CENTRE DE RECERCA MATEMÀTICA

Memòria d'Activitats
Report of Activities
2014

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Centres de recerca de Catalunya

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MEMÒRIA D'ACTIVITATS 2014

REPORT OF ACTIVITIES 2014

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Presentació

L'any 2014 al CRM ha estat marcat en primer lloc pel 30è aniversari del centre, que va ser commemorat amb dos actes de caràcter diferent. Per una banda, un acte de caire institucional, que va tenir lloc al Palau de la Generalitat el dia 13 de juny sota la presidència de l'honorable Sr. Andreu Mas-Colell, i que va comptar amb la participació del Sr. Jean-Pierre Bourguignon, secretari general de l'European Research Council (ERC) i bon amic del CRM. Per l'altra, un acte de caire més acadèmic, que es va celebrar a la seu de l'Institut d'Estudis Catalans (IEC) el dia 27 de maig i que va consistir en dues conferències, a càrrec respectivament de Tamar Ziegler i Angela Stevens. En ambdós actes els assistents van poder visitar l'exposició "Créixer en Matemàtiques, fer país", explicativa de la trajectòria del CRM durant aquests trenta anys, i a cura de Manuel Castellet, director honorari del CRM.

Aquest any ha vist també l'aprovació, per part del Consell Científic Assessor i del Consell de Govern del CRM, del nou pla estratègic del centre pel període 2014-2019 que s'havia anat gestant durant el 2013 i que es nodreix també dels resultats del procés d'avaluació que l'agència CERCA va conduir al CRM. 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 2014 va ser acordat i signat juntament amb els seus respectius indicadors a començaments d'any.

Un altre fet molt significatiu ha estat el ple desenvolupament del programa de Recerca Matemàtica Col·laborativa finançat per la Fundació de l'Obra Social de la Caixa. Durant el 2014 s'han incorporat al centre en el marc d'aquest programa un total de 6 investigadors doctorals i 2 investigadors postdoctorals, tots ells amb contractes renovables fins a un màxim de tres anys. Cal assenyalar també que durant el 2014 quatre investigadors doctorals del CRM van obtindre el títol de doctor en algun dels programes de doctorat de Matemàtiques de les universitats catalanes. Encara en el terreny de la formació doctoral, hem de destacar que un dels dos projectes de formació doctoral que el CRM va presentar al pla de Doctorats Industrials de la Generalitat i que en el 2013 van quedar deserts per falta de candidats, aquest any 2014 s'ha pogut tornar a convocar, s'ha trobat la persona adequada i s'ha aconseguit la subvenció de l'AGAUR per al seu desenvolupament.

En el terreny de la recerca la situació al CRM presenta dues cares prou diferents. Creiem que 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. També és significatiu en aquest sentit que s'ha aconseguit l'acreditació de grup de recerca consolidat a la convocatòria SGR de l'AGAUR per al conjunt de grups del CRM, sota la denominació de "Grup de Recerca Matemàtica Col·laborativa del CRM". En canvi, els resultats no són tan bons pel que fa als recursos competitius captats

pels nostres grups. L'import assignat a aquests projectes és baix, conseqüència de la poca dimensió dels grups. Tal com el nou 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.

En un altre terreny, és del cas destacar que durant el 2014 el centre ha començat de la mà de CERCA el procés per a l'obtenció de l'acreditació europea associada a la *Human Resources Strategy for Researchers (HRS4R)*, gestionada per Euroaxess. En una primera etapa, el centre es va adherir al *Charter&Code for Researchers* i es va comprometre a implementar-ne els seus principis i bones pràctiques. El procés d'acreditació ha començat amb una anàlisi interna per a detectar les mancances que en aquest terreny presenta l'organització interna del centre, que s'ha revelat com a molt útil.

I deixo per al final el punt que al meu criteri és més significatiu i important per al futur del CRM i de la recerca en Matemàtiques a Catalunya. Em refereixo a la Barcelona Graduate School of Mathematics, participada pel CRM, la Facultat de Matemàtiques de la UB, la Facultat de Matemàtiques i Estadística de la UPC i el departament de Matemàtiques de la UAB, i que tal i com destacava en la memòria del 2013, va començar de facto les seves activitats el gener d'aquell any. Doncs bé, a finals del 2014 s'ha fet un pas decisiu, 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 mateixa, cosa que faculta a 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 la presentació per part del CRM, i liderada científicament pel Dr. Marc Noy, d'una sol·licitud a la convocatòria *María de Maeztu* del MINECO per a unitats d'excel·lència, sol·licitud que cap de les quatre institucions participants en la BGSMath té dimensió suficient per fer separadament de les altres. En el moment de redactar aquestes línies, la resolució provisional assenyala la sol·licitud de la BGSMath com una de les sis seleccionades. Es tracta doncs d'un èxit que demostra la força de la unitat i que en definitiva constitueix també un èxit de la missió estatutària del CRM.

Joaquim Bruna, Director

Presentation

The year 2014 at CRM has been marked first by the 30th anniversary of the center, which was commemorated with two events of different character. On one hand, an act of institutional nature, which took place at the Palau de la Generalitat (Government Palace) on 13 June, chaired by the Honorable Mr. Andreu Mas-Colell; Mr. Jean-Pierre Bourguignon, Secretary General of the European Research Council (ERC) and good friend of CRM, also participated in the event. On the other, a more academic act, which was held at the headquarters of the Institut d'Estudis Catalans (IEC) on 27 May, which consisted of two conferences, respectively in charge of Tamar Ziegler and Angela Stevens. In both events the participants were able to visit the exhibition "Créixer en matemàtiques, fer país", explaining the trajectory of CRM during these thirty years, whose curator was Manuel Castellet, the honorary director of CRM.

This year also witnessed the approval of the new strategic plan for the period 2014-2019 by the Scientific Advisory Board and the Board of Governors of the CRM. The plan had been brewing in 2013 and is nourished from the results of the CRM evaluation process led by the CERCA agency. Unlike the previous plan for the period 2008-2013, the new plan is not accompanied by a long-term contract-program with the Government of Catalonia, but its implementation is done by a year by year contract-program. The contract for 2014 was agreed and signed with their respective indicators at the beginning of the year.

Another significant achievement has been the full development of the Mathematics Collaborative Research Program funded by the La Caixa Foundation. During 2014, the center incorporated under this program a total of six doctoral fellows and two postdoctoral researchers, all contracts renewable up to three years. We should also note that during 2014 four CRM doctoral researchers were awarded the PhD in some of the PhD programs in Mathematics of the Catalan universities. Still in the field of doctoral training, we must stress that one of the two doctoral training projects that CRM presented to the Industrial Doctorates plan of the Catalan Government, which had remained deserted for lack of candidates in 2013, could be announced again in 2014 and found the right person to get the AGAUR grant for its development.

In the field of research the situation of CRM has two different sides. We believe that the results of research regarding publications, impact, international visibility, training, etc. are good enough, as the reader can verify in this report. Likewise, all CRM researchers have running projects in the competitive calls of the Spanish system. It is also significant in that respect the accreditation achieved by the CRM research groups as a consolidated research group within the SGR-AGAUR call, under the name "CRM Collaborative Mathematics Research Group". However, the results are not as good concerning competitive funds captured by our groups. The amount allocated to these projects is low due to the limited size of the groups. As the new strategic plan highlights, the unresolved matter of CRM groups, shared by almost all groups in mathematics, is nothing but the presence in European programs and, particularly, in the H2020.

In a different area, it is worth noting that during 2014 the center, with the help of CERCA, has begun the process to obtain the European accreditation associated to the Human Resources Strategy for Researchers (HRS4R), managed by Euroaxess. In the first stage, the center joined the Charter&Code for Researchers and committed to implement its principles and good practices. The accreditation process started with an internal analysis to detect shortcomings that the internal organization of the center shows in these aspects, which has proved very useful.

To conclude this presentation, I focus on the more significant and important point, in my opinion, for the future of the CRM and the research in mathematics in Catalonia. I mean the Barcelona Graduate School of Mathematics, participated by the CRM, the Facultat de Matemàtiques at UB, the Facultat de Matemàtiques i Estadística at UPC and the Department of Mathematics at UAB. As it was already highlighted in the 2013 annual report, the BGSMath began its activities de facto in January of that year. Well, at the end of 2014 a decisive step has occured, the signing of the agreement between the UB, UPC, UAB and CRM has formally created the BGSMath as an interinstitutional unit and designed the CRM as its managing institution, which authorizes the BGSMath acting under the legal identity of CRM. The first action conducted by the BGSMath with the CRM as the managing institution was the presentation by the CRM of a project proposal, led by Dr. Marc Noy, in the context of the María de Maeztu, launched by MINECO, for excellence units; indeed, none of the four participating entities in BGSMath was large enough to be eligible. At the time of writing these lines, the provisional resolution stand the BGSMath out as one of six selected projects. It is therefore a success that proves the strength of the unity and, ultimately, a success within the CRM statutory mission.

Joaquim Bruna, 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 2008-2013:

- 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 stated 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 transversal in the sense that its activities benefit the whole community of mathematical researchers of our country. The scientific policy of the CRM towards fulfilling its mission is structured around two main axes, quoted in the strategic plan within the contract-programme with the Generalitat de Catalunya for the period 2008-2013:

- *To give support to research groups, by organising activities whose size or nature goes beyond the capabilities of the teams, achieving broad visibility and hosting visitors for joint work.*
- *To design and execute strategies aimed at repairing 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 inaugurated its own premises at the UAB's Science Faculty, thanks to 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, 2002 (DOGC No. 3693, August 6, 2002) the creation of the CRM Consortium, formed by the Generalitat de Catalunya and the IEC. The CRM Consortium is a public body with its own legal status. In December 2013 the Universitat Autònoma de Barcelona joined the Consortium.

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

The CRM is one of the centres in the CERCA Institution of research centres sponsored by the Generalitat de Catalunya, and of the Associació Catalana d'Entitats de Recerca (ACER). The CRM is a member of both of 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 president of the IEC, or his delegate.*
- *Three representatives of 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 11 de juliol de 2014. 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 pel seu president, Joandomènec Ros, 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 el gerent, Oriol Fernández. Va actuar com a secretari Josep-Maria Alcoberro. El Consell es va tornar a reunir a l'octubre i al desembre de 2014.

- *Three representatives of the IEC*
- *The Director of CRM, who participates with a voice but not a vote.*

The Governing Board met on December 13, 2014. In that meeting, the Generalitat de Catalunya was represented by Josep Maria Martorell, in his capacity of Director General de Recerca, who assumed the position of Chairman of the Board. The IEC was represented by the president, Joandomènec Ros, by Joaquim Agulló and by Joan Girbau. Lluís Tort, the vice-rector of Strategic Projects and Planning of the UAB, assisted to the meeting on behalf of the rector of the UAB. The CRM director, Joaquim Bruna, and the general manager, Oriol Fernández, also assisted to the meeting. Josep-Maria Alcoberro acted as Secretary. Two more meetings were held in October and December 2014, 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 24 de gener de 2014. 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) is composed of prestigious personalities in 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 January 24, 2014. Throughout the year, on-line meetings were held.

The Governing Board approved on May 23, 2011, a 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.
- Objectiu 2: atraure al CRM una mitjana de 1,5 investigadors júnior per any en els propers

1.5. The CRM strategic plan 2014–2019

The first contract-programme of the CRM with the Catalan Government was signed on June 18, 2003. It remained into force until 2006 and was extended over 2007. On February 14, 2009, a new contract-programme, 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 11th, 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 situation of the center. Next, the document addresses the new plan, which serves as a roadmap of the center in line with its statutory mission. The new plan proposes to develop policies oriented to different areas and to achieve specific goals, grouped as follows.

1.5.1. Research

The CRM as an attracting pole of 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.*
- *Goal 2: attract to the CRM 1,5 junior researcher per year on average in the*

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

El paper de 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, etc.) per comunicar els valors de la investigació matemàtica a la societat.

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 an thorough mid- and long-term planning in order to prepare proposals to apply in competitive calls.*
- *Goal 6: promote the co-supervision of PHD theses within the CRM.*

Thematic networks with 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 interviews, etc.) to spread the impact of mathematical research on society.*

- Objectiu 11: designar els investigadors de CRM com a col·laboradors científics a les universitats. Els actuals acords amb universitats ho permeten. A més, el projecte BGSM 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 els visitants a llarg termini d'usar també una afiliació temporal al CRM quan signen documents originats durant la seva estada al centre.

- *Goal 11: appoint the CRM researchers as scientific collaborators of the local universities, as 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 to long-term visitors a temporary affiliation to the CRM when signing documents originated from their stay at the centre.*

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

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

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 de 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 respect.*
- *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. Coll·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

Advanced Courses CRM Barcelona, edited by Birkhäuser, and reduce to six months the period between the courses and the edition.

Scientific dissemination and institutional image:

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

1.5.5. Procedures, management and premises

- *Goal 30: ellaboration and implementation of an equality plan of 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. Other mission of the BGSMath are the

també té com a objectius millorar l'ocupació de titulats en matemàtiques a la indústria i en l'àmbit no acadèmic en general, i esdevenir una plataforma per a tots els agents actius en recerca matemàtica orientada al desenvolupament de projectes col·laboratius.
Les institucions promotores de la BGSMath són 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.

enhancement of employment of mathematicians in industry and in non-academic environment in general, and becoming a platform for all active agents in mathematical research towards the development of collaborative projects.

The promoting institutions of the BGSMath are the 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.

http://www.bgsmath.cat/

1.6.2. ERCOM

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

El president d'ERCOM és nomenat per un període de quatre anys pel comitè executiu de l'EMS. 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.

1.6.2. ERCOM

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

The president of ERCOM is appointed for a period of four years by the EMS Executive Committee. 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 chair.

La reunió anual d'ERCOM de 2014 tingué lloc els dies 21 i 22 de març, a Roma.

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.

The annual meeting of ERCOM in 2014 was held on March 21 and 22, in Rome.

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.

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

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

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. Actualment, el centre compta amb la presència de l'investigador ICREA Sergey Tikhonov.

CRM participates actively in all the ICREA calls by presenting renowned mathematical researchers as candidates for ICREA positions. Current, the ICREA Research Professor Sergey Tikhonov is appointed at CRM.

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 2014. 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.

1.7.1. 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

1.7. Sponsorships

In the economic and financial situation in which the CRM is currently immersed, some of the projects undertaken in the last times 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 2014. 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. "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

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

Government, approved funding of the training program on Collaborative Mathematics presented by the CRM. See

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

L'objectiu del programa és promoure la recerca matemàtica col·laborativa i interdisciplinària 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".

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".

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 2014 es van concedir les següents beques o contractes (investigadors, temes, supervisor al CRM, supervisors externs):

The funding of this program by La Caixa allows the CRM to offer a number of doctoral and postdoctoral contracts over a period of five years starting January 2014. They consist of 3-year long contracts linked training project on a specific topic defined jointly by a researcher in mathematics as director and a co-director from another discipline. The following fellowships were awarded during 2014 (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). (to start in 2015).
- 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).

