the Universitat Politècnica de Catalunya. Details about the sourcing of each fellowship are given in Section 2.6.1.

Publications

Articles

- O. Güell, F.A. Massucci, **F. Font-Clos**, F. Sagués, M.Á. Serrano, *Mapping high-growth phenotypes in the flux space of microbial metabolism*, Journal of the Royal Society Interface, 12 (2015), 20150543.
- **F. Font-Clos**, A. Corral, *Log-log convexity of type-token growth in Zipf's systems*. Physical Review Letters 114 (2015), 237801.
- **F. Font-Clos**, G. Pruessner, A. Deluca, N.R. Moloney, *The perils of thresholding*. New Journal of Physics 17 (2015), 043066.
- R. García-Millán, **F. Font-Clos**, A. Corral, *Finite-size scaling of survival probability in branching processes*. Physical Review E, 91 (2015), 042122.

Preprints

- **A. Debernardi**, *Maximal values for the simultaneous number of null components of a vector and its Fourier transform*, to appear in *Reports@SCM* (2016).

- J.M. Abelleira-Pereira, S.I. Pérez-Elvira, J. Sánchez-Oneto, **R. de la Cruz**, J.R. Portela, and E. Nebot. *Enhancement of methane production in mesophilic anaerobic digestion of secondary sewage sludge by avanced thermal hydrolysis pretreatment*, *Water Research* **71** (2015), 330–340. `http://dx.doi.org/10.1016/j.watres.2014.12.027`
- **R. de la Cruz**, P. Guerrero, F. Spill, and T. Alarcón, *The effects of intrinsic noise on the behaviour of bistable systems in quasi-steady state conditions*, submitted to *Journal of the Royal Society Interface* (2015).

- M. Gerlach, **F. Font-Clos**, E.G. Altmann, *On the similarity of symbol frequency distributions with heavy tails*, `arXiv:1510.00277`. (accepted in PRX, to be published in 2016. preprint uploaded to arXiv in 2015).

- A. Korobeinikov and **A. Nurtay**, *Mathematical modeling of the development of specialization in viral evolution*, CRM Preprint núm. 1220, April 2016.

- **H. Ribera**, T.G. Myers, *A model for nanoparticle melting with a Newton cooling condition and size-dependent latent heat*. (To be submitted).
- **H. Ribera**, T.G. Myers, *A note on size-dependent latent heat models*. (In preparation).
- V. Cregan, T.G. Myers, S.L. Mitchell, **H. Ribera**, M. Calvo Schwarzwälder, *Nanoparticle evolution via the precipitation method*. (In preparation).

PhD Thesis

• **F. Font-Clos**, *On the Scale Invariance of certain Complex Systems*. Advisor: Álvaro Corral, tutor: Pere Puig. Defense date: July 2^{nd}, 2015.

□ Diffusion activity

• **B. Rovira**, Divulgation talk "What is Neuroscience?" in the course *Bojos per les matemàtiques* from Feemcat, in CRM at March 2015.
• **B. Rovira**, Divulgation talk "Què és la física?" in the primary school CEIP Josep Gras, in the physics formation week at March 2015.

□ Scientific activities

Organisation

• **F. Font-Clos**, Organizer of *Fifth Gefenol Summer School on Statistical Physics of Complex and Small Systems*, Centre de Recerca Matemàtica, July 6^{th} to 17^{th}, 2015.

Participation

Scientific activities

• **H. Ribera**, *Student Mathematical Modelling Workshop*, University of Limerick, June 24^{th} to 26^{th}, 2015.
• **H. Ribera**, *110th European Study Group with Industry*, University of Limerick, June 28^{th} to July 3^{rd}, 2015.
• **H. Ribera**, *115th European Study Group with Industry* Centre de Recerca Matemàtica, January 25^{th} to 29^{th}, 2016.

• **B. Rovira**, UPF-DTIC weekly Research Seminars.
• **B. Rovira**, UPF Computational Neuroscience Group weekly Journal Club.
• **B. Rovira**, IDIBAPS Compte lab weekly Journal Club.
• **B. Rovira**, CRM weekly Camp Seminar.
• **B. Rovira**, Barcelona Computational and Systems Neuroscience 2015, June 18^{th} to 19^{th}, 2015.

Invited lectures in conferences

• **F. Font-Clos**, *Analysis of survival times for a thresholded birth-death process*, February 26^{th}, 2015, Vienna Seminar in Mathematical Finance and Probability.

Communications in conferences

• **G. Colldeforns**, Workshop of the *Models and Numerics in Financial Mathematics*, May 26^{th} to 29^{th}, 2015, Lorentz Center, Leiden (Netherlands). (Poster presentation and attendance)

• **R. de la Cruz**, *Efectos del ruido intrínseco en el comportamiento de sistemas regulatorios celulares biestables bajo condiciones quasi-estacionarias*. Congreso de Jóvenes Investigadores RSME. Universidad de Murcia, September 2015. `http://www.um.es/jovenesrsme2015/aplicada.php`.

• **R. de la Cruz**, *The effects of intrinsic noise on the behaviour of bistable cell regulatory systems under quasi-steady state conditions*. V Summer School on Statistical Physics of Complex and Small Systems (Poster). Centre de Recerca Matemàtica, July 2015. `http://www.crm.cat/en/Activities/Curs_2014-2015/Pages/SSSPCSS.aspx`.

• **R. de la Cruz**, *The effects of intrinsic noise on the behaviour of bistable cell regulatory systems under quasi-steady state conditions*, IV Jornada complexitat.cat (Poster). Universitat Rovira i Virgili, May 2015. `http://jornada.complexitat.cat/`.

• **N. Folguera**, *Mathematical modelling of oncometabolic reprogramming of somatic cells*, and attendance to the IV Jornada de Complexitat.cat: recerca en sistemes complexos. May 25^{th}, 2015, Universitat Rovira i Virgili, Tarragona (Spain). (Poster exhibition)

• **N. Folguera**, *Mathematical modelling of oncometabolic reprogramming of somatic cells*, poster exhibition and attendance to the 5th Summer School on Statistical Physics of Complex and Small Systems. July 6^{th} to 17^{th}, 2015, Centre de Recerca Matemàtica (CRM), Bellaterra, Barcelona (Spain). (Short talk)

• **N. Folguera**, *Mathematical modelling of oncometabolic reprogramming of somatic cells* and attendance to the Workshop 'Present challenges of Mathematics in Oncology and Biology of cancer'. December 7^{th} to 11^{th}, 2015. Centre International de Rencontres Mathématiques (CIRM), Marseille (France). Student selected to receive financial support given by CIRM in order to cover accommodation and meals. (Oral contribution)

• **B. Rovira**, *Memory capacity in plastic neural networks* at CBC Workshop, UPF, June 27^{th}, 2015. (Poster presentation)

• **M. Vegué**, and A. Roxin, *Statistical models of network connectivity in cortical microcircuits*. Neural Coding, Computation and Dynamics Meeting, Bilbao, August 30^{th} to September 2^{nd}, 2015.

• **M. Vegué**, A. Roxin, *Different models of network connectivity can explain non-random features of cortical microcircuits*. Society for Neuroscience Meeting, Chicago, October 17^{th} to 21^{st}, 2015.

Seminars

• **C. Sáez**, *Compactness of the moduli space of the Seiberg-Witten equations*. Series of four lectures given at the geometry seminar of the UAB, June 2015.

• **C. Sáez**, *Compactness and transversality of moduli spaces of the perturbed Seiberg-Witten equations*, talk given at the geometry seminar of the UAB, November 2015.

Research stays

• February 23^{rd} to 27^{th}, 2015: Invited Researcher at Vienna University of Technology, Financial and Actuarial Mathematics Research Unit. Prof. Dr. Thorsten Rheinländer. (**F. Font-Clos**).

• May 3^{rd} to July 30^{th}, 2015: Visiting PhD student at the group of Nicolas Brunel, Department of Statistics, The University of Chicago (**M. Vegué**).

Courses attended

• *IMA 2015: Modern Harmonic Analysis and Applications* at the University of Maryland, Maryland, USA, July – August 2015, `https://www.ima.umn.edu/2014-2015/PISG7.20-8.7.15` (**A. Debernardi**).

• *High-Frequency Financial Econometrics*, June 11^{th} and 12^{th}, 2015, Barcelona GSE and Universitat Pompeu Fabra, Barcelona (**G. Colldeforns**).
• *Interdisciplinary Workshop on Quantitative Finance*, June 25^{th} and 26^{th}, 2015, Centre de Recerca Matemàtica (**G. Colldeforns**).
• *Conic Finance Explained and Applied*, by Wim Schoutens. July 15^{th}, 2015, Faculty of Economics and Business UB, Barcelona (**G. Colldeforns**).
• *Introduction to Python*, within the Research Programme on Statistical Advances for Complex Data, September 8^{th} to 10^{th} 2015, Centre de Recerca Matemàtica.
• *Social Data Mining and analysis* within the Research Programme on Statistical Advances for Complex Data, September 16^{th} to 18^{th} 2015, Centre de Recerca Matemàtica (**G. Colldeforns**).

• Aurora Hernández-Machado, Ignacio Pagonabarraga, Stefan Thurner,..., *V Summer School on Statistical Physics of Complex and Small Systems*, Centre de Recerca Matemàtica, Barcelona (Spain), July 2015, `http://www.crm.cat/en/Activities/Curs2014-2015=Pages=SSSPCSS:aspx` (**R. de la Cruz**).
• Henri Berestycki, Jordi García Ojalvo, Seung-Yeal Ha,..., *Biomat 2015: Emergence and self-organization in social and biological systems*, Universidad de Granada, Granada (Spain), June 2015. `http://www.ugr.es/kinetic/biomat/` (**R. de la Cruz**).
• Bruno Tavares Gonalves, *Social data mining and analysis*, Centre de Recerca Matemàtica, Barcelona (Spain), September 2015, `http://www.crm.cat/en/Activities/Curs2015-2016=Pages=Data-Mining:aspx` (**R. de la Cruz**).