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 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 2014, 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 científincs dels programes de recerca.

1.7.2. Clay Mathematics Institute

The Clay Mathematics Institute is a privately funded operating foundation dedicated to increasing and disseminating mathematical knowledge. One of the programs of the CMI is the "Enhancement and Partnership Proposals", aiming at enhancing activities that are already planned, particularly by funding international participation. Starting 2013, a CRM proposal on this program was approved by CMI to support participation of senior outstanding researchers and young postdocs in the CRM Intensive Research Programs. During 2014, 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.

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 acollirà els primers investigadors dins del *Simons Visiting Program*.

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. During the 2014-15 course, the CRM will host the researchers within the Simons Visiting Program.

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.

Durant el 2014, el CRM ha centrat els esforços en desenvolupar les bases per presentar una patent entre els departaments de Física i Enginyeria Electrònica de la Universitat de Barcelona i el grup de Biologia Matemàtica i Computacional del CRM. Ha estst clau l'anàlisi de valorització i la decisió conseqüent de buscar un model de retorn en base a la llicència a tercers més que la creació d'un *spin-off*.

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.

During 2014, the CRM has concentrated efforts in developing the bases to present a patent together with the departments of Physics and Electronic Engineering in the Universitat de Barcelona and the CRM group on Mathematical and Computational Biology. A key point in this action was the valuation and consequent decision of seeking for a return model based on third party licenses rather than embarking a spin-off.

A part, s'han tancat els projectes amb empreses que requerien una transferència de coneixement *ad hoc* als problemes presentats. Els reptes s'han assolit amb èxit: en el cas de *Hohner Automáticos S.L*, el projecte ha derivat cap a un Doctorat Industrial i, en el cas de *Ferrovial Servicios*, en una extensió del producte per a la seva internacionalització via filials del grup.

Finalment, s'ha mantingut la col·laboració estreta amb el sector bancari i financer impulsant les 2es Jornades CRM-Empresa sobre Finances Quantitatives (vegeu Secció 3.4), així com les reunions amb altres centres CERCA per dotar-los d'eines matemàtiques, sobretot en el sector salut.

On the other side, two projects with companies that required ad hoc transfer solutions to the proposed problems have been finished and the challenges have been successfully achieved: in the case of Hohner Automáticos S.L, the project has led to an Industrial Doctorate, whereas in the case of Ferrovial Servicios, in an extension of the product for its internationalization via affiliated companies.

Finally, a close collaboration with the banking and financial sector has been maintained through the 2nd CRM-companies thematic day on Financial Mathematics (see Section 3.4), as well as meetings with other CERCA centers in order to provide them mathematical tools, mainly in the health sector.

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 the impulse of 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

1.8.3. Industrial Doctorate

The CRM has provided proposals for Industrial Doctorates since the set up of this plan by the

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.

Generalitat de Catalunya. Fortunately, in this second call, one of the proposed projects has been initiated, together with the company Hohner Automáticos S.L. The student who will carry out his PhD thesis in this project is Néstor Costa Jimeno.

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

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, 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. Structure and administration

1.9.1. Team of Directors

The Governing Board elects a Director, proposed by the Chair, 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, 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, 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, 2011.

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. Gerència

El Sr. Oriol Fernández ha ocupat el càrrec de gerent des de l'any 2008 fins a juliol de 2014. A la sessió del mes d'octubre, el Consell de Direcció del CRM va nomenar la Sra. Maria Àngels Huertos com a nova gerent del centre.

1.9.2. General Management

The CRM's Manager has been Mr. Oriol Fernández since 2008 from July 2014. During the meeting in October, Ms. Maria Àngels Huertos was nominated the new Manager by the Board of Governors.

mahuertos@crm.cat telèfon 93 586 8424

Equip d'administració / *Management team*

1.9.3. Equip d'administració

L'equip d'administració del CRM durant el 2014 ha estat format per les persones següents:

1.9.3. Management team

The following people made up the management team in 2014:

Joaquim Berenguer (until April 2014)	jberenguer@crm.cat	Tel: 93 586 8423
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 2014, l'equipament informàtic del CRM constava d'una xarxa LAN Ethernet d'aproximadament unes vuitanta estacions de treball basades en sistemes Microsoft i Linux, i estructurades sota un domini Windows. Entre d'altres serveis, la xarxa constava d'un servidor de correu electrònic, un servidor d'impressió (que gestionava els treballs de cinc impressores), un servidor de fitxers i un *Firewall/Router* que la connectava a la infraestructura de la UAB mitjançant un enllaç d'1 Gb. Es va dotar, dins d'aquesta xarxa, de sistemes per a permetre el treball en remot utilitzant FTP, accés al correu web, accés via SSH a servidors dedicats al càlcul i una securització a través de VPN per accedir a la resta de serveis del centre. Disposava també de connexió a internet sense cables, de set canons de projecció i sistemes de gravació per a les aules i sales de reunions, recursos per a establir videoconferència, sistemes digitals 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*). Des d'aquest any, a més, el CRM compta amb el canal d'emissió on podreu trobar vídeos de conferències celebrades al centre:

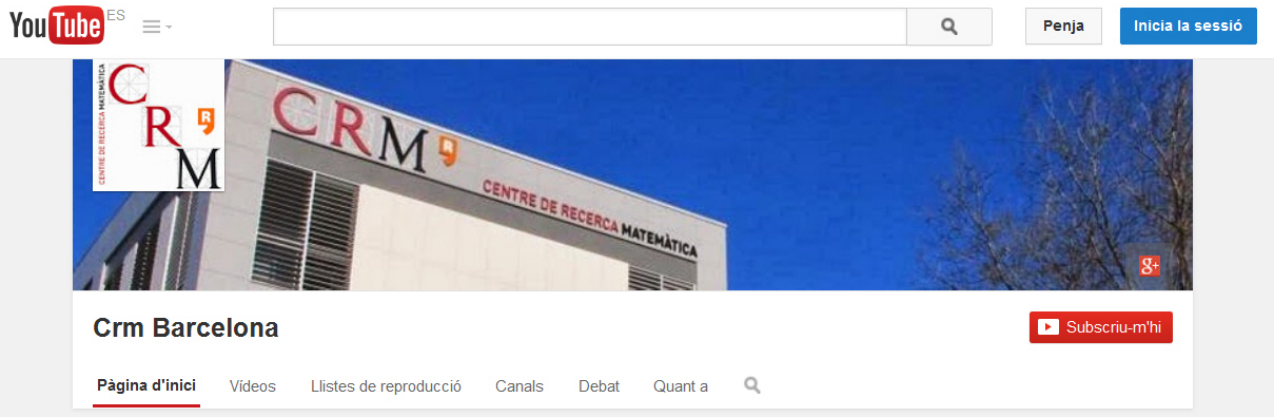
1.10. Equipment

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 2014, the CRM computer equipment was based on a LAN Ethernet net of, approximately, eighty workstations based both on Microsoft and Linux operating systems and structured under a Windows domain. Among other services, the net included an e-mail server, a printer server (managing the tasks of five printers), a file server and a Firewall/Router *that linked it to the UAB infrastructure by means of a 1 Gb connection. The network was endowed with systems that allow the remote access via FTP, webmail access, SSH access to computing servers and a secure system through VPN to have access to the rest of center services. Facilities also included wifi internet connection, seven projectors and recording systems for all the meeting rooms, resources to videoconferencing, digital control systems for the meeting rooms, a tactile CRM presentation panel and the infrastructure for 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 2014 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 2014 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 2014.

Next, we focus on the research lines of each group and the main activities they have carried on during 2014.

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

Àmbit de recerca

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

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

Research Field

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

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

Projectes vigents
Current Projects

- MTM2011-27637. *Análisis Armónico, Teoría de Aproximación y Problemas Extremales*, 2011-2014. PI: S. Tikhonov.

Membres del grup
Research Team

- Sergey Tikhonov (team leader)
- Ramazan Akgun (post-doctoral researcher)
- Petr Chunaev (PhD student)
- Ainur Jumabayeva (PhD student)
- Ahmed Abdeljawad (internship student)
- Askhat Mukanov (internship 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

• Feng Dai	University of Alberta
• 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 2014

During 2014 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.

In particular, R. Akgun studied polynomial inequalities with weights. P. Chunaev studied the Hardy-type inequalities for some special classes of sequences. A. Jumabaeva has continued working on her PhD dissertation focusing on optimal inequalities between certain constructive and structural characteristics of the generalized Liouville derivatives. S. Tikhonov has been working on sharp Remez and Nikol'skii inequalities and weighted norm inequalities for Fourier-type transforms.

Biologia matemàtica i computacional
Computational & Mathematical Biology

Àmbit de recerca

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

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

inerts. Per tant, es necessiten tant models com mètodes nous per analitzar els processos d'escales múltiples en Biologia. Aquest és el camp de recerca del grup de Biologia Computacional i Matemàtica al CRM: la formulació de nous models que siguin rellevants tant per a biòlegs experimentals com per a investigadors clínics, i el desenvolupament de les eines computacionals i analítiques necessàries per al seu estudi. Ens centrem en problemes de rellevància clínica, en particular els relacionats amb càncer.

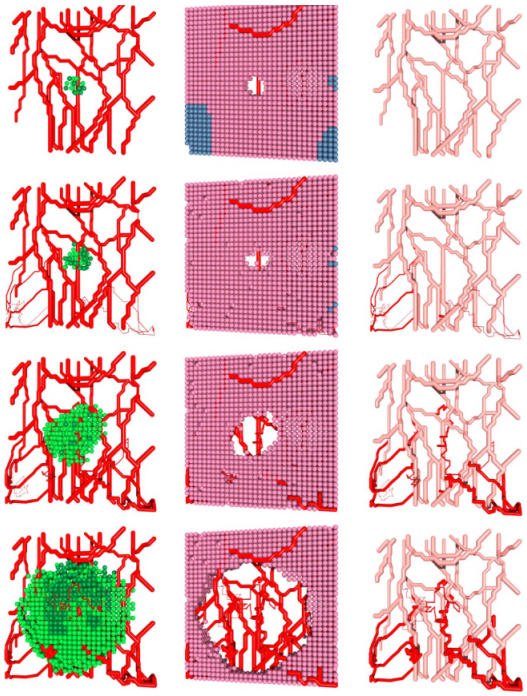
L'activitat del nostre grup s'articula al voltant de les línies de recerca següents:

- Modelització de múltiples escales de creixement tumoral i angiogènesi.
- Dinàmica evolutiva de poblacions amb estructura complexa, en particular, de poblacions de cèl·lules amb estructura jeràrquica i mapa entre genotip i fenotip.
- Modelització del cicle cel·lular.
- Modelització estocàstica de receptors tirosina-quinasa.
- Tumors latents.

systems and, therefore, new methods and models are needed to analyse multi-scale processes in Biology. Such is the remit of the Computational & Mathematical Biology group at CRM: To propose new models relevant to experimental biologists and clinicians and develop the analytical and computational tools necessary for their analysis. We pay special attention to problems with clinical relevance, in particular those related to cancer.

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

- *Multiscale modelling of tumour growth and tumour-induced angiogenesis.*
- *Evolutionary dynamics of populations with complex structure, in particular populations of cells with hierarchical structure and genotype-phenotype map.*
- *Mathematical modelling of the cell-cycle.*
- *Stochastic modelling of tyrosine-kynase receptors.*
- *Tumour dormancy.*



Projectes vigents
Current Projects

- *Mathematical models of biological population dynamics with complex structure*, 2011–2014. PI: Tomás Alarcón.

Membres del grup
Research Team

• Tomás Alarcón	(team leader)
• Ivón Rodríguez-V.	(Postdoctoral researcher)
• Enric Costa	(PhD student, CRM grant, since 09/2014)
• Roberto de la Cruz	(PhD student, FI grant)
• Núria Folguera	(PhD student, La Caixa-CRM, since 09/2014)
• Esther Ibáñez	(PhD student, CRM grant)
• Daniel Sánchez	(PhD student, CRM grant)
• Roger Domingo-Roca	(Internship until July 2014)

Activitats relacionades
Related Activities

- Computational & Mathematical Biology Seminar

Col·laboradors
Collaborators

• Helen M. Byrne	University of Nottingham
• Pilar Guerrero	(post-doctoral researcher)
• 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
• Rui Travasso	Universidade de Coimbra

Group Activity in 2014

During 2014, the group has continued its research activity around 4 basic axes: Stochastic multi-scale modelling of tumour growth, stochastic modelling of the HIV-1 infection, population dynamics of cell populations with genotype-phenotype map, 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 2014, two PhD students of the group, Esther Ibáñez-Marcelo and Daniel Sánchez-Taltavull, were awarded their PhD degrees. Three other students have joined the group in late

2014: Elisa Beltrán-Sáez (funded through a FPU scholarship), Enric Costa-Miracle and Núria Folguera-Blasco (funded through the Obra Social LaCaixa-Collaborative Mathematics programme). There is a further PhD student, Roberto de la Cruz, funded through a FI-AGAUR scholarship, who is at the start of his second year.

Finally, as research output, the group has published 8 papers in peer-reviewed journals during 2014. All of these were published in ISI journals of top quality.

Epidemiologia matemàtica

Àmbit de recerca

Els models matemàtics de les malalties infeccioses dels éssers humans, els animals domèstics i silvestres i les plantes constitueixen una àrea de recerca molt rellevant i en ràpida expansió. L'objectiu del recentment creat grup de recerca en Epidemiologia Matemàtica és l'estudi matemàtica de l'aparició i propagació de malalties infeccioses. El grup investiga en diferents direccions, com ara l'aparició de nous agents patògens, la seva evolució, la dinàmica de les malalties infeccioses en una població, així com la dinàmica de microparàsits dins d'un hoste. També treballem en l'elaboració d'una descripció matemàtica de la resposta immune, per analitzar-ne fallades com la que es dóna en la infecció per VIH. Estem interessats, a més, en el control d'infeccions, tant a nivell d'un sol hoste com a nivell de població i, com a tasca de particular importància, ens proposem col·laborar amb epidemiòlegs i biòlegs en el desenvolupament d'estratègies racionals per al control de malalties infeccioses.

Des del grup d'Epidemiologia Matemàtica treballem en estret contacte amb científics experimentals i amb el grup de recerca en Biologia Computacional i Matemàtica del CRM. En la nostra recerca emprem models matemàtics i tècniques de la teoria de sistemes dinàmics per a descriure i estudiar la dinàmica de les malalties infeccioses. Els nostres interessos particulars se

Mathematical Epidemiology

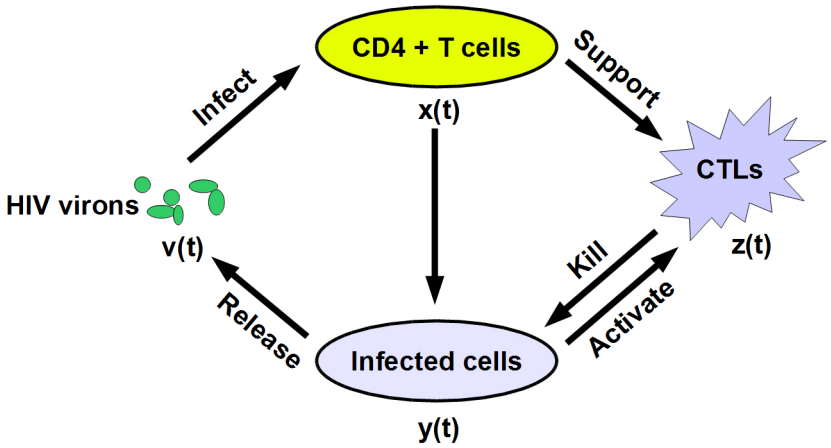
Research Field

The mathematical modelling of infectious diseases of the humans, domestic and wild animals and plants is a rapidly expanding and a highly practically relevant area of research, and the aim of the Mathematical Epidemiology Research Group is to study the emergence and spread of infectious diseases from a mathematical point of view. The group is working towards a number of directions of research such as the emergence of new pathogens, evolution of pathogens, the dynamics of infectious diseases in a population, as well as the dynamics of microparasites within a host. It is also dealing with mathematical description of immune response, as well as with its failure, as in the case of HIV infection. We are also interested in methods to control of infections, at both a single host and a population levels, and consider assisting the epidemiologists and biologists in the development of rational strategies for control of infectious diseases as a task of particular importance.

The Mathematical Epidemiology group, working in close contact with experimental scientists and the Computational & Mathematical Biology Research Group, employs mathematical modelling and the mathematical technique of the Dynamical Systems Theory to describe and study the dynamic of infectious diseases. Our particular interests are in the invasion of newly emerging infections, in

centren en la invasió de les infeccions emergents, en l'estabilitat i persistència d'un agent patogen, així com l'estabilitat de la resposta immune. Estem també interessats en l'evolució viral i microbiana, que és probablement el factor més important responsable de l'aparició de noves infeccions i per al desenvolupament de soques resistents als medicaments, i la prevenció d'un desenvolupament de medicaments i vacunes eficaces. Una de les direccions que actualment estem explorant activament és l'aplicació de les eines i mètodes de la teoria de control òptim per al control de malalties infeccioses.

the stability and persistence of a pathogen, as well as the stability of immune response. We also interested in viral and microbial evolution, which is probably the most important single factor responsible for emergence of new infections and for development of drug resistant strains, and preventing a development of effective drugs and vaccines. One of the directions, which we are currently actively exploring, is application of the tools and methods of the Optimal Control Theory to the control of infectious diseases.



Membres del grup
Research Team

- Andrei Korobeinikov (team leader)
- Carles Barril Basil (PhD student, on leave to UAB)
- Narani van Laarhoven (Internship until July 2014)
- Barry Iyare (Internship until October 2014)
- Clàudia Toral (Internship student)

Activitats relacionades
Related Activities

- Advanced course on Mathematical methods of biological evolution, CRM, Bellaterra, June 23–27, 2014
- Workshop on Virus dynamics and evolution, CRM, Bellaterra, June 30–July 4, 2014

Col·laboradors
Collaborators

• Juana Díez	Universitat Pompeu Fabra
• 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

• Andreas Meyerhans	Universitat Pompeu Fabra
• Michael O'Callaghan	University College Cork
• Alexander Pimenov	Weierstrass Inst. 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 2014

During 2014, 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 (the Samara State Airspace University, Russia) and Graeme Wake (Massey University).

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.

The group organized and hosted organizer of an Advanced course on Mathematical methods of biological evolution and a Workshop on Virus dynamics and evolution, hold at the CRM on June 23 to July 4. These two activities are viewed as the continuation of a recently established CRM series of workshops and advanced courses "Mathematics in Natural and Life Sciences".

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 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.

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

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 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.

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.

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.

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

Ministerio de Economía y Competitividad (MINECO). *Stochastic* 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-CRM, since 09/2014)
- Marc Lagunas (Internship student)

Activitats relacionades
Related Activities

- Seminari de Finances Quantitatives, Xarxa temàtica del CRM.
- Jornada CRM-Empresa sobre Finances Quantitatives, Xarxa temàtica del CRM, June 10, 2014.

Col·laboradors
Collaborators

- Cornelis W. Oosterlee — Centrum voor Wiskunde en Informatica and Delft University
- Elisa Alòs — Universitat Pompeu Fabra
- Ricard Alemany — Crèdit Andorrà

Group Activity in 2014

One doctoral student began her work in the group on October 2014. Gemma Colldeforns began her PhD thesis on the development of numerical methods based on Shannon wavelets to efficiently compute risk measures in a market portfolio. This machinery is being developed in view to extend these computations to portfolios with stochastic holding period and to the solution of backward stochastic differential equations.

Matemàtica Industrial

Industrial Mathematics

Àmbit de recerca

"Matemàtica industrial" és un terme poc precís que cobreix bàsicament qualsevol aplicació de les matemàtiques en un context industrial. El grup de recerca en MI del CRM treball actualment en tres àrees principals:

- Nanomatemàtica. La Nanotecnologia és un àmbit de recerca apassionant en ràpida expansió en el qual apareixen nous reptes constantment. La recerca en aquest camp està dominada per l'experimentació i la computació. El grup de MI està treballant en impulsar l'aplicació de la matemàtica als problemes de la nanociència. Els projectes actuals del grup se centren en la modelització del canvi de fase a la nanoescala, en el flux de nanofluids i en descobrir la natura, a les capes frontera, del flux d'un fluid damunt una superfície sòlida.

- Canvi de fase. Les transicions de fase ocorren en un gran nombre de situacions naturals i industrials, com ara la formació del gel, la formació de metalls a partir de l'estat fos, la fabricació de discos informàtics, les cobertures de xocolata i molts més. El modelatge de les transicions de fase requereix l'estudi del flux calorífic en les diferents fases, que es defineixen en un domini desconegut i en moviment. El group de MI està investigant actualment en aplicacions pràctiques del canvi de fase com ara la solidificació de líquids subrefredats, els efectes a la nanoescala i la descongelació per microones, així com en aspectes teòrics com l'aplicació de mètodes aproximats i qüestions relacionades amb la conservació d'energia.

- Fluxos de pel·lícula fina. Aquesta mena de fluxos pot incloure el moviment de lubrificants, pintures, l'aigua que llisca per una finestra, l'aire que suporta un disc dur de rotació ràpida o el moviment de la lava o d'una glacera. El modelatge matemàtic dels fluxos de pel·lícula fina pot donar lloc a una gran varietat de comportaments

Research Field

"Industrial mathematics" is a rather loose term, basically covering any application of mathematics in an industrial context. The research group at CRM currently has three main focus areas:

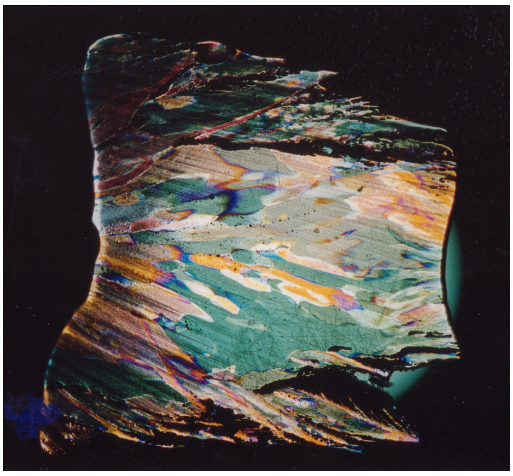
- *Nanomathematics. Nanotechnology is a rapidly growing and exciting research area that is constantly issuing new challenges. Research in this field is dominated by experiment and computation. The IM group is currently working to advance the application of mathematics to nano problems. Current projects deal with the mathematical modelling of phase change at the nanoscale, the flow of nanofluids and discovering the nature of the boundary layer flow of a fluid over a solid surface.*

- *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. To model phase transitions requires studying heat flow in the different phases, which are defined over an unknown, moving domain. The group is currently investigating practical applications of phase change such as solidification of supercooled melts, nanoscale effects and microwave defrosting, as well as theoretical issues such as the application of approximate methods and energy conservation issues.*

- *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*

i, òbviament, té moltes aplicacions. Aquesta recerca involucra tant fluids newtonians com no newtonians.

work involves both Newtonian and non-Newtonian fluids.



Projectes vigents
Current Projects

- MTM2010-17162. *Problemas de frontera móvil en presencia de capas líquidas,* 2011–2015. PI: Tim Myers.

Membres del grup
Research Team

• Tim Myers	(team leader)
• Vincent Cregan	(Postdoctoral res., La Caixa-CRM, since 04/2014)
• Helena Ribera	(PhD student, La Caixa-CRM, since 09/2014)
• Marc Calvo	(Masters student)
• Jarrod Williams	(Research Visitor, Sept-Dec. 2014)
• Beñat Irastorza	(Final year graduate student, UPC)
• Carles Riera	(Final year graduate student, UAB)
• Sergio González	(Final year graduate student, UAB)
• Vicent Ribas	(Scientific Collaborator)
• Marc Galí	(Internship until June 2014)
• Sergio González	(Internship student)

Activitats relacionades
Related Activities

- *Nanomath 2014 conference*, University of Zaragoza, co-organizers.
- *"Introduction to . . ." seminar series.* Providing an introduction to an applied mathematics topic, with guest lecturers (Jon Chapman, Oxford Univ.; Tomás Alarcón, CRM; Tim Myers, CRM). Held at UPC, Oct-Dec 2014.

Col·laboradors
Collaborators

• Jon Chapman	University of Oxford
• Huaxiong Huang	University of Toronto
• James Hill	University of Adelaide
• Sarah Mitchell	University of Limerick
• Ebrahim Momoniat	University of the Witwatersrand, Johannesburg
• Jon Summers	University of Leeds
• Harvey Thompson	University of Leeds
• Brian Wetton	University of British Columbia

Group Activity in 2014

The group's two PhD students, Francesc Font and Michelle MacDevette, both graduated in 2014, both rated Cum Laude. They have been replaced by Helena Ribera who is currently working on nanoparticle melting and the Kirkendal effect. A second PhD student, registered at the University of Limerick, with main supervisor Dr Mitchell is being co-supervised by Tim Myers. Post-doc Vincent Cregan was awarded a La Caixa grant, funding a further three years work with the group.

Tim Myers gave a keynote speech at the conference Fluidos, held in Argentina. He maintains his position on the council of the European Consortium for Mathematics in Industry. He was also part of a successful bid for EU COST funding and is now a member of the management committee for the COST Action, TD1409 Mathematics for industry network (MI-NET). The research of the IM group has been primarily focussed on modelling of nano-phenomena, with a few forays into more traditional industrial problems, such as the impact of legalising rhino horn trade and improving the efficiency of a sugar mill.

Group members published 4 ISI journal articles this year, on topics such as nanofluid flow, nanoparticle melting and liquid crystal deformation. The nanofluid flow paper in particular was ground breaking as it disproved a hundreds of previous experimental, numerical and theoretical results on the heat transfer properties of nanofluids (and explained where the errors occurred in some of the most highly cited works).

The work was presented at conferences and seminar series in Spain, the US, UK, Ireland, South Africa.

The group has been visited by Prof. Huaxiong Huang (U. Toronto), Prof. J. Chapman (Oxford Univ.) and Dr. Maria Chiricotto (Univ. Roma).

Neurociència Computacional

Computational Neuroscience

Àmbit de recerca

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

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

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.

between theorists and experimentalists is important. At the very least, modeling work must be constrained by experimental data.

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

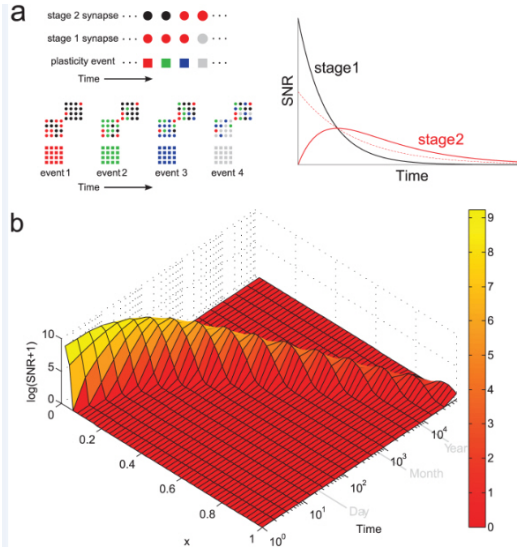
In the Computational Neuroscience group at the CRM, we focus mainly on the dynamics of cortical microcircuits, that is ensembles of hundreds or thousands of neurons in the cerebral cortex. In particular, we study the role of the recurrent connectivity in shaping spontaneous activity in models of cortical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

El grup de Neurociència Computacional es va iniciar el maig de 2012. Durant l'any 2014, s'hi han incorporat diversos membres. En particular, Marina Vegué, distingida amb una de les prestigioses beques de la Fundació La Caixa a la Universitat Politècnica de Catalunya, s'ha unit al grup com a estudiant doctoral per a treballar en models de connectivitat cortical. Un segon estudiant de doctorat, Bernat Rovira, s'ha incorporat al grup gràcies a una beca de formació del Ministeri d'Economia i Competitivitat (equivalent a les antigues FPI) associada al projecte de recerca d'Alex Roxin. Amb aquest mateix projecte es finança un contracte postdoctoral per treballar en models de formació i consolidació de la memòria. Aquesta plaça l'ocupa Panagiota Theodoni des de març de 2014. Recentment el grup ha acollit dos estudiants de doctorat nous, dintre del marc del programa de recerca matemàtica col·laborativa

The group of Computational neuroscience was started in May 2012. Several new members joined the Computational Neuroscience Group in 2013 and early 2014. Specifically, Marina Vegué, awarded with a prestigious doctoral grant from the Caixa Foundation at Universitat Politècnica de Catalunya, joined the group as a PhD student to work on models of cortical connectivity. A second PhD student, Bernat Rovira, joined the group through a student traineeship grant (formerly FPI) associated with the PIs research project from the Spanish Ministry of Economics and Competitiveness. The same grant also funds a postdoctoral position to work on models of memory formation and consolidation. This position has been filled by Panagiota Theodoni, who begun work in March 2014. Most recently two new doctoral students have joined the group in the framework of the collaborative research training program funded

(Collaborative Mathematical Research), patrocinat per la Caixa: Genís Prat i Narani van Laarhoven. Ambdós treballaran conjuntament amb Alex Roxin i Jaime de la Rocha (IDIBAPS), que contribuirà amb dades experimentals. Estan modelitzant la presa de decisions perceptuals i l'activitat d'ones corticals lentes, respectivament.

by the Caixa, Genís Prat and Narani van Laarhoven. Both students are pursuing their doctoral theses jointly with Alex Roxin at the CRM and Jaime de la Rocha (IDIBAPS), who will provide experimental data. They are working on models of perceptual decision making and slow-wave cortical activity respectively.