• Selected by the Universitat Autònoma de Barcelona (UAB), member of the MODCLIM (Modelling Clinic for Industrial Mathematics) project, supported by the Erasmus + Programme of the European Union.
1st stage of MODCLIM: Research Training Course, March 16^{th} to 27^{th}, 2015, Universidad de Las Palmas de Gran Canaria (Spain).
2nd stage of MODCLIM: Problem Solving Workshop, September 7^{th} to 11^{th}, 2015. Lappeenranta University of Technology (LUT), Lappeenranta (Finland). Member of the team working on 'Non-aerobic water purification reactor'. (**N. Folguera**)
• Attendance to Biomat-2015: Emergence and self-organisation in social and biological systems. May 27^{th} to 29^{th}, 2015, Universidad de Granada, Granada (Spain). (**N. Folguera**)

• Attendance to the course 'Social Data Mining and Analysis', within the Research Programme on Statistical Advances for Complex Data. September 16^{th} to 18^{th}, 2015 Centre de Recerca Matemàtica (CRM), Bellaterra, Barcelona (Spain). (**N. Folguera**)
• Attendance to the 5th Integrated Mathematical Oncology (IMO) Workshop: Immune Cancer. November 8^{th} to 13^{th}, 2015. Moffitt Cancer Center, Tampa, Florida (USA).
Winner of one of the 'Travel Deluxe Awards' given by the Integrated Mathematical Oncology Department at Moffitt, in order to cover flights, accommodation, transportation and per diem. (**N. Folguera**)
• Attendance to Barcelona Dynamical Systems Meeting 2015 (BDSM15). December 16^{th}, 2015. Universitat de Barcelona (UB), Barcelona (Spain).
Student selected to receive financial support given by the organising committee in order to cover inscription fees. (**N. Folguera**).

• *III Jornada de Bioinformàtica i Biologia Computacional*, December 18^{th}, 2015 (**A. Nurtay**).

• *V Summer School on Statistical Physics of Complex and Small Systems*, CRM, July 6^{th} to 17^{th}, 2015 (**B. Rovira**).
• Information Theory Course by Barcelona Graduate School of Mathematics, March – June, 2015, (**B. Rovira**).

• *IX Workshop on Symplectic Geometry, Contact Geometry and Interactions*, École Normale Supérieure de Lyon, January 2015 (**C. Sáez**).
• *Algorithmic group theory*, BGSMath graduate course, Barcelona, Fall semester 2015 (**C. Sáez**).
• *Edinburgh Mathematical Society – Societat Catalana de Matemàtiques joint meeting*, Barcelona, May 2015 (**C. Sáez**).

• A. Guillén, A. Martínez, and A. Winter. *Information theory*, BGSMath, Barcelona, Spring 2015. (**M. Vegué**)
• *Cargèse fall school on random graphs*, Cargèse (Corsica), September 20^{th} to 26^{th}, 2015. (**M. Vegué**)

□ Other activities

• **R. de la Cruz**, Solució problema A122, *SCM/Notícies* 37, 71–72, 2015. `http://mat.uab.cat/albert/scm/N37.pdf`.
• **R. de la Cruz**, Solució problema A124, *SCM/Notícies* 38, 90–91, 2015. `http://blogs.iec.cat/scm/wpcontent/uploads/sites/20/2016/01/N38.pdf`.
• **R. de la Cruz**, Solución problema 264, *La Gaceta de la Real Sociedad Matemática Española* 18, 566–567, 2015. `http://gaceta.rsme.es/abrir.php?id=1290`.

• **R. de la Cruz**, Solución problema 241, *La Gaceta de la Real Sociedad Matemática Española* 18, 123–124, 2015. `http://gaceta.rsme.es/abrir.php?id=1204`.

• P. Guerrero and T. Alarcón, *Models estocàstics multiescala de la dinàmica de poblacions cel·lulars: mètodes asimptòtics i numèrics*. Butlletí de la Societat Catalana de Matemàtiques 30(2), 125–166, 2015. Translation to Catalan. (**N. Folguera**)

• Member of the Council of the Complex Systems Society, 2013–2017.
• **F. Font-Clos**, Tutoring: Aleix Boquet, Internship at CRM, *Thresholding a Galton-Watson branching process*.

2.3. 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 i de Matemàtica Industrial 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

2.3. 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 and the Industrial Mathematics Group 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

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.

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.

2.4. Xarxes temàtiques

Estar amatents a les àrees emergents en les matemàtiques i les seves aplicacions és un dels objectius prioritaris del CRM, així com oferir incentius i recursos de manera que investigadors d'àrees més tradicionals o investigadors més joves puguin introduir-se en aquests sectors emergents. Donat l'estat actual de la recerca, moltes de les àrees estratègiques o emergents en Ciència i Tecnologia estan relacionades amb noves aplicacions matemàtiques i permeten així la participació de les matemàtiques en projectes socials a gran escala.

Amb aquest propòsit, el CRM dóna suport a diverses xarxes temàtiques, com a continuació d'altres iniciatives empreses en anys anteriors. Tenen per objectiu la formació multidisciplinària en recerca en àrees considerades d'interès i rellevants actualment. Les xarxes temàtiques del CRM són una estructura transversal que serveix de pal de paller als grups de recerca catalans actius en una determinada àrea, disposats a col·laborar entre ells a través d'activitats conjuntes, les quals típicament inclouen un seminari estable. El CRM dóna suport financer i administratiu a cada xarxa temàtica, i des de 2014 compta amb el suport generós de la Fundació "la Caixa", dins del programa de recerca en Matemàtica Col·laborativa (vegeu el Capítol 1 d'aquesta memòria).

Les xarxes temàtiques actuals al CRM són les següents:

- Xarxa Temàtica en Neurociència Computacional
- Xarxa Temàtica en Finances Quantitatives

2.4. Thematic networks

Monitoring emerging areas in mathematics and their applications is a priority objective for the CRM, as well as offering incentives and resources so that researchers in traditional areas or younger researchers can join these emerging sectors. Given the current state of research, many strategic or emerging areas in Science and Technology are related to new mathematical applications, thus allowing the participation of mathematics in large-scale social projects.

With this purpose, the CRM supports several Thematic Networks, as a continuation of other initiatives undertaken in previous years. It aims at multidisciplinary research training and practice in areas considered to be of interest and relevant at the present time. The CRM Thematic Networks are a transversal activity that serves as a meeting point of research groups in Catalonia active in one of such areas, willing to collaborate through joint activities, which typically include a stable all-year seminar. The CRM gives financial and administrative support to each Thematic Network; starting in 2014 these networks receive also the generous support of "la Caixa" Foundation, within the research program on Collaborative Mathematics (see Chapter 1 of this report).

The current list of CRM Thematic Networks is the following:

- *Thematic Network in Computational Neuroscience*
- *Thematic Network in Quantitative Finance*

La Xarxa de Biologia Computacional s'ha posat en marxa durant el 2014, amb una conferència inicial programada pel febrer de 2015.

The Thematic Network on Computational Biology started its activity in 2014; the first colloquim of the network is scheduled for February 2015.

Les activitats d'aquestes xarxes poden veure's a

The activities of these networks can be checked at

www.crm.cat/en/Research/Networks/Pages/default.aspx

2.5. Investigadors visitants

2.5. List of visitors

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 quatre tipus diferents:

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:

- 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 programa "Dev-Math" per a investigadors de països en vies de desenvolupament.

- *Visiting the CRM.*
- *Research in pairs at CRM.*
- *"Lluís Santaló" visiting positions for Latin-American researchers (sponsored by IEC).*
- *The "Dev-Math" program for researchers from developing countries.*

El llistat de visitants de 2015 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. La plaça "Lluís Santaló" va ser ocupada enguany per Deborah Oliveros (Universidad Nacional Autónoma de México), per un període de 2 mesos, del 28 de maig al 28 de juliol de 2015, mentre que l'estada del programa Dev-Math 2015 va ser concedida a Adewunmi Fareo, fins juliol 2015.

The list of 2015 visitors is the following. This list does not include CRM staff researchers nor visitors whose stay was shorter than eight days. The "Lluís Santaló" post was held by Deborah Oliveros (of the National Autonomous University of Mexico) for two months, from May 28 to July 28, 2015. The Dev-Math 2015 grant was awarded to Adewunmi Fareo to fund a research stay that will run until July 2015.

Krzysztof Apt	Centrum Wiskunde and Informatica (CWI)
Carmen Armero	Universitat de València
Luchezar L. Avramov	University of Nebraska-Lincoln
Paul Balmer	University of California at Los Angeles
Silvana Bazzoni	Università degli studi di Padova
Hanno Becker	Universität Bonn
Driss Bennis	Mohamend V University

David J. Benson	University of Aberdeen
Arkady Berenstein	University of Oregon
Julia Bergner	University of California at Riverside
Anthony Blanc	Universität Wien
Aleix Boquet Pujadas	Universitat Autonòma de Barcelona
Herbert Brasselmann	Center for Environmental Health
Simion Breaz	Universitatea Babes-Bolyai
Michael Brown	University of Nebraska-Lincoln
Ragnar-Olaf Buchweitz	University of Toronto
Alejandra Cabaña	Universitat Autonòma de Barcelona
Malu Calle	Universitat de Vic
Juan Calvo	Universitat Pompeu Fabra
Marc Calvo Schwarzwälder	Universitat Politècnica de Catalunya
Alessio Caminata	Universitát Osnabrück
Ela Celikbas	University of Connecticut
Olgur Celikbas	University of Connecticut
Lars Christensen	Texas Tech University
Nicholas Clarke	University of Manchester
Tobias Columbus	Karlsruher Institut für Technologie
Anthonius Coolen	Institute for Mathematical and Molecular Biomedici
Marianna Csörnyei	University of Chicago
Urania Dafni	National and Kapodistrian University of Athens
Hailong Dao	University of Kansas
Pedro Delicado	Universitat Politècnica de Catalunya
Ivo Dell'Ambrogio	Université de Lille 1
Josep Díaz	Grup de Recerca ALBCOM, UPC
Albert Diaz-Guilera	Universitat de Barcelona
Umesh V. Dubey	Chennai Mathematical Institute
Alex Dugas	University of California at Santa Barbara
Tobias Dyckerhoff	Universität Bonn
Martin Dyer	University of Leeds
Jochen Einbeck	Durham University
Irina Espejo Morales	Universitat Autonòma de Barcelona
Anna Espinal	Universitat Autonòma de Barcelona
Sergio Estrada Dominguez	Universidad de Murcia
Luigi Ferraro	University of Nebraska-Lincoln
Nicolas Fraiman	University of Philadelphia
Jordina Francès De Mas	Universitat Autonòma de Barcelona
Vincent Franjou	Université de Nantes
Vincent Gelinas	University of Toronto
Ronald Geskus	Academic Medical Centre
Adewunmi Gideon Fareo	University of the Witwatersrand
Ioannis Giotis	Universitat Politècnica de Catalunya
Paul Goldberg	Oxford University
Mordecai Golin	Hong Kong University of Science and Technology
Guadalupe Gómez	Universitat Politècnica de Catalunya

Moises Gómez-Mateu	Universitat Politècnica de Catalunya
Dmitry Gorbachev	Tula State University
John Greenlees	University of Sheffield
Moritz Groth	Radboud University Nijmegen
Meng Guo	Harvard University
Dolors Herbera	Universitat Autonòma de Barcelona
Aurora Hernández-Machado	Universitat de Barcelona
Daniel Hernandez	University of Utah
Reiner Hermann	Norwegian University of Science and Technology
Ivo Herzo	The Ohio State University
Michal Hrbek	Charles University
Lidia A. Hügel	Università degli Studi di Verona
Alina Iacob	Georgia Southern University
Kiyoshi Igusa	Brandeis University
Osamu Iyama	Nagoya University
Srikanth B. Iyengar	University of Nebraska-Lincoln
Kostiantyn Iusenko	Universidade de São Paulo
Valerii Ivanov	Tula State University
Jack Jeffries	University of Utah
David Jou Mirabent	Universitat Autonòma de Barcelona
Martin Kalck	Universität Bielefeld
Anargyros Katsampekis	University of Macedonia
Chainarong Kesamoon	Universitat Autonòma de Barcelona
KyungMann Kim	University of Wisconsin-Madison
Stephen J. Kirkland	Hamilton Institute
Lefteris Kirousis	N&K University of Athens
Celestin Kokonendji	Laboratoire de Mathématiques de Besançon
Iurii Kolomoitsev	IAMM of NAS of Ukraine
Elias Koutsoupias	University of Oxford
Henning Krause	Universität Bielefeld
Rosa Lamarca	Almirall SA
Nitin Lalwani	University of Edinburgh
Klaus Langohr	Universitat Politècnica de Catalunya
Bernard Leclerc	Université de Caen
Graham Leuschke	Syracuse University
Haydee Lindo	University of Utah
Antonio Lozano Vicente	Universidad de Zaragoza
Víctor Luengo Luque	Centre de Recerca Matemàtica
Stef Maree	Delft University of Technology
Vangelis Markakis	Athens University of Economics and Business
Henri Martikainen	University of Helsinki
Didac Martinez Granado	University of Cambridge
Simon Masnou	Université Claude Bernard Lyon 1
Shreedevi K. Masuti	Chennai Mathematical Institute
Colin McDiarmid	Oxford University
Abbas Mehrabian	University of Waterloo

Giuseppe Mingione	University of Parma
Ciprian Modoi	Universitatea Babes-Bolyai
Santiago Molina Blanco	Universitat Politècnica de Catalunya
Nicholas R. Moloney	London Mathematical Laboratory
Tasos Moulinos	University of Illinois
Askhat Mukanov	L.N. Gumilyov Eurasian National University
Tobias Müller	University Utrecht
Fernando Muro	Universidad de Sevilla
Amnon Neeman	Australian National University
Paige North	University of Cambridge
Anel Nurtay	Nazarbayev University
Sinem Odabasi	Universidad de Murcia
Deborah Oliveros Braniff	Universidad Nacional Autónoma de México
Joaquín Ortega Sánchez	Centro de Investigación en Matemáticas de México
Ignacio Pagonabarraga	Universitat de Barcelona
Pranav Pandit	University of Vienna
Núria Perez	Fundació Lluita contra la SIDA
Xavier Perez	University of Waterloo
Julia Pevtsova	University of Washington
Wolfgang Pitsch	Universitat Autonòma de Barcelona
Pawel Pralat	Ryson University
Pavel Prihoda	Charles University in Prague
Gunnar Pruessner	Imperial College London
Pere Puig Casado	Universitat Autonòma de Barcelona
Adolfo J. Quiroz Salazar	Universidad de Los Andes
Hamid Rahmati	University of Miami
Vladimir Retakh	Rutgers University
Vicent Ribas	Sabirmedical
Paul Rochet	Université de Nantes
Tim Roughgarden	Stanford University
Montserrat Rue	Universitat de Lleida
Domènec Ruiz i Balet	Universitat Autonòma de Barcelona
Carlos Sáez Calvo	Universitat de Barcelona
Alex Sánchez Pla	Universitat de Barcelona
William Sanders	University of Kansas
Manuel Saorín	Universidad de Murcia
Maria Serna	Universitat Politècnica de Catalunya
Elena Shchepakina	Samara State Aerospace University
Charmaine Sia	Harvard University
Vladimir Sobolev	Samara State Aerospace University
Mikis Stasinopoulos	London Metropolitan University
Marc Stephan	École Polytechnique Fédérale de Lausanne
Greg Stevenson	Universität Bielefeld
Peter Symonds	University of Manchester
Tom Sutton	University of Sheffield
Ryo Takahashi	Nagoya University

Bruno M. Tavares Gonçalves	Centre Physique Théorique
Louis-Philippe Thibault	University of Toronto
Jan Šaroch	Charles University in Prague
Dragan Stevanovic	University of Primorska
Jan Šťovicek	Charles University
Matteo Varbaro	University of Genova
Lourdes Vega	MATGAS
Brian Wetton	The University of British Columbia
Roger Wiegand	University of Nebraska-Lincoln
Jeremy Williams	Universitat Autònoma de Barcelona
Emily Witt	University of Utah
Nick Wormald	Monash University
Santiago Zarzuela	Universitat de Barcelona

En total, el CRM ha hostatjat 334 mesos d'estada d'investigadors al llarg de l'any 2015.

Summing up, the CRM has hosted 334 months of stays of researchers during 2015.

2.6. 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 2015.

2.6. 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 2015.

2.6.1. 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 Tomás Alarcón, amb el suport de l'equip de direcció del CRM.

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

2.6.1. 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 Tomás Alarcón with the support of the CRM direction team.

The UFD has a programme of activities consisting of:

- 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.

- *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 2015 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):

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

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

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

Francesc Font Clos is working on his PhD thesis, supervised by Álvaro Corral since December 2011. Funded by FI-AGAUR scholarship.

Anel Nurtay is working on her PhD thesis, supervised by Andrei Korobeinikov since March 2015. 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.

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

Narani van Laarhoven worked on her PhD thesis, supervised by Alexander Roxin till July 2015.

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

Isabel Moreno worked on her PhD thesis, supervised by Álvaro Corral till August 2015.

Enric Costa has been working on his PhD thesis, supervised by Tomás Alarcón since November 2014. Funded by CRM program.

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

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

2.6.2. Curs de màster

El Màster de Matemàtiques per als Instruments Financers es va impartir per dissetena vegada el 2015 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 2015 han acabat el màster 10 alumnes.

2.6.2. Master's Course

The CRM master's course on Financial Mathematics was held for the seventeenth time in 2015 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 2015 a total of 10 students completed the master's course.

2.6.3. 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 2015, un total de 14 estudiants van participar en aquest programa:

2.6.3. 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 2015, 14 students visited the CRM within this program:

- Albert Aloy (Neurociència Computacional/*Computational Neuroscience*)
- Aleix Boquet Pujadas (Sistemes Complexos/Complex Systems)
- Irina Espejo (Sistemes Complexos/Complex Systems)
- Jordina Francès (Neurociència Computacional/*Computational Neuroscience*)
- Rosalba García (Sistemes Complexos/Complex Systems)
- Sergio González Fernández (Matemàtica Industrial/Industrial Mathematics)
- Nitin Lalwani (Epidemiologia Matemàtica/Mathematical Epidemiology)
- Antonio Lozano (Matemàtica Financera i Control de Riscos/Financial Mathematics and Risk Control)
- Stef Maree (Matemàtica Financera i Control de Riscos/Financial Mathematics and Risk Control)
- Albert Miquel (Neurociència Computacional/*Computational Neuroscience*)
- Carles Riera (Matemàtica Industrial/Industrial Mathematics)
- Domènec Ruiz i Balet (Sistemes Complexos/Complex Systems)
- Clàudia Toral (Epidemiologia Matemàtica/Mathematical Epidemiology)
- Jermy Williams (Matemàtica Financera i Control de Riscos/Financial Mathematics and Risk Control)

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*.

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

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

- *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.

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 2015. 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 2015 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 Algorithmic Perspective in Economics and Physics

April 7^{th} *to June* 19^{th}*, 2015*

Scientific Coordinator	Josep Díaz	Universitat Politècnica de Catalunya
Scientific Committee	Dimitris Achlioptas	National and Kapodistrian University of Athens and Department of Computer Science, UC Santa Cruz
	Josep Díaz (Chair)	Universitat Politècnica de Catalunya
	Lefteris Kirousis	University of Athens
	Maria Serna	Universitat Politècnica de Catalunya

Summary

Multidisciplinary research in the algorithmic aspects of Game Theory, on one hand, and the Theory of Combinatorial Phase Transitions, on the other, towards understanding the evolution of large networks. In particular, themes to be considered:

- Game theory applied to phase transitions in characteristics of combinatorial objects (algorithmic complexity, existence of solutions).
- Probabilistic techniques developed for the study of combinatorial phase transitions applied in game theoretic analysis.
- Large networks as used, or created, by competing agents and their phase transitions.

All program information can be found at:
`http://www.crm.cat/en/Activities/Pages/ActivityFoldersAndPages/Curs%202014-2015/APEP/APEP.aspx`

Visiting Researchers

Dimitrios Achlioptas (University of California at Santa Cruz), Krzysztof Apt (Centrum Wiskunde and Informatica (CWI)), Josep Díaz (Universitat Politècnica de Catalunya), Martin Dyer (University of Leeds), Dimitris Fotakis (National Technical University of Athens), Nicolas Fraiman (University of Pennsylvania), Ioannis Giotis (Universitat Politècnica de Catalunya), Paul Goldberg (Oxford University), Mordecai Golin (Hong Kong University of Science and Technology), Lefteris Kirousis (N&K University of Athens), Elias Koutsoupias (Oxford University), Vangelis Markakis (Athens University of Economics and Business), Colin McDiarmid (Oxford University), Abbas Mehrabian (University of Waterloo), Dieter Mitsche (Université de Nice Sophia Antipolis), Tobias Müller (University Utrecht), Miquel Oliu (Université Paris 6), Christos Papadimitriou (University of California at Berkeley), Xavier Perez (University of Waterloo), Guiseppe Persiano (Università di Salerno), Pawel Pralat (Ryson University), Tim Roughgarden (Stanford University), Maria Serna (Universitat Politècnica de Catalunya), Gregory Sorkin (The London School of Economics), Paul G. Spirakis (University of Liverpool), Lutz Warnke (University of Cambridge), Nick Wormald (Monash University).