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)
• George Paul Cribari	(Masters Student, Neuroscience UAB)
• Mauro Martínez	(Undergraduate student, Physics UAB)
• Albert Aloy	(Internship student)

Col·laboradors
Collaborators

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

Group Activity in 2014

Two new doctoral students began their thesis work in the group in Fall 2014, Genís Prat and Narani van Laarhoven. The arrival of these hew students marks the beginning of a new collaborative research effort between the Computational Neuroscience Group at the CRM and the Cortical Circuit Dynamics Group at IDIBAPS. This effort will encompass two projects. The first is to understand how fluctuations, either stimulus driven or internal, can influence neuronal activity and thence animal behavior in a simple task known as perceptual decision making. The second project is to study the physiological mechanisms underlying the generation of so-called slow-wave activity in the cortex, during which neurons switch between an active and an inactive state in a highly synchronous manner. This activity is thought to be crucial for the process of memory consolidation. Additionally, we have continued to work on our ongoing projects involving statistical models of cortical connectivity (Marina Vegué) and memory consolidation (Bernat Rovira and Panagiota Theodoni). These ongoing projects were presented at international conferences, including a poster and three invited talks. The Computational Neuroscience Group at the CRM co-organized the 2014 Barcelona Computational and Systems Neuroscience Conference in June (held at the Institut d'Estudis Catalans) as well as the 2014 Summer School in Computational Neuroscience at the CRM.

Sistemes Complexos

Complex Systems

Àmbit de recerca

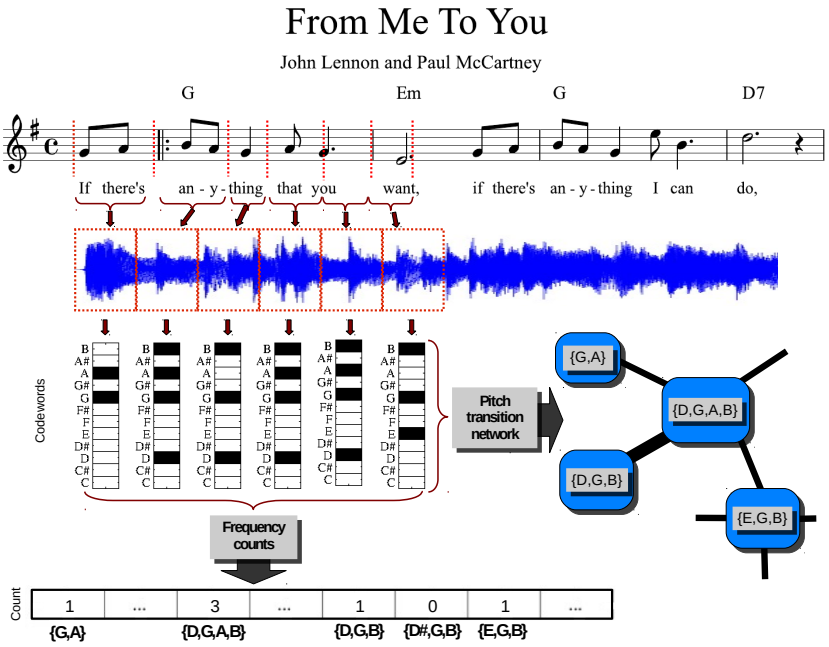
Podem considerar com a sistemes complexos aquells formats per un nombre molt gran de components que interactuen intensament. Molts dels reptes actuals de la humanitat estan en comprendre el comportament de sistemes complexos, com ara el clima, l'economia, la societat, el cervell humà, la biologia del desenvolupament, etc. En oposició a aquest concepte, l'àtom d'hidrogen, 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

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 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

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.

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)

Activitats relacionades
Related Activities

- II ECCS Warm Up School on Complex Networks, Lucca (September 19–21, 2014)

Col·laboradors
Collaborators

• Gemma Boleda	Universitat Pompeu Fabra
• Anna Deluca	Max Planck Institute for the Physics of Complex Systems
• Albert Díaz-Guilera	University of 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	IIIA - CSIC
• M. Ángeles Serrano	Universitat de Barcelona

Group Activity in 2014

The year 2014 has brought some important changes to the CRM Complex Systems Group. Anna Deluca got a postdoc position at the prestigious Max Planck Institute for the Physics of Complex Systems, in Dresden. As compensation, two new members have joined the group in 2014, Isabel Moreno as a predoctoral researcher and Isabel Serra as a postdoc. The collaborations of the group have expanded, increasing the links with non-mathematician scientists of the Barcelona area (see list above). The main goal is to find common projects that can be grouped under the label of collaborative mathematics. The 2014 projects included paleoearthquakes, branching process theory, prediction of rain time series, pattern recognition in time series, statistical laws in linguistics, metabolic networks, and transportation networks. It is notheworthy that the group, through I. Serra, has started to do consulting projects of the CRM Technology Transfer Unit, working in the first place for Ferrovial. In addition, several

visitors of the group have contributed to the CRM CAMP Seminars, being these: Víctor Martínez de Albéniz, IESE (Estimating and Optimizing the Impact of Inventory on Consumer Choices in a Fashion Retail Setting); Mariusz Bialecki, Polish Academy of Sciences (Motzkin Numbers out of an Earthquake Cellular Automaton Model); and Édgar Roldán, ICFO (Thermodynamics of symmetry breaking). It is also remarkable the co-organization by F. Font-Clos of the II ECCS Warm Up School on Complex Networks, as a satellite event of the European Conference on Complex Systems, in Luca, Italy, and the collaboration of A. Corral in the organization of the III Jornada complexitat.cat, which took place at the UPC Nord Campus, Barcelona.

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).

2.2.1. Investigadors Sènior

2.2.1. Senior Researchers

Tomás Alarcón

During 2014, my activity has continued to focus around four basic areas: Stochastic multi-scale modelling of tumour growth, stochastic modelling of the HIV-1 infection, population dynamics of cell populations with genotype-phenotype map, and mathematical and experimental microfluidics. An important task that I have undertaken in order to consolidate the Computational & Mathematical Biology group is the initiation and/or consolidation of collaborations with both the mathematical and experimental local communities. As a result, I 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, in 2014 two PhD students under my supervision, Esther Ibáñez-Marcelo and Daniel Sánchez-Taltavull, were awarded their PhD degrees. Three other students have joined the group in late 2014: Elisa Beltrán-Sáez (funded through a FPU scholarship), Enric Costa-Miracle and Núria Folguera-Blasco (funded through the La Caixa Foundation-Collaborative Mathematics programme). I further supervise a PhD student, Roberto de la Cruz, funded through a FI-AGAUR scholarship, who is at the start of his second year.

Regarding research output, I have published 8 papers in peer-reviewed journals during 2014. All of these were published in ISI journals of top

□ Publications

Articles

- J.A. Menendez, T. Alarcón, B. Corominas-Faja, E. Cuyàs, E. López-Bonet, A.G. Martin, L. Vellon, *Xenopatients 2.0: Reprogramming the epigenetic landscapes of patient-derived cancer genomes*, Cell Cycle **13**, 17 (2014).
- J.A. Menendez, T. Alarcon, J. Joven, *Gerometabolites: The pseudohypoxic ageing side of cancer*, Cell Cycle **13**, 609 (2014).
- D. Sánchez-Taltavull, T. Alarcón, *Robustness of differentiation cascades with symmetric stem cell division*, J. R. Soc. Interface **11**, 20140264 (2014).
- T. Alarcón, *Stochastic quasi-steady state approximations for asymptotic solutions of the Chemical Master Equation*, J. Chem. Phys. **140**, 184109 (2014).
- E. Ibáñez-Marcelo, T. Alarcón, *The topology of robustness and evolvability in evolutionary systems with genotype-phenotype map*, J. Theor. Biol. **356**, 144–162 (2014).
- T. Alarcón, Ph. Getto, Y. Nakata, *Stability analysis of a renewal equation for cell population dynamics with quiescence*, SIAM J. Appl. Math. **74**, 1266–1297 (2014).
- 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).
- P. Guerrero, T. Alarcon, *Stochastic multiscale models of cell population dynamics: Asymptotic and numerical methods cell population dynamics: Asymptotic and numerical methods*, Mathematical Modelling of Natural Phenomena **10**, 64–93 (2015).
- J.A. Menéndez, T. Alarcon, *Metabostemness: A New Cancer Hallmark*, Frontiers in Oncology **4**, 262 (2014).

Preprints

- D. Sánchez-Taltavull, T. Alarcón, *Stochastic modelling of viral blips in HIV-1-infected patients: Effects of inhomogeneous density fluctuations*, submitted to J. Theor. Biol.
- P. Guerrero, H.M. Byrne, P.K. Maini, T. Alarcón, *From invasion to latency: Intracellular noise and cell motility as key controls of the competition between resource-limited cellular populations*, submitted to J. Math. Biol.
- E. Ibáñez-Marcelo, T. Alarcón, *Evolutionary escape on complex genotype-phenotype networks*, submitted to J. R. Soc. Interface.
- E. Ibáñez-Marcelo, T. Alarcón, *Surviving evolutionary escape on complex genotype-phenotype networks*, submitted to J. Math. Biol.

Patents

- I. Rodriguez-Villarreal, T. Alarcon, J. Colomer, A. Hernandez-Machado, P. Miribel. Method apparatus for measuring viscosity of Newtonian and Non-Newtonian fluids. Under review.

□ Research projects

- *Mathematical modelling of biological populations with complex structure,* MICINN, MTM2011-29342. From 2012 to 2014. 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

Undergraduate project supervision

• Nuria Folguera-Blasco, Mathematics, Universitat Autònoma de Barcelona. *Competition and invasion in stochastic population models* (CRM internship).

• Roger Domingo-Roca, Physics, Universitat Autònoma de Barcelona. *Experimental microfluidics*. Co-supervised by Ivon Rodriguez-Villarreal (CRM internship).

PhD supervision

• Elisa Beltrán-Sáez. *Evolutionary dynamics of systems with degeneracy*, since October 2014. Funded by a FPU scholarship of the Spanish government at the Universitat de Barcelona.

• Roberto de la Cruz (CRM). *Stochastic multiscale modelling of tumour growth*, since January 2013. Co-supervised by Pilar Guerrero (Dept. Mathematics, University College London). Funded by a scholarship of the Generalitat de Catalunya (FI-AGAUR).

• Esther Ibáñez-Marcelo (CRM). *Dynamics of cell populations with genotype-phenotype map*, since January 2011. Funded by the CRM. She defended her PhD thesis on December 19th, 2014.

• Daniel Sánchez-Taltavull (CRM). *Evolutionary dynamics of hierarchically-structured cell populations*, since January 2011. Funded by the CRM. He defended his PhD thesis on December 12th, 2014.

Postdoc supervision

• Ivón Rodríguez-Villarreal (CRM). *Micro-rheology of biofluids*. Funded by the CRM. Co-supervised by Aurora Hernández-Machado (Physics Dep., University of Barcelona), since March 2013.

□ Teaching activity

• T. Alarcón, A. Corral, and A. Roxin. *A short introduction to Statistical Physics.* Graduate course for the CRM Doctoral Training Unit, Centre de Recerca Matemàtica, Barcelona, May 2014.

• 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 2014-2015

□ Scientific activities

Organisation

- Member of the Scientific Committee of the *Barcelona Graduate School in Mathematics*, September 2014 – Present.
- Member of the Organising Committee of the GEFENOL *Summer School on Statistical Physics and Physics of Small Systems*. To be held at the CRM in July 2015.
- Co-organiser (jointly with Juan Soler, Universidad de Granada) of the special session on *Mathematics in the Life Science* within the conference *Barcelona Mathematical Days 2014*, to be held in Barcelona, November 2014.
- Member of the organising committee of the workshop on *Virus Dynamics & Evolution* to be held at the Centre de Recerca Matemàtica, Bellaterra, Barcelona, June 2014.

Participation

Invited lectures in conferences

- T. Alarcón, *Metabostemness: The link between metabolism and cellular reprogramming*, Workshop on Patterning, Segregation and Differentiation in Complex Networks held at the Institute of Physics, UNAM, Mexico City, Mexico, Oxford, January 2014.
- T. Alarcón, *Stochastic modelling of gene regulatory networks: Metabolic regulation of cellular reprogramming*, Seminar delivered at the Centre for Genomic Regulation (CRG), Barcelona, January 2014.
- T. Alarcón, *Stochastic multiscale modelling of tumour growth*, Conference Biomat 2014, University of Granada, June 2014.
- T. Alarcón, *Stochastic multiscale modelling of tumour growth*, Workshop on Virus Dynamics & Evolution, CRM, Barcelona, June 2014.
- T. Alarcón, *Multiple scales in stochastic modelling in Biology*, Research and Innovation Topics module of the Master on Modelling in Science and Engineering, Universitat Autònoma de Barcelona, October 2014.

Advanced & Summer school courses

- T. Alarcón, *An Introduction to Mathematical Biology*, Advanced Course on Mathematical Methods of Biological Evolution, Centre for Systems Biology, CRM, Barcelona, June 2014.

Álvaro Corral

The research activity has been dispersed about several research lines, including: the predictability 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. Garcia-Millan; the study of paleoearthquakes in New Zeland, with collaborators there and at the University of Hawaii (B. Gomez); the search for patterns in time series, with I. Serra and J. Serrà and J. L. Arcos (from the Institut d'Investigació en Intel·ligència Artificial); and statistical laws in quantitative linguistics, with F. Font-Clos, G. Boleda, and R. Ferrer-i-Cancho. This year, in addition, an important activity has been developed as invited speaker at several conferences and workshops, detailed below.

□ Publications

Articles

- A. Deluca and A. Corral, *Scale invariant events and dry spells for medium-resolution local rain data*, Nonlinear Processes in Geophysics **21**, 555–567 (2014).
- A. Corral and F. Font-Clos, *Processos de ramificació, criticitat i autoorganització: aplicació als desastres naturals*, Butlletí de la Societat Catalana de Matemàtiques **29(1)**, 5–49 (2014).

Preprints

- B. Gomez, A. Corral, A. R. Orpin, M. J. Page, H. Pouderoux and P. Upton, *Lake Tutira paleoseismic record confirms random, moderate to major and/or great Hawke's Bay (New Zealand) earthquakes*, accepted in *Geology*.
- A. Corral, *Scaling in the timing of scaling events*, accepted in *Chaos, Solitons, and Fractals*.
- J. Serrà, I. Serra, A. Corral and J. L. Arcos, *Ranking and Significance of Variable-length Similarity-based Time Series Motifs*, submitted to *Data Mining and Knowledge Discovery*.
- F. Font-Clos and A. Corral, *Reply to "Comment on 'A Scaling law beyond Zipf's law and its relation to Heaps' law'*, see `http://arxiv.org/abs/1405.0207`.
- A. Corral, G. Boleda and Ramon Ferrer-i-Cancho, *Zipf's law for word frequencies: word forms versus lemmas in long texts*, see `http://arxiv.org/abs/1407.8322`.
- A. Deluca, N. R. Moloney and A. Corral, *Data-Driven Prediction of Thresholded Time Series of Rainfall and SOC models*, see `http://arxiv.org/abs/1411.2256`.
- R. Garcia-Millan, F. Font-Clos and A. Corral, *Finite-size scaling of survival probability in branching processes*, see `http://arxiv.org/abs/1411.2817`.
- F. Font-Clos and A. Corral, *Log-log Convexity of Type-Token Growth in Zipf's Systems*, see `http://arxiv.org/abs/1412.4577`.