Activities

- **Weekly Seminar**

Speakers

Colin McDiarmid, Oxford University
Random perfect graphs
April 15^{th}, 2015

Abbas Mehrabian, University of Waterloo
Bounds for randomized rumour spreading protocols
April 22^{nd}, 2015

Dieter Mitsche, Université de Nice
The set chromatic number of the random graph
April 29^{th}, 2015

Nick Wormald, Monash University
Proof of Tutte's 3-flow conjecture for almost all 5-regular graphs
May 6^{th}, 2015

Nicolas Fraiman, University of Pennsylvania, Philadelphia
Connectivity of geometric k-out graphs
May 20^{th}, 2015

Paul Goldberg,Oxford University
Learning game-theoretic equilibria via protocols
May 27^{th}, 2015

Christos Papadimitriou, University of California, Berkeley
Complexity in Game Theory
June 3^{rd}, 2015

Lutz Warnke, Cambridge University
The lower tail: Poisson approximatioin revisited
June 17^{th}, 2015

• Workshop on Strategic Behavior and Phase Transitions in Random and Complex Combinatorial Structures
June 8^{th} to 12^{th}, 2015.
Participants: 29

Speakers

Dimitrios Achlioptas (University of California at Santa Cruz), Carme Àlvarez (Universitat Politècnica de Catalunya), Georgios Amanatidis (Athens University of Economics and Business), Georgios Birmpas (Athens University of Economics and Business), Endre Csóka, Victor Dalmau (Universitat Pompeu Fabra), Josep Díaz (Universitat Politècnica de Catalunya), Martin Dyer (University of Leeds), Dimitris Fotakis (National Technical University of Athens), Nicolas Fraiman (University of Pennsylvania), Ioannis Giotis (Universitat Politècnica de Catalunya), Mordecai Golin (Hong Kong University of Science and Technology), Lefteris Kirousis (N & K University of Athens), Elias Koutsoupias (Oxford University), Joonkyung Lee (University of Oxford), Vangelis Markakis (Athens University of Economics and Business), Colin McDiarmid (Oxford University), Dieter Mitsche (Grup de Recerca ALBCOM, UPC), Tobias Müller (University Utrecht), Miquel Oliu (Université Paris 6), Mustapha Oussam (Universitat Pompeu Fabra), Xavier Perez (University of Waterloo), Guiseppe Persiano (Università di Salerno), Pawel Pralat (Ryson University), Tim Roughgarden (Stanford University), Maria Serna (Universitat Politècnica de Catalunya), Oriol Serra (Universitat Politècnica de Catalunya), Stratis Skoulakis (National Technical University of Athens), Gregory Sorkin (The London School of Economics), Paul G. Spirakis (University of Liverpool), Nick Wormald (Monash University).

3.1.2. CRM Research Programme on IRTATCA: Interactions between Representation Theory, Algebraic Topology and Commutative Algebra

January 7^{th} *to June* $30^{\text{th}}, 2015$

Scientific Committee	William Dwyer	University of Notre Dame
	Dolors Herbera	Universitat Autònoma de Barcelona
	Srikanth B. Iyengar	University of Nebraska
	Henning Krause	Universität Bielefeld
	Bernard Leclerc	Université de Caen
	Wolfgang Pitsch	Universitat Autònoma de Barcelona
	Santiago Zarzuela	Universitat de Barcelona

Summary

The IRTATCA program was the abutment of a long process that started around 2006 with a seminar at the UAB on work by Benson, Dwyer, Greenlees, Iyengar, linking methods from various fields, commutative algebra, algebraic topology, non-commutative methods and fitting them in a common framework. This continued with a seminar on 2010 on, at that time, very recent aspects of support theory, where we reviewed basics facts on the work by Neeman, Balmer, etc. that was much talked about during the program and even the matter of part of the Advanced courses.

The preparation of the program itself took the form of a doctorate course at the new funded BGSMath given by the 3 organizers in common and that was attended by around 15 students. So the process to prepare the program in itself already had an impact in the local mathematical community.

The origin of the majority of the funding for the program: NSF and Bielfeld university means that most of the participants where foreigners, most notably Germans and from USA. This means that for those local mathematicians that attended the program, around 30 over the little more than 100 participants, this was a great opportunity to talk to leading mathematicians from abroad (e.g., Neeman, Benson, Greenlees, Wiegand, Buchweitz, Iyama, etc.) and to present their work in front of a high level audience, sometimes for the first time in our universities. This translates into a higher level of expectations from both the mathematical content and the quality of exposition from our local mathematicians that in turn leads to a higher mathematical quality as people match up the expectations.

To participate in the activities the program offered quite a number of grants mainly addressed to young participants (doctoral students and post-docs) from all over the world. Special attention has been paid in promoting the participation of young people from less favoured countries and women participation has been also encouraged.

Course notes for the 2 advanced courses *(Re)emerging methods in Commutative Algebra and Representation Theory* and *Building bridges between Algebra and Topology*, were available in advance.

The plan is to publish 2 volumes in the CRM series in the *advanced courses series* with a re-elaboration of these notes.

We are working on one volume of extended abstract, covering the 2 workshops and the final conference, within the series *Research Perspectives CRM Barcelona*.

All program information can be found at:

`http://www.crm.cat/en/Activities/Pages/ActivityFoldersAndPages/Curs%202014-2015/IRTATCA/RP-IRTATCA.aspx`

Visiting Researchers

Ana Agore (Vrije Universiteit Brussel), Josep Àlvarez-Montaner (Universitat Politècnica de Catalunya), Lidia Angeleri (Università degli Studi di Verona), Pere Ara (Universitat Autonòma de Barcelona), Luchezar L. Avramov (University of Nebraska-Lincoln), Paul Balmer (University of California at Los Angeles), Silvana Bazzoni (Università degli studi di Padova), Hanno Becker (Universität Bonn), Driss Bennis (Mohammed V University (Rabat)), David J. Benson (University of Aberdeen), Arkady Berenstein (University of Oregon), Julia Bergner (University of California at Riverside), Anthony Blanc (Universität Wien), Simion Breaz (Universitatea Babes-Bolyai), Michael Brown (University of Nebraska-Lincoln), Ragnar-Olaf Buchweitz (University of Toronto), José Ignacio Burgos (ICMAT/CSIC Madrid), Alessio Caminata (Universität Osnabrück), Natàlia Castellana (Universitat Autonòma de Barcelona), Olgur Celikbas (University of Connecticut), Ela Celikbas (University of Connecticut), Wojciech Chachólski (KTH Royal Institute of Technology), Lars Christensen (Texas Tech University), Nicholas Clarke (University of Manchester), Tobias Columbus (Karlsruher Institut für Technologie), Hailong Dao (University of Kansas), Ivo Dell'Ambrogio (Université de Lille 1), Alex Dugas (University of the Pacific), Tobias Dyckerhoff (Universität Bonn), Sergio Estrada (Universidad de Murcia), Luigi Ferraro (University of Nebraska-Lincoln), Vincent Franjou (Université de Nantes), Imma Gálvez (Universitat Politècnica de Catalunya), Vincent Gelinas (University of Toronto), John Greenlees (University of Sheffield), Moritz Groth (Max Planck Institute for Mathematics (Bonn)), Meng Guo (Harvard University), Dolors Herbera (Universitat Autonòma de Barcelona), Reiner Hermann (Norwegian University of Science and Technology), Daniel Hernandez (University of Utah), Ivo Herzo (The Ohio State University), Alina Iacob (Georgia Southern University), Kiyoshi Igusa (Brandeis University), Osamu Iyama, (Nagoya University), Srikanth B. Iyengar, University of Utah), Jack Jeffries (University of Utah), Ana Jeremías (Universidade de Santiago de Compostela), Martin Kalck (University of Edinburgh), Ryo Kanda (Nagoya University), Anargyros Katsampekis (University of Macedonia), Henning Krause (Universität Bielefeld), Bernard Leclerc (Université de Caen), Graham Leuschke

(Indiana University), Shreedevi K. Masuti (Chennai Mathematical Institute), Ciprian Modoi (Universitatea Babes-Bolyai), Tasos Moulinos (University of Illinois), Fernando Muro (Universidad de Sevilla), Yusuke Nakajima (Nagoya University), Amnon Neeman (Australian National University), Hop Nguyen (Friedrich-Schiller Universität Jena), Adi Niv (Inria Saclay), Paige North (University of Cambridge), Pranav Pandit (University of Vienna), Julia Pevtsova (University of Washington), Wolfgang Pitsch (Universitat Autonòma de Barcelona), Pavel Prihoda (Charles University in Prague), Hamid Rahmati (Miami University), Alessandro Rapa, Idun Reiten (Nordisk Teknik-Naturvikenskapelige Universitet), Vladimir Retakh (Rutgers University), Beren Sanders (University of Copenhagen), William Sanders (University of Kansas), Manuel Saorín (Universidad de Murcia), Jan Šaroch, Liran Shaul (Antwerp University), Brooke Shipley (University of Illinois), Charmaine Sia (Harvard University), Marc Stephan (École Polytechnique Fédérale de Lausanne), Greg Stevenson (Universität Bielefeld), Jan Stovicek (Charles University), Janet Striuli (Fairfield University), Tom Sutton (University of Sheffield), Peter Symonds (University of Manchester), Ryo Takahashi (Nagoya University), Louis-Philippe Thibault (University of Toronto), Gordana Todorov (Northeastern University), Jan Trlifaj (Charles University), Umesh V. (Chennai Mathematical Institute), Matteo Varbaro (University of Genova), Roger Wiegand (University of Nebraska-Lincoln), Sylvia Wiegand (University of Nebraska-Lincoln), Emily Witt (University of Utah), Santiago Zarzuela (Universitat de Barcelona).

Activities

• Weekly Seminar

Speakers

William Sanders, University of Kansas
Support Varieties and tensor product
February 23^{rd}, 20r15.

Sergio Estrada, Universidad de Murcia
Model category structures arising from complete cotorsion pairs
February $24^{\text{th}}, 2015$

Hamid Rahmati, Miami University
Duality for Koszul homology over Gorenstein rings
March $3^{\text{rd}}, 2015$

Roger Wiegand, University of Nebraska-Lincoln
Brauer-Thrall theorems for totally reflexive modules over local rings
March $3^{\text{rd}}, 2015$

Santiago Zarzuela, Universitat de Barcelona
Frobenius algebras of Stanley-Reisner rings
March $10^{\text{th}}, 2015$

Wolfgang Pitsch, Universitat Autònoma de Barcelona
A point free approach to supports
March $19^{\text{th}}, 2015$

Peter Symonds, University of Manchester
Degree bounds on homology and a conjecture of Derksen
March $19^{\text{th}}, 2015$

Jan Šaroch, Charles University
Mittag-Leffler modules and right almost split maps
March $24^{\text{th}}, 2015$

Julie Bergner, University of California at Riverside
Homotopy algebraic structures
March $24^{\text{th}}, 2015$

Moritz Groth, Max Planck Institute for Mathematics and Jan Stovicek, Charles University
Axiomatic homotopy theory via Grothendieck derivators.
Special seminar sessions, April 7^{th} to $10^{\text{th}}, 2015$

Samira Roointan, Isfahan University of Technology, Iran
Decomposition of Modules into Direct Sums of Cyclics
May $5^{\text{th}}, 2015$

Shreedevi Masuti, Chennai Mathematical Institute, India
Maps between G_n, k and G_n, l
May $12^{\text{th}}, 2015$

Tobias Columbus, Karlsruher Institut für Technologie
Quasicategorical models of spectra
May $19^{\text{th}}, 2015$

Umesh V. Dubey, Indian Institute of Science
Enriched Eilenberg-Moore construction and remark of Balmer
May $19^{\text{th}}, 2015$

Ivo Herzog, The Ohio State University
The representation theory of the Dubrovin-Puninski ring
June $5^{\text{th}}, 2015$

Idun Reiten, Norwegian University of Science and Technology
Preprojective algebras and Coxeter groups
June $16^{\text{th}}, 2015$

Arkady Berenstein, University of Oregon
Double canonical bases
June $23^{\text{rd}}, 2015$

Anargyros Katsampekis, University of Macedonia
Defining ideals of monomial curves in $\mathbb{A}^4(K)$
June $25^{\text{th}}, 2015$

• **Advanced course. (Re)emerging methods in Commutative Algebra and Representation Theory**

February 9^{th} *to* $13^{\text{th}}, 2015$

Participants: 42

Lecturers

Ragnar Olaf Buchweitz, University of Toronto
Matrix Factorizations for Commutative Algebraists.

Tobias Dyckerhoff, University of Oxford
Higher Hall algebras.

Osamu Iyama, Nagoya University
Tilting theory and Cohen-Macaulay representations.

• **Workshop: Homological bonds between Commutative Algebra and Representation Theory**

February 16^{th} *to* $20^{\text{th}}, 2015$

Participants: 54

Speakers

Josep Álvarez-Montaner (Universitat Politècnica de Catalunya), Pere Ara (Universitat Autonòma de Barcelona), Umamaheswaran Arunachalam (Umamaheswaran S Arunachalam), Silvana Bazzoni (Università degli studi di Padova), Ragnar-Olaf Buchweitz (University of Toronto), Alessio Caminata (Universität Osnabrück), Carles Casacuberta (IMUB), Ferran Cedó (Universitat Autonòma de Barcelona), Lars Christensen (Texas Tech University), Nicholas Clarke (University of Manchester), Gemma Colomé (Universitat Pompeu Fabra), Tobias Columbus (Karlsruher Institut für Technologie), Tere Cortadellas (Universitat de Barcelona), Laura Costa (Universitat de Barcelona), Carlos D'Andrea (Universitat de Barcelona), Joan Elías (Universitat de Barcelona), Sergio Estrada (Universidad de Murcia), Eslam Farag (Universitat Autonòma de Barcelona), Alberto Fernandez (Universitat Pompeu Fabra), Luigi Ferraro (University of Nebraska-Lincoln), Vincent Franjou (Université de Nantes), Imma Gálvez (Universitat Politècnica de Catalunya), Ricardo García (Universitat de Barcelona), Vincent Gelinas (University of Toronto), José Mª Giral (Universitat de Barcelona), Michal Hrbek (Charles University), Alina Iacob (Georgia Southern University), Kostiantyn Iusenko (Universidade de São Paulo), Osamu Iyama (Nagoya University), Srikanth B. Iyengar (University of Utah), Martin Kalck (Universität Bielefeld), Ryo Kanda (Nagoya University), Hiroyuki Minamoto (Osaka Prefecture University), Dongho Moon (Sejong University), Yusuke Nakajima (Nagoya University), Juan Carlos Naranjo (Universitat de Barcelona), Vicenç Navarro (Universitat de Barcelona), Hop Nguyen (Friedrich-Schiller Universität Jena), William Sanders (University of Kansas), Liran Shaul (Antwerp University), Marcela Silva (Universidade Estadual de Maringá), Marc Stephan (École Polytechnique Fédérale de Lausanne), Janet Striuli (Fairfield University), Diana Suzana (Jakarta State University), Ryo Takahashi (Nagoya University),

Louis-Philippe Thibault (University of Toronto), Jan Trlifaj (Charles University), Matteo Varbaro (University of Genova), Simone Virili (Università degli studi di Padova), Roger Wiegand (University of Nebraska-Lincoln), Sylvia Wiegand (University of Nebraska-Lincoln), Amnon Yekutieli (Ben-Gurion University of the Negev), Fajar Yuliawan (Universität Bielefeld), Santiago Zarzuela (Universitat de Barcelona).

• Advanced course: Building bridges between Algebra and Topology
April 13^{th} *to* $17^{\text{th}}, 2015$
Participants: 41

Lecturers

Wojciech Chachólski, KTH Chacholski
Idempotent symmetries in algebra and topology

John Greenlees, University of Sheffield
Homotopy invariant commutative algebra

Greg Stevenson, Universität Bielefeld
Support theory for triangulated categories

• Workshop: Brave new Algebra: opening perspectives
April 20^{th} *to* $24^{\text{th}}, 2015$
Participants: 44

Speakers

Leo Alonso (Universidade de Santiago de Compostela), Driss Bennis (Mohammed V University), David J. Benson (University of Aberdeen), Simion Breaz (Universitatea Babes-Bolyai), Carles Broto (Universitat Autonòma de Barcelona), Carles Casacuberta (Institut de Matemàtica Universitat de Barcelona), Natàlia Castellana (Universitat Autonòma de Barcelona), Ferran Cedó (Universitat Autonòma de Barcelona), Gemma Colomé (Universitat Pompeu Fabra), Tobias Columbus (Karlsruher Institut für Technologie), Alberto Fernandez (Universitat Pompeu Fabra), Ramón J. Flores (Universidad Autónoma de Madrid), Imma Gálvez (Universitat Politècnica de Catalunya), Alberto Gavira (Universitat Autonòma de Barcelona), John Greenlees (University of Sheffield), Moritz Groth (Max Planck Institute for Mathematics), Meng Guo (Harvard University), Reiner Hermann (Norwegian University of Science and Technology), Joachim Kock (Universitat Autonòma de Barcelona), Henning Krause (Universität Bielefeld), John Lind (Universität Regensburg), Mikel Lluvia (Universitat de Barcelona), George C. Modoi (Universitatea Babes-Bolyai), Tasos Moulinos (University of Illinois), Fernando Muro (Universidad de Sevilla), Mohamad Nakcha (HIASST), Rand Nakcha (Rand Nakcha Nakcha), Paige North (University of Cambridge), Sinem Odabaşi (Universidad de Murcia), Julia Pevtsova (University of Washington), Chrysostomos Psaroudakis (Norwegian University of Science and Technology), Oriol Raventós-Morera (Universität Regensburg), Ricard Riba (Universitat Autonòma de Barcelona), Marcy Robertson (Universität Tübingen), Abdó Roig-Maranges (Universitat Politècnica de Catalunya), Albert Ruiz (Universitat Autonòma de Barcelona),

Charmaine Sia (Harvard University), Johan Steen (NTNU, Trondheim, Norway), Greg Stevenson (Universität Bielefeld), Jan Šťovíček (Charles University), Tom Sutton (University of Sheffield), Marco Tarantino (Università degli studi di Padova), Andrew Tonks (London Metropolitan University), Simone Virili (Università degli studi di Padova).

- **Conference: Opening Perspectives in Algebra, Representations, and Topology (OP-ART)**

May 25^{th} *to* $29^{\text{th}}, 2015$

Participants: 56

Speakers

Leo Alonso (Universidade de Santiago de Compostela), Lidia Angeleri (Università degli Studi di Verona), Pere Ara (Universitat Autonòma de Barcelona), Eman Atef (Institut d'Estudis Catalans), Luchezar L. Avramov (University of Nebraska-Lincoln), Paul Balmer (University of California at Los Angeles), Hanno Becker (Universität Bonn), Pieter Belmans (Universiteit Antwerpen), Driss Bennis (Mohammed V University), Simion Breaz (Universitatea Babes-Bolyai), Carles Broto (Universitat Autonòma de Barcelona), Michael Brown (University of Nebraska-Lincoln), Ragnar-Olaf Buchweitz (University of Toronto), José Ignacio Burgos (CMAT/CSIC Madrid), Carles Casacuberta (Universitat de Barcelona), Natàlia Castellana (Universitat Autonòma de Barcelona), Ela Celikbas (University of Connecticut), Olgur Celikbas (University of Connecticut), Lars Christensen (Texas Tech University), Ivo Dell'Ambrogio (Université de Lille 1), Alex Dugas (University of the Pacific), Alberto Fernandez (Universitat Pompeu Fabra), Imma Gálvez (Universitat Politècnica de Catalunya), Manuela Garcia (Universitat de Barcelona), Matthew Garcia (Brandeis University), Dolors Herbera (Universitat Autonòma de Barcelona), Reiner Hermann (Norwegian University of Science and Technology), Srikanth B. Iyengar (University of Utah), Ana Jeremías (Universidade de Santiago de Compostela), Martin Kalck (University of Edinburgh), Henning Krause (Universität Bielefeld), Bernard Leclerc (Université de Caen), Graham Leuschke (Syracuse University), Mikel Lluvia (Universitat de Barcelona), Andrey Mikhovich (Belarusian State University), Tasos Moulinos (University of Illinois), Ian Musson (University of Wisconsin - Madison), Amnon Neeman (Australian National University), Adi Niv (Inria Saclay), Greg Piepmeyer (Columbia Basin College), Wolfgang Pitsch (Universitat Autonòma de Barcelona), Alessandro Rapa, Vladimir Retakh (Rutgers University), Samira Roointan (Isfahan University of Technology), Albert Ruiz (Universitat Autonòma de Barcelona), Beren Sanders (University of Copenhagen), Manuel Saorín (Universidad de Murcia), Olaf Schnürer (Universität Bonn), Ryo Takahashi (Nagoya University), Gordana Todorov (Northeastern University), Andrew Tonks (London Metropolitan University), Jan Trlifaj (Charles University), Umesh Kumar V. (Indian Institute of Science), Simone Virili (Università degli studi di Padova), David White (Wesleyan University), Santiago Zarzuela (Universitat de Barcelona).