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

• Manuel Carbonell, degree in Mathematics, UAB, February 2014.
• Sergi Soto, degree in Physics, UAB, September 2014.
• Rosalba García Millán, double degree in Mathematics and Physics, UAB (CRM internship).

PhD supervision

• Francesc Font Clos, PhD student (CRM, Generalitat de Catalunya FI grant).
• Isabel Moreno Sánchez, PhD student (CRM, Projecte Fundació La Caixa).

Teaching activity

Lectures and short courses

• A. Corral, T. Alarcón and A. Roxin, *A short introduction to statistical physics*, Course of the CRM Doctoral Training Unit, May 2014.

Scientific activities

Organisation

• 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.

Participation

Communications in conferences

• A. Corral, *Power Laws, Zipf's Law, and Scaling Laws in Human Language and Music*, Fifth Workshop Dynamical Systems Applied to Biology and Natural Sciences, DSABNS, Lisbon, Portugal, February 2014.
• A. Corral et al., *Temporal Scale-invariance and Extreme Events*, Physical origins of correlated extreme events, EXEV14, MPIPKSs, Dresden, June 2014.
• A. Corral et al., *Zipf's law and a scaling law, in texts and in music*, SUMMERSOLSTICE 2014, International Conference on Discrete Models of Complex Systems, Institute Jozef Stefan, Ljubljana, Slovenia, June 2014.

• A. Corral, *Fitting and goodness-of-fit test of non-truncated and truncated power-law distributions*, Data analysis and modeling in Earth sciences, DAMES, IMATI, Milano, October 2014.
• A. Corral, *Tests for the Tail of the Seismic-Moment Distribution of Global Shallow Earthquakes*, American Geophysical Union Fall Meeting, San Francisco, California, December 2014.

Seminars

• A. Corral, *Language and music: power laws, Zipf's law, scaling laws, Heaps' law, and even complex networks*, Departament de Física Fonamental, Universitat de Barcelona, March 2014.

□ Other activities

• Member of the evaluation committee of the PhD thesis of Albert Ossó, PhD in physics, UB, July 2014.
• Referee of the PhD thesis of Esther Ibáñez, PhD in Mathematics, UPC, December 2014.
• Member of the evaluation committee of the master thesis of Gerard Rocher, master in mathematical modeling, UAB, July 2014.
• Member of the evaluation committee of the master thesis of Jesús Ros, master in mathematical modeling, UAB, July 2014.
• Referee of the journals PLos ONE (2), Physica A, Physical Review E (3), and Scientific Reports.
• Chairman of the scientific committee of the network complexitat.cat.
• Member of the Lorenz Lecture committee of the American Geophysical Union.
• Member of the Executive Comission of the Centre de Recerca Matemàtica.

Andrei Korobeinikov

During 2014, 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 pathogen evolution. 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. (iii) The third direction of my research in 2014 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 biological treatment of waste water. 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

- C. Vargas-De-León, L. Esteva, A. Korobeinikov, *Age-dependency in host-vector models: the global analysis*, *Applied Mathematics and Computation* **243**, 969–981 (2014).
- E.V. Grigorieva, E.N. Khailov, N.V. Bondarenko, A. Korobeinikov, *Modeling and optimal control for antiretroviral therapy*, *Journal of Biological Systems* **22(2)**, 199–217 (2014).
- A. Korobeinikov, C. Dempsey, *A continuous phenotype space model of RNA virus evolution within a host*, *Math. Biosci. Eng.* **11(4)**, 919–927 (2014).

Preprints

- 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*, to appear in *Theoretical Population Biology* (2015).
- A.A. Archibasov, A. Korobeinikov, V.A. Sobolev, *Asymptotic expansions of solutions for a singularly perturbed model of viral evolution*, to appear in *Computational Mathematics and Mathematical Physics* (2015).
- V. Sobolev, E. Shchepakina, A. Korobeinikov, *Models order reduction and equivalence: Paradox of enrichment is a 3-dim bacteriophages dynamics model as case study*, CRM Preprint Series 1201.
- E.V. Grigorieva, E.N. Khailov, A. Korobeinikov, *Optimal control for an epidemic in a population of varying size*, CRM Preprint Series 1193.
- A. Korobeinikov, A. Archibasov, V. Sobolev, *Order reduction for an RNA virus evolution model*, CRM Preprint Series 1190.
- L. Shaikhet, A. Korobeinikov, *Stability of a stochastic model for HIV-1 dynamics within a host*, CRM Preprint Series 1191.
- A. Pimenov, D. Rachinskii, A. Korobeinikov, *Adaptive behaviour in a predator-prey model leads to multiple equilibrium states*, CRM Preprint Series 1195.

Books or book chapters

- A. Corral, A. Deluca, F. Font-Clos, P. Guerrero, A. Korobeinikov, F. Massucci (Editors), *Extended Abstracts Spring 2013. Complex Systems. Control of Infectious Diseases*, in *Trends in Mathematics; Research Perspectives, CRM Barcelona, vol. 2* (978-3-319-08137-3).

Conference proceedings

- V. Sobolev, A. Korobeinikov, *System order reduction methods with application to a bacteriophages dynamics model*, Workshop on Emergence, Spread and Control of Infectious Diseases, CRM, Bellaterra, June 10 to 11, 2013 Birkhäuser (2014).

• A. Korobeinikov, V. Sobolev, *The phenomenon of apparent disappearance in the marine bacteriophage dynamics*, Workshop on Emergence, Spread and Control of Infectious Diseases, CRM, Bellaterra, June 10 to 11, 2013 Birkhäuser (2014).

• C. Barril, A. Korobeinikov, *Global properties of a core group model for sexual transmitted infections*, Workshop on Emergence, Spread and Control of Infectious Diseases, CRM, Bellaterra, June 10 to 11, 2013 Birkhäuser (2014).

□ Research projects

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

• *Analisis de sistemas con dinàmica compleja en las àreas de medicina matemàtica y fisica utilizado los mètodos de localización de conjuntos compactos invariantes,* CONACYT (Mexico), grant N 219614. From 2014 to 2017. Principal investigator: Konstantin Starkov.

• *Grup de recerca en matematica 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.

□ Activity in research training

• Narani Van Laarhoven (MSc thesis, MAMME-UPC, July 2014): *Mathematical modelling of viral evolution with immune response.*

• Juan Carlos Cantero Guardeño (undergraduate research project, UAB, 2014): *Modelling of the spread of two viral subtypes on a plant leaf.*

□ Teaching activity

Lectures and short courses

• *Mathematical methods of biological evolution*, CRM Advanced course, Bellaterra, June 23–27 , 2014.

□ Scientific activities

Scientific activities organised

• Principal organizer of Advanced course on *Mathematical methods of biological evolution*, CRM, Bellaterra, June 23–27, 2014.

• Principal organizer of the *Workshop on Virus dynamics and evolution*, CRM, Bellaterra, June 30–July 4, 2014.

• Member of scientific committee of the 1st WSEAS International Conference on Pure Mathematics (PUMA '14), Tenerife, January 10–12, 2014.

• Member of scientific committee of the 2014 International Conference on Pure Mathematics - Applied Mathematics (PM-AM 2014), Venezia, March 15–17, 2014.

Participation in scientific activities

Invited plenary lectures in conferences

- IX Regional Academic Encouter ERA2014 and IV Research and Academic Congress, Tijuana, Baja California, México, April 9–11, 2014.

Research stays

- April, 2014: Invited Researcher at CITEDI, Tijuana, México, (1 weeks).

□ Other activities

- Member of Editorial board, Mathematical Biosciences and Engineering (MBE).
- Member of Editorial board, Journal of Nonlinear Systems and Applications (JNSA).
- Member of Editorial board, International Journal of Biology and Biomedical Engineering (IJBBE).
- Member of Editorial board, International Journal of Mathematics and Computers in Simulation (IJMCS).
- Member of Editorial board, International Journal of Pure Mathematics (IJPM).
- Member of Editorial board, Infectious Diseases: Research and Treatment.
- Member of Editorial board, Journal of Mathematics and Statistics.
- Member of Editorial board, Conference Papers in Mathematics.
- Member of Editorial board, Abstract and Applied Analysis.
- Member of Editorial board, Research and Communications in Biological Sciences.

Tim Myers

During 2014 much of my research activity was focussed on the application of mathematics to nanotechnology. My two PhD students, Francesc Font and Michelle MacDevette both graduated Cum Laude from UPC. Their work on nanoparticle evolution and nanofluid flow is being continued by a new PhD student, Helena Ribera and a post-doc Vincent Cregan. In particular they are working on projects stemming from experiments being carried out at the Catalan Institute of Nanotechnology on Ostwald ripening and the Kirkendal effect on the nanoscale. Together with a number of Masters and undergraduate students I am investigating how nano effects impact on the basic formulation of the heat equation and subsequently how this affects our understanding of heat flow and phase change.

On the teaching side I have once again been active at the Universitat Politècnica de Catalunya, taking part in the course *Models Matemàtics de la Tecnologia*.

In the meantime I have continued as a council member of the European Consortium for

Mathematics in Industry and on the editorial board of Applied Mathematical Modelling and have recently joined the editorial board of a new book series from Springer. I was involved in a successful EU COST Action proposal concerning mathematics in industry and have become a member of the management committee. This project will take off mid-2015.

Publications

Articles

- T. G. Myers, F. Font, *On the one-phase reduction of the Stefan problem with a variable phase change temperature*, Int. Comm. Heat Mass Trans. **doi:10.1016/j.icheatmasstransfer.2014.11.008**, 5 pages (Online 2 Dec.).
- M. M. MacDevette, T. G. Myers, B. R. Wetton, *Boundary layer analysis and heat transfer of a nanofluid*, Microfluidics and Nanofluidics **DOI 10.1007/s10404-013-1319-1**, 12 pages (January).
- T.G. Myers, F. Font, V. Cregan & M. MacDevette, *Nanomatemàtiques: modelització matemàtica a la nanoescala* , Butlletí de la Societat Catalana de Matemàtiques **29(2)**, 115–134 (2014).
- L.J. Cummings, J. Low, T.G. Myers, *Extensional flow of nematic liquid crystal with an applied electric field*, Euro. J. Appl. Math. **29(4)**, 397–423 (2014).
- T.G. Myers, M.M. MacDevette, F. Font, V. Cregan , *Continuum mathematics at the nanoscale*, Journal of Mathematics in Industry **4(1)**, 11pages (2014).

Conference proceedings

- T. G. Myers, M. M. MacDevette, V. Cregan, *Theoretical modelling on nanofluids for heat transfer*, *NSTI-Nanotech 2014, www.nsti.org, Vol. 2* National Science and Technology Institute (2014).
- F. Font, T. G. Myers, M. M. MacDevette, *A Mathematical Model for the Melting of Spherical Nanoparticles* , *Progress in Industrial Mathematics at ECMI 2012* Springer International Publishing (2014).

- T. G. Myers, *Enhanced Water Flow in Carbon Nanotubes and the Navier Slip Condition*, *Progress in Industrial Mathematics at ECMI 2012* Springer International Publishing (2014).

Research projects

- *Problemas de frontera móvil en presencia de capas líquidas*, MTM2010-17162. From 2011 to 2014. Principal investigator: Tim G. Myers

Activity in research training

Supervision of research students

Undergraduate project supervision

- Jarrod Williams, Oxford Uni., *Contact melting of nanofluids*, Sept-Dec. 2014.
- Carles Riera, UAB: *The hyperbolic heat equation*, Sept. 2014 - .
- Sergio Gonzalez, UAB: *Modelling flow enhancement in carbon nanotubes*, Sept. 2014 - .
- Beñat Irastorza, UPC: *Heat transfer and phase change at the nanoscale*, Dec 2014 - .

Master's project supervision

- Marc Calvo, *Nanoparticle melting* UAB, Oct 2014.

PhD supervision

- Helena Ribera, PhD project: *Mathematical modelling of nanoparticle evolution*, Sept 2014 - .
- Gary O'Keeffe, PhD project: *Mathematical modelling of nanofluid direct absorption solar cells* , Sept 2014 - .
- Michelle M. MacDevette, PhD project: *Mathematical modelling of the convective transport and thermal properties of nanofluids*, completed Feb 2014, graduated Cum Laude.
- Francesc Font Martinez, PhD project: *Beyond the classical Stefan problem*, completed July 2014, graduated Cum Laude.

Postdoc supervision

- Vincent Cregan, La Caixa Post-doc, *Nanoparticle evolution*, Sept. 14 - ; Visiting Researcher funded by Marie Curie Re-integration grant, Sept 13 - Aug. 14.

□ Teaching activity

- Adjunct Professor at Universitat Politècnica de Catalunya. I teach for the Facultad de Matematiques i Estadistica, Department of Matemàtica Aplicada I on the undergraduate course Models Matemàtics de la Tecnologia, mathematics degree.

□ Scientific activities

Organisation

- 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 2014*, U. Zaragoza, Oct 2014, see `http://iuma.unizar.es/es/actividades/nanomath2014`.
- Organiser of "An introduction to"seminar series, Faculty of Math. & Stats., U. Politecnica de Catalunya, where experts in a field give an introductory lecture to a general audience.

Participation

Invited lectures in conferences

- T. G. Myers, *Continuum modelling of nanoscaled flows*, Fluidos 2014, Tandil, Argentina, November.
- T. G. Myers, *Invited international expert*, South African Mathematics in Industry Study Group, U. Witwatersrand, South Africa, January.

Communications in conferences

• T. G. Myers, *Mathematical modelling of nanoscale phenomena*, Nanotech 2014, Washington, June.
• T. G. Myers, *Boundary layer analysis and heat transfer of a nanofluid*, European Consortium for Mathematics in Industry Conference, Taormina, Sicilia, June.
• T. G. Myers, *Continuum modelling of nanoscale flows*, Nanomath 2014, Zaragoza, October.

□ Other activities

• Winner of Premi (Prize) Albert Dou, Catalan Maths Society. `http://blogs.iec.cat/scm/premis/premi-albert-dou/`
• Research Stay: July (4 weeks), Department of Mathematics, Vrije Universiteit, Netherlands.
• 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.
• External examiner, University of Limerick applied mathematics undergraduate courses, 2011-2014.
• PhD examiner, Dept of Applied Mathematics, University of Leeds; Dept of Applied Mathematics, Queensland University of Technology.
• Evaluator for Tecniospring Fellowships, Generalitat de Catalunya.
• Evaluator for King Abdul Aziz University, HiCi Distinguished Professor Visiting Programme.
• Referee for Applied Mathematical Modelling; Cold Region Science and Technology; International Journal of Thermal Science; Journal of Fluid Mechanics; Physics of Fluids.