3.1.3. CRM Research Programme on Statistical Advances for Complex Data

September to November, 2015

Scientific Committee

Alejandra Cabaña Universitat Autonòma de Barcelona
Malu Calle Universitat de Vic
Pedro Delicado Universitat Politècnica de Catalunya
Anna Espinal Universitat Autonòma de Barcelona
Guadalupe Gómez (coordinator) Universitat Politècnica de Catalunya
Rosa Lamarca Almirall SA
Pere Puig Casado Universitat Autonòma de Barcelona
Montse Rue Universitat de Lleida
Alex Sánchez Pla Universitat de Barcelona

Summary

Statistics is the science of data collection, analysis, and interpretation. Research in statistics has always been binded to scientific discovery and has influenced science, humanity and society by transforming data into knowledge and policies. Some of the problems we face today include complex data arisen from genomics, clinical trials, radiation analysis, etc. Datasets are currently being, or have already been, collected that contain, hidden in their complexity, important information waiting to be discovered. These discoveries will increase the scientific understanding of our world. The incredible potential of statistics in a world becoming more and more data-driven is the main goal of the Research Programme on Statistical Advances for Complex Data.

To this end we have distinguished three main topics:

1. Modeling and analysis of biological/biomedical data where new statistical methods for radiation analysis and omics data analysis will be studied. This includes statistical methods for radiation analysis, to explain, for instance, the underdispersion found in the samples of dicentrics for very high doses of radiation and new multivariate methods for the integrative analysis of omics data in such a way that noise can be minimized and relevant biological information can be extracted.

2. Biostatistical methods for clinical trials and for complex time-to-event data where multistate models accounting for interval censored data and Bayesian methods for joint modeling of longitudinal and time to event data might help explain the time an HIV patient needs to have their next DXA scan as well as to assess the impact of a false positive result in screening mammography. New developments in clinical trials will be approached to handle missing data and to reduce the needed sample size to detect the effect of a new treatment.

3. Statistics and big data where questions such as how big data differ from traditional data sets, and what implications do these differences have in the application of classical statistical methods will be studied. The use of distance-based methods when the size of data sets makes prohibitive the explicit computation of distance matrices and the use of Generalized additive models for large data sets to fit complex and potentially more realistic models are among the methods to undertake. Computational together with new statistical tools, are the keys to answering questions about data we might have had or might have in the future.

The program aims to facilitate broader, and deeper, interaction between researchers interested in either one of these broad fields. To this end, distinguished experts will participate in this program, teaching advanced courses on subjects of current interest. Further activities include workshops and regular seminars, with specific emphasis on opportunities for young researchers to learn new ideas and techniques.

All program information can be found at:
`http://www.crm.cat/en/Activities/Curs_2015-2016/Pages/SACD.aspx`

Visiting Researchers

Carmen Armero (Universitat de València), Herbert Brasselmann (Center for Environmental Health), Alejandra Cabaña (Universitat Autonòma de Barcelona), Malu Calle (Universitat de Vic), Malu Calle (Universitat de Vic), Aedin Culhane (Harvard University), Urania Dafni (National and Kapodistrian University of Athens), Pedro Delicado (Universitat Politècnica de Catalunya), Rodrigo Dienstmann (Vall d'Hebron Institute of Oncology), Jochen Einbech (Durham University), Anna Espinal (Universitat Autonòma de Barcelona), Ronald Geskus (Academic Medical Center), Ronald Geskus (Academic Medical Center), Guadalupe Gómez (Universitat Politècnica de Catalunya), Guadalupe Gómez (Universitat Politècnica de Catalunya), Moises Gómez-Mateu (Universitat Politècnica de Catalunya), KyungMann Kim (University of Wisconsin-Madison), Celestin Kokonendji (Laboratoire de Mathématiques de Besançon), Rosa Lamarca (Almirall SA), Klaus Langohr (Universitat Politècnica de Catalunya), Jonathan Marchini (Oxford University), Giovanni Montana (King's College London), Joaquín Ortega (Centro de investigación en Matemáticas de México), Núria Perez (Fundació Lluita contra la SIDA), Oleguer Plana (Aarhus University), Pere Puig (Universitat Autonòma de Barcelona), Pere Puig (Universitat Autonòma de Barcelona), Adolfo J. Quiroz (Universidad de Los Andes), Montserrat Rue (Universitat de Lleida), Alex Sánchez (Universitat de Barcelona), Mikis Stasinopoulos (London Metropolitan University), Mikis Stasinopoulos (London Metropolitan University), Bruno Miguel Tavares (Université d'Aix-Marseille), Bruno Miguel Tavares (Université d'Aix-Marseille), Simon Wood (University of Bath).

Activities

• Weekly Seminar

Speakers

Urania Dafni, National and Kapodistrian University of Athens
Current Issues in Clinical Trials: A Biostatciscian's perspective
September 10^{th}, 2015

Adolfo J. Quiroz, Universidad de los Andes
Nearest neighbours for Support vector machines (addressed mainly to MSc students)
September 22^{th}, 2015

Joaquin Ortega, Centro de investigación en Matemáticas de México
The two-sample problem for functional data
September 23^{rd}, 2015

Adolfo J. Quiroz, Universidad de los Andes
Mini course: Graph Theoretic Methods in Multivariate Statistics
September 28^{th} and 29^{th}, 2015

Adolfo J. Quiroz, Universidad de los Andes
Permutation methods in the two-sample problem for Functional Data
October 1^{st}, 2015

KyungMann Kim, University of Wisconsin-Madison
Marginal Mean Models for Zero-Inflated Count Data
October 13^{th}, 2015

Carmen Armero, Universitat de València
A multi-state model for estimating the progression of stage IV non-small cells lung cancer
October 28^{th}, 2015

Herbert Braselmann, Helmholtz Zentrum Muenchen
The Wilcoxon-Mann-Whitney test under scrutiny for molecularbiological data
November 3^{rd}, 2015

Celestin Kokonendji, Laboratoire de Mathématiques de Besançon
Bayesian estimations of bandwidth in semiparametric discrete kernel estimations
November 6^{th}, 2015

Celestin Kokonendji, Laboratoire de Mathématiques de Besançon
Nonparametric estimation of the number of zeros in truncated count distributions
November 12^{th}, 2015

Simon Wood, University of Bath
General smooth additive modelling
November 25^{th}, 2015

• **Advanced course: Introduction to Python**
September 8^{th} *to* $10^{\text{th}}, 2015$
Participants: 19

Lecturers — Jaume Baixeries, Universitat Politècnica de Catalunya
Introduction to Python's.

• **Advanced course: Data mining and social network analysis?**
September 16^{th} *to* $18^{\text{th}}, 2015$
Participants: 12

Lecturers — Bruno Tavares Gonçalves, Centre Physique Théorique
Social Data Mining and Analysis.

• **Advanced course: Competing risks: concepts, methods and software**
October 14^{th} *to* $16^{\text{th}}, 2015$
Participants: 23

Lecturers — Ronald Geskus, Academic Medical Center, Amsterdam
Competing risks: concepts, methods and software.

• **Advanced course: Flexible regression and smoothing**
November 16^{th} *to* $18^{\text{th}}, 2015$
Participants: 21

Lecturers — Mikis Stasinopoulos, London Metropolitan University
Flexible regression and smoothing.

• **DoreMi LD-RadStat: Workshop for statistical interested in contributing to EU low dose radiation research**
October 26^{th} *and* $28^{\text{th}}, 2015$
Participants:

• **Biostatnet workshop on biomedical (big) data**
November 26^{th} *and* $27^{\text{th}}, 2015$
Participants: 67

Speakers — Urko Aguirre (Hospital Galdakao-Usansolo), Adrià Alcalà (Universitat de les Illes Balears), Concepcion Arenas (Universitat de Barcelona), Carmen Armero (Universitat de València), Inmaculada Arostegui (Universidad del País Basc), Llorenç Badiella (Universitat Autònoma de Barcelona), Irantzu Barrio (Universidad del País Basc), Antoni Berenguer (Institut de Recerca Biomedicina Barcelona), Marta Bofill (Universitat Politècnica de Catalunya), Ramon Boix (Institut de Recerca Biomédica de Lleida), Ferran Briansó (Vall d'Hebron Institut de Recerca), Alejandra Cabaña (Universitat Autònoma

de Barcelona), Malu Calle (Universitat de Vic), Gerard Castellà (Institut de Recerca Biomédica de Lleida), Aedín Culhane (Harvard University), Rodrigo Dienstmann (Vall d'Hebron Institute of Oncology), Jenifer Espasandín (Universidad de Santiago de Compostel·la), Anna Espinal (Universitat Autònoma de Barcelona), Joan del Castillo (Universitat Autònoma de Barcelona), Amanda Fernández-Fontelo (Universitat Autònoma de Barcelona), Nuria Folguera (Centre de Recerca Matemàtica), Vicente Gallego (Universitat de Vic), Moisés Gómez-Mateu (Universitat Politècnica de Catalunya), Guadalupe Gómez (Universitat Politècnica de Catalunya), Clara Gregori-Pla (ICFO-Institut de Ciències Fotòniques), Ipek Guler (Universidad de Santiago de Compostel·la), Raquel Iniesta (King's College London), Klaus Langohr (Universitat Politècnica de Catalunya), Dae-Jin Lee (Universidad del País Basc), Jesús López (Universidad de Castilla-la Mancha), Jonathan Marchini (Oxford University), Jose Antonio Moler (Universitat Pública de Navarra), Giovanni Montana (King's College London), Nuria Pérez-Alvarez (Universitat Politècnica de Catalunya), Pere Puig (Universitat Autònoma de Barcelona), Alicia Quirós (Hospital Universitario Clínico San Carlos), Ferran Reverter (Fundació Centre de Regulació Genòmica), Javier Rivera (Universitat de Vic), Yarlosva Robles-Bykbaev (Universitat de la Corunya), Montserrat Rué (Universitat de Lleida), Marta Ruiz-Riol (Universitat Autònoma de Barcelona), Alex Sánchez (Universitat de Barcelona), Francisco-José Santonja (Universitat de València), Isabel Serra (Centre de Recerca Matemàtica), Carles Serrat (Universitat Politècnica de Catalunya), Francesc Solsona (Universitat de Lleida), Aikaterini Symeonidi (Institut de Recerca Biomèdica), Joan Valls (Institut de Recerca Biomèdica de Lleida), Esteban Vegas (Universitat Politècnica de Catalunya), Natàlia Vilor (Centre de Recerca en Epidemiologia Ambiental), Simon Wood (University of Bath), Oana Zeleznik (Graz University of Technology).

3.2. Congressos i Workshops

En aquest apartat es detallen els congressos i *workshops* que va organitzar el CRM durant l'any 2015 al marge dels programes de recerca.

3.2. Conferences and Workshops

This section lists the congresses and workshops organised by CRM during 2015 not included in research programmes.

4th Barcelona Computational, Cognitive and Systems Neuroscience (BARCSYN) 2015

June 18^{th} *and* $19^{\text{th}}, 2015$

Participants: 74

Organisers	Albert Compte (IDIBAPS), Jaime de la Rocha (IDIBAPS), Lluis Fuentemilla (Universitat de Barcelona), M. Victòria Puig (IMIM).
Keynote Speakers	Andreas Nieder (Universität Tübingen) *Quantity processing in the primate association cortex and its modulation by dopamine.*

Maneesh Sahani (Gatsby Computational Neuroscience Unit (London))
Perceiving is Believing: Bayesian inference in unexpected places.

Interdisciplinary Workshop on Quantitative Finance

June 25^{th} *and* $26^{\text{th}}, 2015$
Participants: 49

Organisers	Elisa Alòs (UPF), Joan del Castillo (UAB), José Manuel Corcuera (UB), Luis Ortiz-Gracia (CRM), Josep Vives (UB)
Speakers	Elisa Alòs (Universitat Pompeu Fabra), Jan De Spiegeleer (Jabre Capital Partners), Luca del Viva (ESADE), Albert Ferreiro Castilla (Banc de Sabadell), Chainarong Kesamoon (Universitat Autonòma de Barcelona), Jesús Marín Solano (Universitat de Barcelona), Luis Ortiz Gracia (Centre de Recerca Matemàtica), Salvador Ortiz Latorre (University of Oslo), Josep Perelló Palou (Universitat de Barcelona), David Ruiz Baños (University of Oslo), Miguel Santolino (Universitat de Barcelona), Isabel Serra Mochales (Centre de Recerca Matemàtica) Sara Solanilla (University of Oslo), Arturo Valdivia (Universitat de Barcelona), Josep Vives (Universitat de Barcelona)

Introducció a la Matemàtica Financera

7 al 9 de setembre de 2015
Participants: 34

Organisers	Joan del Castillo (Universitat Autònoma de Barcelona), Pere Puig (Universitat Autònoma de Barcelona)

3.3. Cursos avançats

En aquest apartat es detallen els cursos avançats que va organitzar el CRM durant l'any 2015 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 2015.

Combinatorial matrix theory

June 29^{th} *to July* $3^{\text{rd}}, 2015$
Participants: 27

Organisers	Andrés M. Encinas (Universitat Politècnica de Catalunya), Carlos Da Fonseca (Kuwait University), Margarida Mitjana (Universitat Politècnica de Catalunya).
Lecturers	Richard A. Brualdi (University of Wisconsin-Madison) *Combinatorial matrix theory* Angeles Carmona Mejías (Universitat Politècnica de Catalunya-BarcelonaTech) *Boundary value problems on finite networks*

Stephen J. Kirkland (University of Manitoba)
The group inverse for the Laplacian matrix of a graph

Dragan Stevanovic (Serbian Academy of Sciences and Arts (SANU))
Spectral radius of graphs

Pauline van den Driessche (University of Victoria)
Sign pattern matrices

Summer School on Nonlinear PDE's and Applications to Image Analysis. A scientific tribute to Vicent Caselles

July 20^{th} *to* $24^{\text{th}}, 2015$
Participants: 61

Organisers: Juan Calvo (Universitat Pompeu Fabra), Antonin Chambolle (CMAP, Ecole Polytechnique, CNRS), Bartomeu Coll (Universitat de les Illes Balears), Gloria Haro (Universitat Pompeu Fabra), Matteo Novaga (Università di Pisa), Philippe Salembier (Universitat Politècnica de Catalunya), Petia Radeva (Universitat de Barcelona / CVC).

Lecturers:

Luigi Ambrosio (Scuola Normale Superiore di Pisa)
Functions of bounded variation, sets of finite perimeter and image processing

Xavier Cabré Vilagut (ICREA and Universitat Politècnica de Catalunya)
Minimizers of nonlocal operators and the corresponding fractional diffusion equations

Simon Masnou (Université Claude Bernard Lyon 1)
Nonlocal models for image/video restoration

Jean-Michel Morel (Centre de mathématiques et de leurs applications, École Normale Superieure de Cachan)
The structure of digital images

Martin Rumpf (Universität Bonn)
Variational discretization of geometric calculus on shape spaces

V Summer School on Statitstical Physics of Complex and Small Systems

July 6^{th} *to* $17^{\text{th}}, 2015$
Participants: 57

Organisers: Álvaro Corral (Centre de Recerca Matemàtica), Tomás Alarcón (Centre de Recerca Matemàtica), Francesc Font Clos (Centre de Recerca Matemàtica).

Lecturers:

Anthonius Coolen (Institute for Mathematical and Molecular Biomedici)
Statistical physics of tailored random graphs: entropies, processes, and generation

Ignacio Pagonabarraga (Universitat de Barcelona)
Coarse grained dynamics and mesoscopic computational methods

Gunnar Pruessner (Imperial College London)
Field theory of reaction diffusion processes

Stefan Thurner (University of Vienna)
Information theory for complex systems

Geometric Analysis
September 14^{th} *to* $18^{\text{th}}, 2015$
Participants: 41

Organisers	M. Carmen Reguera (University of Birmingham), Xavier Tolsa (ICREA-UAB).
Lecturers	Marianna Csörnyei (University of Chicago) *Tangents of sets and differentiability of functions* Pekka Koskela (University of Jyväskylä) *Sobolev spaces on simply connected planar domains* Giuseppe Mingione (University of Parma) *Recent progresses in nonlinear potential theory*

3.4. Jornades temàtiques

El CRM promou també trobades intensives de recerca sota la denominació de "jornades temàtiques". El 2015 es van celebrar les següents:

3.4. Thematic Days

The CRM also promotes intensive research meetings generically named "thematic days". In 2015 the following have been hosted:

- *CRM Colloquium: Human contact networks: empirical data, modeling, and dynamics*, March $26^{\text{th}}, 2015$

  Speakers: Romualdo Pastor-Satorras (Universitat Politècnica de Catalunya)

- *CRM Colloquium: Challenges and opportunities using Statistical Mechanics modeling in the industrial world*, July $7^{\text{th}}, 2015$

  Speakers: Lourdes F. Vega (Plataforma Tecnológica Española del CO2).

- *The physics and mathematics of viral assembly*, December $2^{\text{nd}}, 2015$

  Speakers: David Reguera (Departament de Física Fonamental de la Universitat de Barcelona).

3.5. Seminaris del CRM

El CRM difon l'activitat de tots els seminaris de recerca matemàtica de Catalunya, però també 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.

3.7. CRM Seminars

The CRM disseminates the activity of all the research seminars in mathematics in Catalonia, 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*: Francesc Font Clos (CRM) until July 2015. Roberto de la Cruz (CRM) from September 2015 onwards.

30/07/2015. Daniel Sánchez Taltavull, Ottawa Hospital Research Institute, *Modelling red blood cell development*.

04/06/2015. Aurora Hernández-Machado, Universitat de Barcelona, *Roughness and wetting at microscales*.

09/06/2015. Carlos Lugo, Sainsbury Lab, Cambridge, *Structural features of RNA phenotype networks and its effects on biological evolution*.

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).

05/03/2015 . Susanne Ditlevsen, University of Copenhagen, *Partially observed stochastic models in neuroscience*.

09/04/2015. Guillaume Hennequin, University of Cambridge, *Inhibition-stabilized balanced dynamics account for stimulus-induced changes of noise variability in the cortex*.

16/04/2015. Alla Borisyuk, University of Utah, *Periodically driven noisy neuronal models: a spectral approach*.

21/05/2015. Michael Graupner, Laboratoire de Physiologie Cérébrale- Université Paris Descartes, *Unreliable tone-evoked activity in the auditory cortes*.

15/05/2015. Tobias Donner, University of Amsterdam, *Brainstem modulation of cortical decision computations*.

10/07/2105. Horacio Rotstein, New Jersey Institute of Technology, *Inhibition-based theta resonance in a hippocampal network: a modeling study*.

Seminar Cycle on Quantitative Finance

Organitzadors/*Organisers*: Joan del Castillo (UAB), José Manuel Corcuera (UB), Josep J. Masdemont (UPC), Luis Ortiz Gracia (CRM) (Coordinador), Frederic Utzet (UAB), Josep Vives (UB).

15/01/2015. Christian Brownlees, Universitat Pompeu Fabra, *Network estimation for time series*.