Luis Ortiz

During 2014, 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. Four papers have been published in ISI journals and one has been submitted for publication. On October 2014, I started the supervision of a PhD thesis in co-direction with professor C.W. Oosterlee form the CWI, the national research institute for mathematics and computer science, the Netherlands. The thesis is devoted to find efficient numerical solutions of backward stochastic differential equations arising in finance and I supervised a BSc project on binomial trees for option pricing as well. Regarding research dissemination, I delivered several seminars at international level and organized

a minisymposium on computational finance in an international congress and the second workshop between industry and academia at the CRM. My teaching activity within this year comprises two courses on mathematics for undergraduate students at the Universitat Pompeu Fabra, where I usually teach as an adjunct professor, and one course on scientific computing in finance for MSc students at the CRM.

Publications

Articles

- L. Ortiz-Gracia, C. W. Oosterlee, *Efficient VaR and Expected Shortfall computations for nonlinear portfolios within the delta-gamma approach*, Applied Mathematics and Computation **244**, 16–31 (2014).
- L. Ortiz-Gracia, J.J. Masdemont , *Peaks and jumps reconstruction with B-splines scaling functions*, Journal of Computational and Applied Mathematics **272,**, 258–272 (2014).
- L. Ortiz-Gracia, J.J. Masdemont, *Credit risk contributions under the Vasicek one-factor model: a fast wavelet expansion approximation*, Journal of Computational Finance **17(4)**, 59–97 (2014).
- J.J. Masdemont,Ortiz-Gracia, *Haar wavelets-based approach for quantifying credit portfolio losses*, Quantitative Finance **14(9)**, 1587–1595 (2014).

Preprints

- L. Ortiz-Gracia, *Efficient wavelets-based valuation of synthetic CDO tranches*, submitted for publication.

Research projects

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

Activity in research training

Supervision of research students

Undergraduate project supervision

- Carles Pérez (Universitat Autònoma de Barcelona), *Implementation of a web-based toolkit for option pricing and risk management*, September 2014-July 2015.
- Marc Lagunas (Universitat de Barcelona), *Value-at-Risk computation with Haar wavelets*, April 2014-July 2014.

PhD supervision

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

□ Teaching activity

• Graduate level: First term 2014-2015: *Scientific Computing in Financial Risks*, Master of Mathematics in Finance, 12 hours, Universitat Autònoma de Barcelona.
• Undergraduate level: First term 2014-2015: *Matemàtiques I* (Mathematics I), Economics, 30 hours, Universitat Pompeu Fabra.
• Undergraduate level: Third term 2013-2014: *Matemàtiques III* (Mathematics III), Economics, 48 hours, Universitat Pompeu Fabra.

Lectures and short courses

• *Scientific Computing in Financial Risks*, 6 hours, Universidade da Coruña, October 2014.

□ Scientific activities

Organisation

• Co-organizer (with Prof. Carlos Vázquez Cendón and Juan Carlos Reboredo) of the *Minisymposium Computational Finance*. 14th International Conference Computational and Mathematical Methods in Science and Engineering, Rota (Cádiz), 03/07/2014-07/07/2014.
• Co-organizer (with Prof. Joan del Catillo) of the *II Jornada CRM-Empresa sobre Finances Quantitatives*. Industry-Academia workshop at Centre de Recerca Matemàtica, Barcelona, 10/06/2014.
• Coordinator of the *Seminar Cycle on Quantitative Finance* at Centre de Recerca Matemàtica, Barcelona, 10/2013-Present.

Seminars

• L. Ortiz-Gracia. *A Novel Fourier Inversion Method in Finance*. Seminar at CWI, Amsterdam, the Netherlands, September 2014.
• L. Ortiz-Gracia. *Haar Wavelets-Based Approach for Quantifying Credit Portfolio Losses*. Premia annual meeting, INRIA, Paris, March 2014.
• L. Ortiz-Gracia. *A Wavelet Look to the Discounted Expected Payoff Pricing Formula*. Seminari de Probabilitats de Barcelona, Universitat de Barcelona, Barcelona, February 2014.

• L. Ortiz-Gracia. *A Wavelet Look to the Discounted Expected Payoff Pricing Formula*. Applied Mathematics and Physics Seminar Cycle, Centre de Recerca Matemàtica, Barcelona, January 2014.

Courses attended

• 2nd European Credit and Counterparty Risk Conference International Conference London, England, June 19 to 20, 2014.

Alex Roxin

My research group has been focused on two main problems. 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-Rényi sense. That is, the probabilty 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 inhomogeneous 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.

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 Hopfield 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. 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 interneurons. 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 Yota Theodoni respectively.

In addition, two new PhD students have begin their thesis work in collaboration with Jaime de la Rocha at the Institut d'Investigacions Biomèdiques August Pi i Sunyer. Genís Prat has begun work on computational models of perceptual decision making and the role of fluctuations on the dynamics of decision making specifically. Narani van Laarhoven has begun work on computational models of so-called up/down state dynamics in cortical network. This type of activity, also known as slow-wave activity, occurs during sleep and is thought to play a role in memory consolidation.

□ Research projects

- *Codificación y consolidación de la memoria: un estudio computacional,* MINECO BFU2012-33413. From Jan 2013 to Dec 2014. Principal investigator: Alex Roxin.
- *Network Dynamics,* SGR Grup Emergent 2014 SGR 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).
- George-Paul Cribari, Master's Student in Neuroscience (UAB). Thesis Title: Power spectral analysis of sleep EEG
- Mauro Martinez, Undergraduate student in Physics (UAB). Thesis Title: Pràctiques al CRM en simulació de xarxes neuronals.
- Adrià Galán, Guanyador premi extraordinari de batxillerat (ACER) (CRM).

Diffusion activity

- I gave a talk on Mathematics and Neuroscience for highschool teachers within the framework of the "Programa de formació científica tecnològica i matemàtica (CTM) per a professors", Dec 2014.

Teaching activity

- Taught one week of lectures on models of memory formation in the advanced course "A short introduction to statistical physics."at the CRM, May 2014.
- Co-organized and taught at the week-long Barcelona Summer School in Computational Neuroscience at the CRM, July 2014.

Scientific activities

Scientific activities organised

- Member of the organising committee of *Barcelona Computational and Systems Neuroscience Conference*, Institut d'Estudis Catalans, June 2014.
- Co-organizer of the *Barcelona Summer School in Computational Neuroscience*, CRM, July 2014.

Participation in scientific activities

Invited lectures in conferences

- A. Roxin. *Simple statistical models of connectivity in cortical microcircuits* Invited talk at the Workshop on Mathematical Modeling and Statistical Analysis in Neuroscience. University of Copenhagen, July 2014.
- A. Roxin. *Exact meanfield description of networks of heterogeneous quadratic integrate-and-fire neurons* Invited talk at the International Workshop on Neurodynamics. Castro Urdiales, July 2014.
- A. Roxin. *Feedforward and feedback models of memory consolidation* Invited talk at the Workshop on Sleep Rhythms and Memory Consolidation, CNS. Quebec, July 2014.

Sergey Tikhonov

I am an ICREA research professor appointed at the CRM. During 2014, my research activities include the following topics. I continue investigating, with Andrey Bondarenko, weighted Bernstein's 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 proved sharp Ulyanov-type inequalities between Lorentz-Zygmund spaces. Jointly with Polina Glazyrina, I studied sharp Landau-type inequalities for algebraic polynomials and sharp Ulyanov inequalities for the K-functionals. 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 two PhD students: Petr Chunaev and Ainur Jumambaeva. Petr Chunaev studied Hardy's inequalities for sequences of monotonic type. Ainur Jumabaeva continues working on her PhD and investigates the Liouville derivatives. Moreover, I have been an editor of several books to be published in the series Advanced Courses in Mathematics CRM Barcelona, Birkhauser. 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. Also, I have given several talks in different conferences in Germany, Italy, and Spain, including a Colloquium talk in Universität zu Lübeck, Germany (November). In June and July I was invited to the Hausdorff Institute for Mathematics in Bonn to participate at the research program ´´Harmonic Analysis and Partial Differential Equations". Besides, I was a member of the Ph.D. Committee for Diana Chigambayeva, University of Padova, Italy.

□ Publications

Articles

- A. Gogatishvili, B. Opic, S. Tikhonov, W. Trebels, *Ulyanov-type inequalities between Lorentz-Zygmund spaces*, Journal Fourier Anal. Appl. **Vol. 20, Is. 5**, 1020–1049 (2014).
- A. Kolesnikov, S. Tikhonov, *Regularity of the Monge-Ampère equation in Besov's spaces*, Calculus of Variations and Partial Differential Equations **http://link.springer.com/article/10.1007%2Fs00526-013-0617-5**, 49 (1187–1197).
- E. Nursultanov, S. Tikhonov, *Weighted norm inequalities for Riesz potential in the Lorentz spaces*, Potent. Analysis **42 (2)**, 435–456 (2015).

Preprints

- 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.*.
- P. Glazyrina, S. Tikhonov, *Jacobi weights, fractional integration, and sharp Ulyanov inequalities*, to appear in *Journal of Approx. Theory*.

• F. Dai, H. Feng, S. Tikhonov, *Reverse Hölder's inequality for spherical harmonics*, submitted to Proc. Amer. Math. Soc..

• E. Nursultanov, M. Ruzhansky, S. Tikhonov, *Nikolskii inequality and Besov, Triebel-Lizorkin, Wiener and Beurling spaces on compact homogeneous manifolds*, submitted, see arXiv:1403.3430.

Books or chapters

• S. Tikhonov, M. Zeltser, *Weak monotonicity concept and its applications*, in *Fourier Analysis and Pseudo-Differential Operators. Fourier Analysis, Trends in Mathematics* (2014).

□ Research projects

• *Grup de Teoria de Funcions de la UB/UAB,* Generalitat de Catalunya, Support to research groups of quality, type B, 2014 SGR 289. From 2014 to pr. Principal investigator: C. Cascante.

□ Activity in research training

Supervision of research students

PhD supervision

• Petr Chunaev (doctorate student at the UAB).

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

□ Scientific activities

Participation

Invited lectures in conferences

• S. Tikhonov. *Weighted Bernstein inequality.* Functional Analysis Meeting dedicated to Richard Aron, València, December 2014.

• S. Tikhonov. *Polynomial inequalities.* Workshop on Harmonic Analysis and related topics, Ulm, October 2014.

• S. Tikhonov. *Two weight inequalities for Fourier transforms.* Workshop on Real Analysis, Bonn, July 2014.

• S. Tikhonov. *Weighted inequalities for convolution and Riesz potential.* Mini-courses in Mathematical Analysis 2014, Padova, June 2014.

Colloquium talks

• S. Tikhonov. Universität zu Lübeck, November 2014.

Seminars

• S. Tikhonov. *Wiener–type theorem on Fourier coefficients* Gumilyov Eurasian National University, Astana, March 2014.

• S. Tikhonov. *Weighted Bernstein inequality* Approximation Theory Seminar, Besov/Nikolskii Seminar, Moscow, Russia, October 2014.

• S. Tikhonov. *Inequalities for moduli of smothness* Approximation Theory Seminar, Steklov Mathematical Institute, Moscow, Russia, October 2014.

Research stays

- March, 2014: Visiting Researcher, Gumilyov Eurasian National University, Astana.
- June-July, 2014: Visiting Researcher, The Hausdorff Research Institute for Mathematics, Bonn.

□ Other activities

- Humboldt Research Fellowship for Experienced Researchers (granted by the Alexander von Humboldt Foundation).
- Editor, books of the series Advanced Courses in Mathematics CRM Barcelona, Birkhäuser (Basel):
  - "Introduction to the Variable Lebesgue Spaces" by David Cruz-Uribe and Alberto Fiorenza;
  - "Analysis on h-harmonics and Dunkl Transforms" by Feng Dai and Yuan Xu;
  - "Asymptotic Behaviour of Solutions to Hyperbolic Partial Differential Equations" by Michael Ruzhansky and Jens Wirth;
  - "Sparse Approximation with Bases" by Vladimir Temlyakov.
- Journal of Mathematical Analysis and Applications.
- Member of Editorial board, Abstract and Applied Analysis.
- Member of Editorial board, Bulletin of Mathematical Analysis and Applications.
- Member of Editorial board, The Scientific World Journal.
- Member of International Society for Analysis, its Applications and Computation.

2.2.2. Investigadors Postdoctorals

2.2.2. Postdoctoral Researchers

Vincent Cregan

In April 2014 I began a three year postdoctoral position with the CRM's Industrial Mathematics Research Group (IMRG) under the supervision of Tim Myers, thanks to a postdoctoral contract within the La Caixa-CRM program on Collaborative Mathematics. This position follows a research visit with the same group from September 2013 to March 2014. My research interests lie in the fields of nanoscience, fluid dynamics, heat and mass transfer, ordinary and partial differential equations and perturbation theory. Since taking on my new position I have been mainly working on two projects. The first project consists of modelling heat transfer in a nanofluid-based direct absorption solar collector. In particular, we are interested in predicting the increase in collector efficiency as a result of the inclusion of nanoparticles. The aim of the second project is to develop a working theory for the particle growth process referred to as Ostwald ripening. In particular, we have been studying this process in the context of nanoparticles. I have also been helping with other ongoing projects in the IMRG such as nanoparticle melting and the hyperbolic Stefan problem.

During my first nine months at the CRM I have published two papers (and currently have two in preparation) and presented work at the Nanomath2014 conference in Zaragoza.

□ Publications

Articles

- T.G. Myers, M.M. MacDevette, F. Font and V. Cregan, *Nanomaths: Mathematical modeling at the nanoscale*, El Butlletí de la Societat Catalana de Matemàtiques **29**, 115-134 (2014).
- T.G. Myers, M.M. MacDevette, F. Font and V. Cregan, *Continuum mathematics at the nanoscale*, Journal of Mathematics in Industry **4.1**, (2014).

Scientific reports

- G. Hocking, S. Mitchell, T. Myers, M. MacDevette, V. Cregan and R. Loubser, *Unsteady flow in a diffuser*, Proceedings of the Mathematics in Industry Study Group 2014 (Johannesburg) , (2014).

□ Teaching activity

- Assistant lecturer of *Models Matemàtics de la Tecnologia* (final year course) in the Facultat de Matemàtiques i Estadística, UPC, September 2014 – December 2014.

□ Scientific activities

Participation

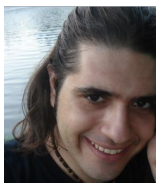
Communications in conferences

- V. Cregan, T.G. Myers and F. Font, *Nanoparticle evolutionary phenomena: melting and growth.*, Nanomath2014, Zaragoza, October 2014.

Research stays

- July 7–July 11, 2014: Research visit at VU University (Amsterdam).

Mihalis Mourgoglou



I have been in the CRM as an EPDI post-doctoral researcher since September 2014.

□ Scientific activities

Participation

Seminars

- Mihalis Mourgoglou *Recent results on representation, uniqueness and duality for boundary value elliptic problems for elliptic systems.* Analysis Seminar UAB-UB, November 2014.

Conferences attended

- Barcelona Mathematical Days, November 2014.