19/02/2015. Marjon Ruijter, CWI, *Numerical Fourier Method and second-order Taylor Scheme for Backward SDEs in Finance*.

16/11/2015. Umut Çetin (London School of Economics, London), *Risk averse market makers and Kyle's model*.

16/11/2015. Stéphane Crepey (University of Evry, France), *Multivariate shortfall risk allocation and systemic risk* .

04/12/015. Michael Coulon, University of Sussex, *Electricity price modeling: Structural approaches, derivative pricing techniques and ongoing challenges*.

3.6. Altres activitats / Other activities

- *III Jornada d'Investigadors Predoctorals Interdisciplinària*, February 5, 2015
- *Thresholding the birth-death process*, February 18, 2015
- *Tasta la BioMatemàtica al CRM a càrrec del Dr. Tomás Alarcón (CRM)*, March 21, 2015
- *International Conference on Risk Analysis ICRA 6/RISK 2015*, May 26 to 29, 2015
- *Helly-type theorems and beyond*, June 11, 2015
- *Geometric Measures theory, optimal mass transportation and PDEs*, june 15 to 19, 2015
- *Applied Geometric Algebra in Computer Science and Engineering - AGACSE 2015*, July 29 to 31, 2015
- *Barcelona Topology Workshop (BaToWo)*, November 27 to 28, 2015.

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 2015, ha estat format per Enric Ventura (editor en cap), Antoni Guillamon (en representació de l'Equip de Direcció) 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 2015.

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 2015, it was formed by Enric Ventura (Editor-in-Chief), Antoni Guillamon (representing the Team of Directors) 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 2015.

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 reelaborades pels mateixos autors. Es tracta de llibres de text, especialment adreçats a estudiants

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 handed out to students and later reworked by the authors. These volumes are especially addressed

de doctorat avançats i a joves investigadors postdoctorals.

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).

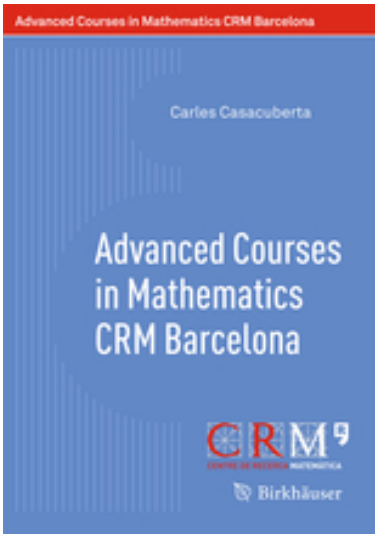
L'any 2015 han aparegut quatre volums d'aquesta sèrie:

to advanced doctoral and young post-doctoral students.

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).

The following four volumes of this series were published in 2015:

- Jaume Llibre, Richard Moeckel, Carles Simó. *Central Configurations, Periodic Orbits, and Hamiltonian Systems*, edited by Montserrat Corbera, Josep Maria Cors, Enrique Ponce. Advanced Courses in Mathematics CRM Barcelona, Birkhäuser, Basel, 2015. ISBN 978-3-0348-0932-0
- Vlady Bally, Lucia Caramellino, Rama, Cont. *Stochastic Integration by Parts and Functional Itô Calculus*, edited by Frederic Utzet, Josep Vives. Advanced Courses in Mathematics CRM Barcelona, Birkhäuser, Basel, 2015. ISBN 978-3-0348-0920-7
- Paul Hacking, Radu Laza, Dragos Oprea. *Compactifying Moduli Spaces*, edited by Gilberto Bini, Martí Lahoz, Emanuele Macrì, Paolo Stellari. Advanced Courses in Mathematics CRM Barcelona, Birkhäuser, Basel, 2015. ISBN 978-3-319-34119-4
- Valery Alexeev. *Moduli of Weighted Hyperplane Arrangements*, edited by Gilberto Bini, Martí Lahoz, Emanuele Macrì, Paolo Stellari. Advanced Courses in Mathematics CRM Barcelona, Birkhäuser, Basel, 2015. ISBN 978-3-0348-0914-6



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 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*.
Els editors de la sèrie són Antoni Guillamon i Enric Ventura.

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 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.

The series editors are Antoni Guillamon and Enric Ventura.

4.3. Quaderns

La sèrie *Quaderns* recull el contingut d'activitats especialitzades, principalment els apunts lliurats prèviament pel professorat de cursos avançats del CRM. Durant l'any 2015 s'han publicat els exemplars següents:

Booklets in the Quaderns *series contain specialized texts, mostly preliminary notes delivered by the lecturers of the advanced courses held at the CRM. The following issues were printed in 2015:*

- Ragnar Olaf Buchweitz, Tobias Dyckerhoff, and Osamu Iyama. *Advanced Course on (Re)emerging methods in Commutative Algebra and Representation Theory*, Vol. 70, Febrer 2015.
- Wojciech Chachólski John Greenlees, Greg Stevenson. *Advanced Course on Building Bridges between Algebra and Topology*, Vol. 71, Abril 2015.
- Richard A. Brualdi, Angeles Carmona Mejías, Stephen J. Kirkland, Dragan Stevanovic, Pauline van den Driessche. *Advanced Course on Combinatorial Matrix Theory*, Vol. 72, Juny 2015.
- Luigi Ambrosio, Xavier Cabré Vilagut, Simon Masnou, Jean-Michel Morel, Martin Rumpf. *Summer School on Nonlinear PDE's and Applications to Image Analysis. A scientific tribute to Vicent Caselles*, Vol. 73, Juliol 2015.
- Ronald Geskus. *Competing risks: Concepts, methods and software*, Vol. 74, Octubre 2015.

4.4. Preprints

La sèrie de prepublicacions del CRM s'ha incrementat amb els 17 títols següents durant l'any 2015:

The CRM preprint series grew with the following 17 issues in 2015:

- R. Rabanal. *Hamiltonian stability in some open surfaces with simple singularities*, preprint no. 01/2015.
- L. Ortiz-Gracia and Cornelis W. Oosterlee. *A highly efficient Shannon Wavelet Inverse Fourier Technique for pricing European options*, preprint no. 02/2015.
- J. Calvo, M. Novaga, and G. Orlandi. *Parabolic equations in time dependent domains*, preprint no. 03/2015.
- D.V. Gorbachev, V.I. Ivanov, and S.Yu. Tikhonov. *Sharp Pitt inequality and logarithmic uncertainty principle for Dunkl transform in* L^2, preprint no. 04/2015.
- F. Muro. *Cylinders for non-symmetric DG-operads via homological perturbation theory*, preprint no. 05/2015.
- D. Benson, S.B. Iyengar, H. Krause, and J. Petsova. *Stratification and* π*-cosupport: Finite groups*, preprint no. 06/2015.
- H. Krause. *Highest weight categories and recollements*, preprint no. 07/2015.
- A. Berenstein, V. Retakh. *Generalized adjoint actions*, preprint no. 08/2015.
- C.E. Parra and M. Saorín. *Addendum to 'Direct limits in the heart of a* t*-structure: The case of a torsion pair'*, preprint no. 09/2015.
- S. Estrada, S. Virili. *Cartesian modules over representations of small categories*, preprint no. 10/2015.
- L.W. Christensen and S.B. Iyengar. *Tests for injectivity of modules over commutative rings*, preprint no. 11/2015.
- I. Moreno-Sánchez, F. Font-Clos, and A. Corral. *Large-scale analysis of Zipf's law in English texts*, preprint no. 12/2015.
- J. Šaroch. *On the non-existence of right almost split maps*, preprint no. 13/2015.
- A. Pimenov, T.C. Kelly, A. Korobeinikov, M.J.A. O'Callaghan, and D. Rachinskii. *Memory and adaptive behaviour and in population dynamics: Anti-predator behaviour as a case study*, preprint no. 14/2015.
- E. Grigorieva, E. Khailov, and A. Korobeinikov. *Optimal control for a SIR epidemic model with nonlinear incidence rate*, preprint no. 15/2015.
- I. Serra and A. Corral. *Deviation from power law of the global seismic moment distribution*, preprint no. 16/2015.
- I. Dell'Ambrogio, G. Stevenson, and J. Šťovíček. *Gorestein homological algebra and universal coefficient theorems*, preprint no. 17/2015.

5

Resum econòmic

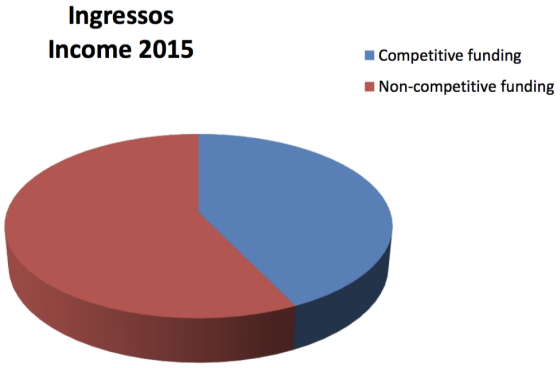
Financial Summary

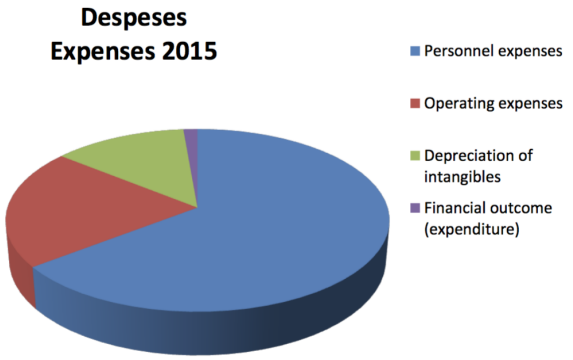
5.1 Ingressos — 5.1. Income

Ingressos competitius *Competitive funding*	697.566,44 €
Ingressos no competitius *Non-competitive funding*	932.272,03 €
TOTAL	**1.629.838,47 €**

5.2 Despeses — 5.2. Expenses

Despeses de personal *Personnel expenses*	1.035.102,65 €
Despeses d'explotació *Operating expenses*	339.199,78 €
Altres despeses *Other expenses*	63.143,58 €
Amortització immobilitzat *Depreciation of intangibles*	206.454,32 €
Resultat financer (despesa) *Financial outcome (expenditure)*	21.721,42 €
Resultat exercici *Annual profit*	-35.783,28 €
TOTAL	**1.629.838,47 €**





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