Ivón Rodríguez

During 2014, I was in charge of maintenance and the effective operation of laboratory activities. Moreover I worked and supervise the experimental studies with Newtonian and non-Newtonian fluids to develop new biomedical technologies, including experimental set-up, microdevice fabrication, testing the device and collected data analysis.

There are two correlated projects carried out jointly the Dynamics of interfaces in nanotechnology, fluidics and biophysics group led by Prof. Aurora Hernández Machado and Discrete to Integrated System Lab (D2In) group led by Dr. Pere Miribel-Català, both groups from the University of Barcelona (UB). These projects consist on:

1. Understand and control Newtonian fluids within a microchannel in order to develop a micro-viscometer. This research comprises experimental test and mathematical modeling.
2. Understand and manipulate Non-Newtonian fluids at the microscale to develop a biocompatible micro-rheometer. This interdisciplinary work combines mathematical modeling, experimental microfluidics, clinical laboratory and electronic detection. This project was performed in cooperation of Hospital Clinic of Barcelona (by Dr. Joan Cid).

I have collaborated with the Electronics Department (D2In) and the Hospital Clinic to develop a full custom device (electronic instrumentation and software) which measures the hematocrit concentration in blood samples for anemia detection. The device is based on impedance analysis and has been tested with blood samples from different patients with and accuracy error of 1.75%.

Moreover, I collaborate to develop an early prototype of a portable system for Electrochemical Impedance Spectroscopy. The system has been characterized and validated using different sensors and biocompatible materials, getting a full spectrum analysis of impedance behavior. The research was carried out with the Electronic Deparment (D2In group), the Hospital Clinic and the University of South Australia (by Dr. Beatriz Prieto Simon).

Part of this work is under patent process, therefore, its publication still pending.

□ Publications

Articles

- J. Punter-Villagrasa, J. Cid, J. Colomer-Farrarons, I. Rodriguez-Villarreal, P.L. Miribel-Catala, *Toward an Anemia Early Detection Device Based on 50-μL Whole Blood Sample*, IEEE Transactions on Biomedical Engineering **62 (2)**, 708–716 (2014).
- J. Punter-Villagrasa, J. Cid, C. Páez-Avilés, I. Rodríguez-Villarreal, E. Juanola-Feliu, J. Colomer-Farrarons, P.Ll. Miribel-Català, *An Instantaneous Low-Cost Point-of-Care Anemia Detection Device*, Sensors **15 (2)**, 4564–4577 (2015).

Scientific reports

- G. Hocking, S. Mitchell, T. Myers, M. MacDevette, V. Cregan and R. Loubser, *Unsteady flow in a diffuser*, Proceedings of the Mathematics in Industry Study Group 2014 (Johannesburg) , (2014).

Conference proceedings

- J. Punter-Villagrasa, B. del Moral-Zamora, J. Colomer-Farrarons, P. Miribel-Catala, J. Cid, I. Rodriguez-Villarreal, B. Prieto-Simon, *Towards a portable point-of-use blood analysis with EIS technique device*. Multi-Conference on Systems, Signals & Devices (SSD) (2014) 11th International, February 1-6, 2014, Barcelona.
- J. Punter-Villagrasa, B. del Moral-Zamora, J. Colomer-Farrarons, P. Miribel-Catala, J. Cid, I. Rodriguez-Villarreal, B. Prieto-Simon, *A portable point-of-use EIS device for in-vivo biomedical applications*. Conference on Design of Circuits and Integrated Circuits (DCIS), November 1-6, 2014, Madrid.

□ Teaching activity

Lectures and short courses

- *Stochastic treatment of water resources*. Assistant lecturer of this final year course in the Universitat Politècnica de Catalunya, September 2014 - December 2014.

□ Scientific activities

Research stays

- July 7–July 11, 2014: Research visit at VU University (Amsterdam).

Isabel Serra

In September 2014, Isabel Serra joined the group of Complex Systems within the La Caixa-CRM program on Collaborative Mathematics to work on

□ Publications

Articles

- J. Serrà, I. Serra, A. Corral, J. L. Arcos, *Ranking and significance of variable-length similarity-based time series motifs*. Data Mining and Knowledge Discovery. Submitted
- J. del Castillo, I. Serra, *Likelihood inference for Generalized Pareto Distribution*. To appear in Computational Statistics and Data Analysis.

Books or book chapters

- J. Castillo, I. Serra, *New realistic methodology to model the extremes value. Statistical and Biometrical Challenges*. T. Oliveira, K.E. Biebler, A. Oliveira and B. Jäger (Ed.). Shaker Verlag. Aachen. ISBN: 978-3-8440-2680-1, ISNN: 1439-5320, pp 67-73 (2014).

Panagliota Theodoni

I joined the Computational Neuroscience group of CRM in March 2014. My postdoctoral position is funded by Alex Roxin's research project from the Spanish Ministery of Economics and Competitiveness. My research is on developing models of memory formation and memory consolidation. To this aim, we consider reported behavioral and neurophysiological data from cortical and subcortical regions of animals engaged in memory experiments. The goal of this research is to computationally explore the brain capacity of storing memories and to understand the underlying physiological mechanisms of the consolidation process.

Seminars

- Panagliota Theodoni *Fluctuations in Perceptual Decisions.* CAMP Seminar, CRM, May 2014.

2.2.3. Col·laboradors Científics

Durant l'any 2014, 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 2014, 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.

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/`.

Vicent Ribas

This research report covers the period between June 2013 and July 2014. Its main objective is to outline the research activities carried out by Dr. Vicent J. Ribas at the Centre de Recerca Matemàtica - CRM - in Barcelona under the supervision of Prof. Dr. Timothy Myers.

The original terms of the scientific collaboration between CRM and Dr Ribas covered the areas of Algebraic Models, Machine Learning and Artificial Intelligence in the areas of Industrial Mathematics, Mathematical Biology and Medicine (system modelling for diagnostics support).

Dr Ribas has collaborated with the Industrial Mathematics group in the following topics:

1. Algebraic statistics applied to graphical models and inference functions. We are currently using this methodology in the detection of potential biomarkers of Shock.
2. Algebraic statistics for the definition of Deep Learning Architectures understood as the generalisation of Stochastic Factor Analysis Models. In particular, we are working in two papers related to the assessement of electrocardiograms and screening lung tumors.

From an application point of view, Dr Ribas also continued and strengthened his clinical collaboration with the Intensive Care Unit at Hospital Vall d'Hebron in Barcelona.

□ Publications

Articles

• V.J. Ribas Ripoll, A. Vellido, E. Romero, J. C., Ruiz-Rodríguez, *Sepsis Mortality Prediction with Quotient Basis Kernel* Artificial Intelligence in Medicine **61** (2014), 45–52.

• V. J. Ribas Ripoll, A. Wojdel, P. Ramos, E. Romero, J. Brugada, *Assessment of Electrocardiograms with Pretraining and Shallow Networks*. Computing in Cardiology **41**, 1061–1064.

• V. J. Ribas Ripoll, A. Wojdel, A. Sáez de Tejada, J. C. Ruiz-Rodriguez, A. Ruiz-Sanmartin, A. de Nadal, E. Romero, A. Vellido, *Continuous blood pressure assessment from a photoplethysmographic signal with deep belief networks*. FASEB **28** (2014), no. 1, Supplement LB674

Preprints

• T. Myers, V. J. Ribas Ripoll, A. Sáez de Tejada, S. Mitchell, M. J. McGuinness, *Modelling the cardiovascular system for automatic interpretation of the blood pressure curve*.

Claudia Trejo

Claudia Trejo participates also in the CRM lab for Microrheology of Biofluids. She belongs to the group on *Dynamics of interfaces in nanotechnology, fluidics and biophysics* from Universitat de Barcelona.

2.2.4. Visitants de llarga durada

2.2.4. Long-term visitors

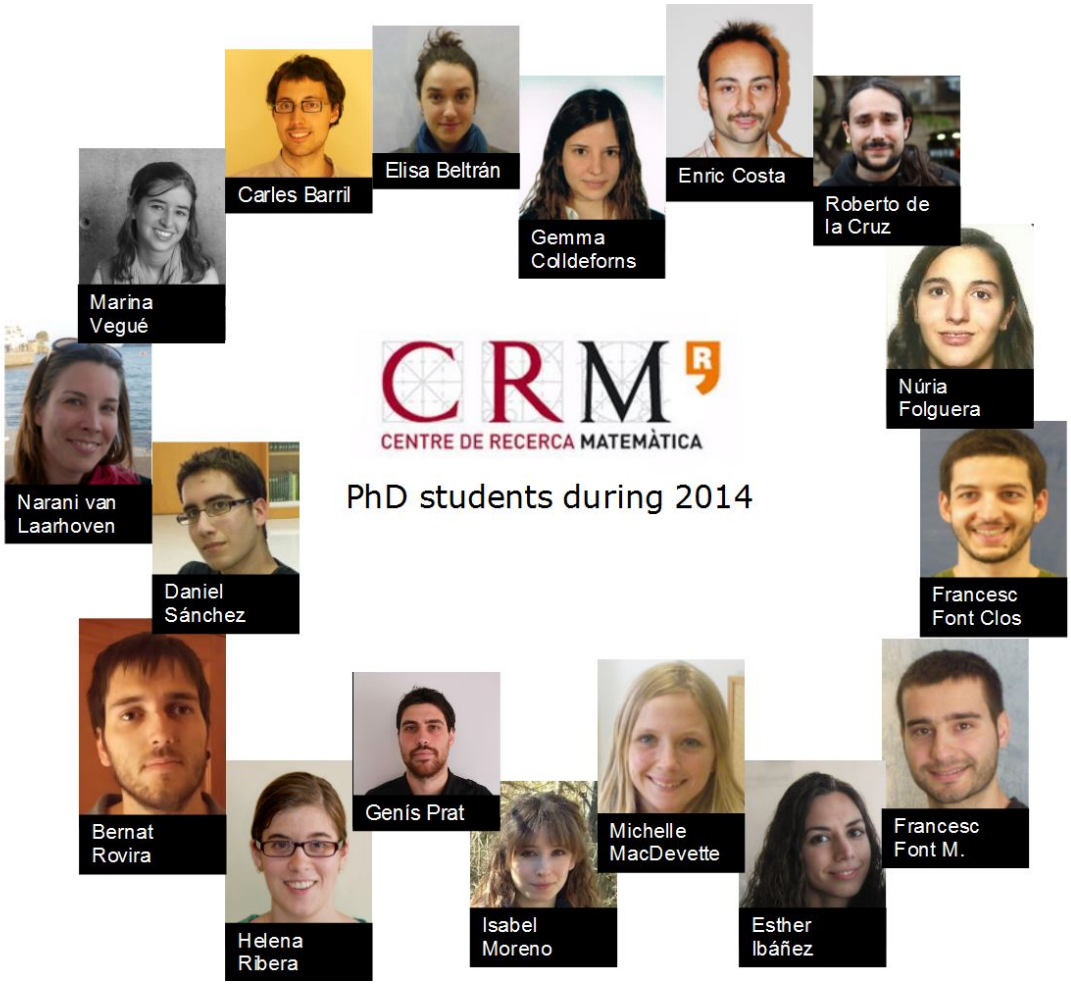
Salomón Rebollo-Perdomo

Salomón Rebollo-Perdomo is a researcher on dynamical systems and its applications who collaborates with the UAB group on Dynamical Systems, `www.gsd.uab.cat`. He has been visiting the CRM until July 2014. He has been working in reducing the difficulty of the study of zeros of Abelian integrals, one of the main problems related to the second part of the Hilbert's sixteen problem. He also works on the study of limit cycles of generalized Liénard equations.

□ Publications

Preprints

• S. Rebollo-Perdomo, *Poincaré–Pontryagin–Melnikov functions for a class of perturbed planar Hamiltonian equations*, CRM preprint no. 01/2014.



The 17 PhD students on the picture have been working on her/his PhD at the CRM during some period in 2014: Carles Barril (*Math. Epidemiol.*); Elisa Beltrán (*Comp. & Math. Biol.*); Gemma Colldeforns (*Financ. Math.*); Enric Costa (*Comp. & Math. Biol.*); Roberto de la Cruz (*Comp. & Math. Biol.*); Núria Folguera (*Comp. & Math. Biol.*); Francesc Font-Clos (*Complex Syst.*); Francesc Font Martínez (*Ind. Math.*); Esther Ibáñez (*Comp. & Math. Biol.*); Michelle MacDevette (*Ind. Math.*); Isabel Moreno (*Complex Syst.*); Genís Prat (*Comp. Neuro.*); Helena Ribera (*Ind. Math.*); Bernat Rovira (*Comp. Neuro.*); Daniel Sánchez-Taltavull (*Comp. & Math. Biol.*); Narani van Laarhoven (*Comp. Neuro.*); Marina Vegué (*Comp. Neuro.*)

2.2.5. Estudiants de doctorat

Presentem a continuació els estudiants de doctorat dels grups del centre i la seva activitat més rellevant durant el 2014. Tal com s'ha anat indicant en altres part d'aquesta memòria, les beques d'aquests estudiants es financien per diverses fonts: beques competitives de la Generalitat de Catalunya (FI) o del Ministeri (FPI, FPU), beques del programa de recerca col·laborativa La Caixa-CRM, beques pròpies del CRM i una beca del programa especial de l'Obra Social de La Caixa vinculada a la Universitat Politècnica de Catalunya. A l'apartat 2.6.1. es detalla la procedència de cadascuna de les beques.

2.2.5. CRM PhD Students

Next we present the postgraduate students of the CRM research groups and their activity along the year 2014. As pointed out in other parts of this report, the grants of these students are funded from different sources: competitive grants of the Generalitat de Catalunya (FI) or Spanish Ministeries (FPI, FPU), grants from the La Caixa-CRM program collaborative research, CRM-funded grants and one grant from a special program of the La Caixa foundation, which is based at the Universitat Politècnica de Catalunya. Details about the sourcing of each fellowship are given in Section 2.6.1.

Publications

Articles

- O. Sagarra, **F. Font-Clos**, C. J. Pérez-Vicente, A. Díaz-Guilera. *The configuration multi-edge model: Assessing the effect of fixing node strengths on weighted network magnitudes*, EPL (Europhysics Letters) **107(3)**, 38002 (2014). DOI:10.1209/0295-5075/107/38002.

- T.G. Myers, **F. Font Martínez**, V. Cregan, M.M. MacDevette. *Nanomatemàtiques: modelització matemàtica a la nanoescala*, Butlleti de la Societat Catalana de Matematiques (Submitted, September 2014).
- T.G. Myers, **F. Font Martínez**. *On the one-phase reduction of the Stefan problem with a variable phase change temperature*, International Communications on Heat and Mass Transfer (Accepted, Oct. 2014).
- **F. Font Martínez**, T.G. Myers, S.L. Mitchell. *A mathematical model for nanoparticle melting with density change, Microfluidics and Nanofluidics* (2014). DOI:10.1007/s10404-014-1423-x.
- T.G. Myers, M.M. MacDevette, **F. Font Martínez**, V. Cregan. *Continuum mathematics at the nanoscale*, Journal of Mathematics in Industry **4**, 11 (2014).

- **E. Ibáñez**, T. Alarcón. *The topology of robustness and evolvability in evolutionary systems with genotype-phenotype map*. Journal of Theoretical Biology **356**, 144–162 (2014).
- **E. Ibáñez**, M. Casanellas. *EM for phylogenetic topology reconstruction on nonhomogeneous data*. BMC Bioinformatics **14**, 132 (2014).

- **D. Sánchez-Taltavull**, T. Alarcón. *Robustness of differentiation cascades with symmetric stem cell division.* Journal of the Royal Society Interface **11**, 20140264 (2014).

Preprints

- J. M. Abelleira-Pereira, S. I. Pérez-Elvira, J. Sánchez-Oneto, **R. de la Cruz**, J. R. Portela, E. Nebot. *Enhancement of methane production in mesophilic anaerobic digestion of secondary sewage sludge by avanced thermal hydrolysis pretreatment*, In Press, Accepted Manuscript in *Water Research* (2015).http://dx.doi.org/10.1016/j.watres.2014.12.027
- **R. de la Cruz**, P. Guerrero, F. Spill, 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).

- R. Garcia-Millan, **F. Font-Clos**, A. Corral. *Finite-size scaling of survival probability in branching processes*, (2014). http://arxiv.org/abs/1411.2817.
- **F. Font-Clos**, G. Pruessner, A. Deluca, N. R. Moloney. *The perils of thresholding*, (2014). http://arxiv.org/abs/1410.6048.
- O. Güell, F. A. Massucci, **F. Font-Clos**, F. Sagués, M. Á. Serrano. *Mapping high-growth phenotypes in the flux space of microbial metabolism*, (2014). http://arxiv.org/abs/1409.4595.

• **E. Ibáñez**, T. Alarcón. *Surviving evolutionary escape on complex genotype-phenotype networks*. Journal of Mathematical Biology Submitted, October 2014.
• **E. Ibáñez**, T. Alarcón. *Evolutionary escape on complex genotype-phenotype networks*. Journal of the Royal Society Interface. Submitted, September 2014.

• **D. Sánchez-Taltavull**, T. Alarcón, *Stochastic modelling of viral blips in HIV-1-infected patients: Effects of inhomogeneous density fluctuations*, to appear in Journal of theoretical biology 2015. Quartile-JCR cathegory.
• **D. Sánchez-Taltavull**, A. Vieiro, T. Alarcón, *Stochastic modelling of the eradication of the HIV-1 infection by stimulation of latently infected cells in patients under highly active anti-retroviral therapy*, additional info: preprint number or submitted to Journal of Mathematical Biology (2014).

Conference proceedings

• **E. Ibáñez**, T. Alarcón. *Conference proceedings: Evolutionary escape in populations with genotype-phenotype structure*. Research Perspectives CRM Barcelona: Trends in Mathematics Birkhäuser Science (Springer), (to appear).
• **D. Sánchez-Taltavull**, T. Alarcon. *Are viral blips in HIV-1 infected patients clinically rellevant?*. Extended Conference Abstracts, Spring 2014, Research Perspectives CRM Barcelona, Birkhäuser series "Trends in Mathematics", Volume 4 (2014).

□ Activity in research training

• *Mathematical modelling of biological populations with complex structure,* Ministery or Science and Innovation (MCINN)-Spanish government, MTM2011-29342. From 01-01-2012 to 31-12-2014. Principal investigator: Tomás Alarcón. (**R. de la Cruz**)

□ Scientific activities

Organisation

• **F. Font-Clos** I have co-organized the *II ECCS Warm Up: School on Complex Networks*, an activity to which the CRM has given logistic support. The event took place on 19-21st September 2014, coinciding with the *European Conference on Complex Systems 2014*. The organizing comittee was formed by Oleguer Sagarra (UB), Michele Starnini (UPC), Giovanni Petri (ISI Foundation) and Francesc Font-Clos (CRM). The sponsors were: *Complex Systems Society*, *Institute for Advanced Studies Lucca*, *Complexitat.CAT* and *ECCS'14*.
This event was aimed to offer young researchers the opportunity to learn new methods, present their work and meet fellow researchers. The invited speakers where Dr. Roberta Sinatra, Dr. Ciro Cattuto and Prof Stefano Battiston, three internationally recognized researchers in the field of Complex Networks.
In this second edition, the school was once more very succesful, with almost 50 attendants.

• **E. Ibáñez** Organizer of The CRM Applied Mathematical and Physics (CAMP) seminars.
• **D. Sánchez-Taltavull** Member of the organising committee of *2a Jornada d'Investigadors Predoctorals Interdisciplinaria*, University of Barcelona, February 2014.
• **D. Sánchez-Taltavull** Member of the scientific committee of the *2a Jornada d'Investigadors Predoctorals Interdisciplinaria*, University of Barcelona, February 2014.

Participation

Invited lectures in conferences

• **D. Sánchez-Taltavull**, *Stochastic dynamics of HIV-1 infection* Invited talk at the Barcelona Mathematical Days 2014. Institut d'Estudis Catalans, October 2014.

Communications in conferences

• **C. Barril**, *A brief story about beaks, seeds and mathematical models*, 2a Jornada d'Investigadors Predoctorals Interdisciplinària, Barcelona, February 6, 2014.
• **C. Barril**, *Bacillary growth along an intestine*, Trobada d'EDPs i aplicacions, IMAE-UdG, Girona, June 6, 2014.
• **C. Barril**, *Microbial dynamics within the gastrointestinal ecosystem*, Workshop on PDEs: Modelling, Analysis and Numerical Simulation, IEMath-GR, Universidad de Granada, September 15, 2014.

• **R. de la Cruz**, T. Alarcón, P. Guerrero, *Stochastic quasi-steady approximation in the Hamilton-Jacobi representation of the Chemical Master Equation*, Workshop on Virus Dynamics and Evolution, CRM (Bellatera, Barcelona), July 2014.

• **F. Font-Clos** *Incompatibility between Zipf's law and Heaps' law*. European Conference on Complex Systems 2014, Lucca, September 26, 2014.
• **F. Font-Clos** *Vocabulary growth curves: from random to real books*, Student Conference on Complex Systems, Brighton, August 20, 2014.
• **F. Font-Clos** *Random weighted networks with fixed strengths*, Student Conference on Complex Systems, Brighton, August 21, 2014.

• **F. Font Martínez** *Mathematical model for the melting of a nano-thin lm*. 18th European Conference on Mathematics for Industry (Taormina, Sicilia), July 2014.

• **E. Ibáñez** Poster. *Evolutionary escape in populations with genotype-phenotype structure*. III Jornada complexitat.cat, Universitat Politècnica de Catalunya, Barcelona, 19 June 2014.
• **E. Ibáñez** Talk. *Evolutionary escape in populations with genotype-phenotype structure*. Workshop on Virus Dynamics and Evolution, Centre de Recerca Matemàtica, Barcelona, 30 June-4 July 2014.

• **E. Ibáñez** Talk. *Evolutionary escape and surviving in populations with genotype-phenotype structure* Barcelona Mathematical Days, Institut d'Estudis Catalans, Barcelona, 7-8 November 2014.

• **D. Sánchez-Taltavull** *Are viral blips in HIV-1 infected patients clinically relevant?*. Poster presentation FisEs, Ourense, April 2014.
• **D. Sánchez-Taltavull**, *Are viral blips in HIV-1 infected patients clinically relevant?*, Workshop on Virus Dynamics and Evolution, Centre de Recerca Matemàtica (Bellaterra), June 2014.
• **D. Sánchez-Taltavull**, *Are viral blips in HIV-1 infected patients clinically relevant?*, 3a Jornada complexitat.cat, Barcelona, July 2014.

• **M. Vegué**, A. Roxin, *Statistical models of network connectivity in cortical microcircuits*, Barcelona Computational and Systems Neuroscience congress, Barcelona, June 2014.

Seminars

• **F. Font-Clos***Two scaling regimes in a thresholded birth-death process*, Mathematics Department Seminars. Imperial College London, London, April 2014.

• **F. Font Martínez***Mathematical modelling of special solid-liquid phase transitions*. Fluids Dynamics Seminar Series, New Jersey Institute of Technology, Newark (New Jersey), October 2014.

• **D. Sánchez-Taltavull**, *Latency in cell populations* seminar at ESTaN Seminar at Centre de Recerca Matematica, November 2014.
• **D. Sánchez-Taltavull**, *Stochastic dynamics of HIV-1 infection* Seminar at the Departamento de Matematica Aplicada a la ingenieria aeroespacial. Escuela Tecnica SUperior de Ingenieria Aeronautica y del Espacio. Universidad Politecnica de Madrid, December 2014.

Research stays

• April 7–11, 2014: Visiting Researcher at Department of Mathematics, Imperial College London. (**F. Font-Clos**)
• August 12th – September 12th, 2014: Visiting Researcher at London Mathematical Laboratory, London. (**F. Font-Clos**)
• October 27th – November 26th, 2014: Visiting Researcher at Max-Planck-Institute for the Physics of Complex Systems, Dresden.
(**F. Font-Clos**)

• October–December, 2014: Visiting Researcher at Department of Mathematical Sciences, New Jersey Institute of Technology, Newark, New Jersey. (**F. Font Martínez**)

Courses attended

• X. Cabré and M. del Mar González, *Partial Differential Equations*, BGSMath, Barcelona, Spring semester 2014,`http://www.bgsmath.cat/partial-differential-equations/` (**C. Barril**)

• T. Alarcón, N. Barton, S. F. Elena, Andrei Korobeinikov, Yoh Iwasa, *Advanced Course on Mathematical Methods of Biological Evolution*, CRM, Bellatera June 2014. `http://www.crm.cat/en/Activities/Pages/ActivityFoldersAndPages/Curs%202013-2014/ACMathMethods/ACMathematicalMethods.aspx`.
(**R. de la Cruz**)
• T. Alarcón, N. Bellemo, Miroslaw Lachwicz,..., *Biomat 2014: Complexity and Emergence in Social and Biological Systems*, University of Granada, June 2014. `http://www.ugr.es/~kinetic/biomat/`. (**R. de la Cruz**)

• S. Battiston, C. Cattuto, R. Sinatra. *II ECCS Warm-Up: School on Complex Networks*, Lucca, September 19–21, 2014. `http://www.eccswarmup.wordpress.com`. (**F. Font-Clos**)
• *2a Jornada d'Investigadors Predoctorals Interdisciplinària*, Barcelona, 6 Februrary 2014. (**E. Ibáñez**)
• *III Jornada complexitat.cat*, Universitat Politècnica de Catalunya, Barcelona, 19 June 2014. (**E. Ibáñez**)
• *Advanced Course on Mathematical Methods of Biological Evolution*, CRM Bellaterra, June 23–27, 2014. (**E. Ibáñez**)
• *Workshop on Virus Dynamics and Evolution*, CRM Bellaterra, June, 30 – July 4, 2014. (**E. Ibáñez**)
• *Barcelona Mathematical Days*, Institut d'Estudis Catalans, Barcelona, November 7–8, 2014. (**E. Ibáñez**)

• T. Alarcón, A. Corral, A. Roxin. *A short introduction to statistical physics*, CRM Bellaterra, May 5–22, 2014. (**R. de la Cruz**, **F. Font-Clos**, **M. Vegué**,...)

□ Other activities

• A. Castaño, **R. de la Cruz**, G. García, Solución problema 219, *La Gaceta de la RSME* 17, 104, 2014. `gaceta.rsme.es/abrir.php?id=1190`.
• **R. de la Cruz**, Solución problema 224, *La Gaceta de la RSME* 17, 303-304, 2014. `gaceta.rsme.es/abrir.php?id=1204`
• **R. de la Cruz**, Solució problema A110, *SCM/Notícies* 35, 71–72, 2014. `http://mat.uab.cat/~albert/scm/N35.pdf`.

• **F. Font Martínez**: Borsa Ferran Sunyer i Balaguer (3960 euros) per a una estada de recerca de 3 mesos al New Jersey Institute of Technology, Newark, New Jersey.
• **F. Font Martínez**: defensa de la tesi doctoral *Beyond the Classical Stefan Problem*, a la Facultat de Matemàtiques i Estadística, Universitat Politècnica de Catalunya, juliol de 2014.

• **E. Ibáñez**: defensa de la tesi doctoral *Evolutionary dynamics of populations with genotype-phenotype map*, a la Facultat de Matemàtiques i Estadística, Universitat Politècnica de Catalunya, desembre de 2014.

• **D. Sánchez-Taltavull**: defensa de la tesi doctoral *Stochastic modelling of cellular populations: effects of latency and feedback*, a la Facultat de Matemàtiques, Universitat de Barcelona, desembre de 2014.

• **D. Sánchez-Taltavull**: Member of Editorial board, Bulletin of Particle Populations.

• **D. Sánchez-Taltavull**: Member of International Society for Particle Populations and Applications.

• **Bernat Rovira**: PhD Proposal *Memory encoding and consolidation*, September 2014.

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 en Nanotecnologia, Fluídica i Biofísica de la Facultat de Física de la Universitat de Barcelona, dirigit per la Prof. Aurora Hernández-Machado, col·laboradora científica del CRM.

2.3. 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 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).

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).

Les xarxes temàtiques actuals al CRM són les següents:

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

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

Les activitats d'aquestes xarxes poden veure's a

The current list of CRM Thematic Networks is the following:

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

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

The activities of these networks can be checked at

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

2.5. Investigadors visitants

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

- Estades de recerca al CRM.
- Estades de recerca en col·laboració.
- Places "Lluís Santaló" per a visitants d'Amèrica llatina (finançada per l'IEC).
- El programa "Dev-Math" per a investigadors de països en vies de desenvolupament.

El llistat de visitants de 2014 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 Renato Calleja (IIMAS-Universidad Nacional Autónoma de México), per col·laborar amb Àngel Jorba (UB) per un període de dos mesos, mentre que les estades del programa Dev-Math que es van concedir per al 2014 s'han posposat, per motius personals, al 2015.

2.5. List of visitors

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

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

The list of 2014 visitors is the following. This list does not include CRM staff researchers nor visitors whose stay was shorter than eight days. The "Lluís Santaló" visiting position was held by Renato Calleja (Universidad Nacional Autónoma de México), who visited Àngel Jorba (UB) for a two-month period. The positions of the Dev-Math program awarded for 2014 have been postponed to 2015 for personal reasons.

Antonio Ache	*Princeton University*
Guglielmo Albanese	*Università degli studi di Milano*
Spyros Alexakis	*University of Toronto*
Janine Bachrachas	*McGill University*
Florent Balacheff	*Université de Lille 1*
Romero Barbieri	*Universitat Politècnica de Catalunya*
Ayanbayev Birzhan	*L.N. Gumilyov Eurasian National University*
Xia Bo	*Université Paris-Sud*
Marián Boguñá	*Universitat de Barcelona*
Alexei Bolsinov	*University Loughborough Leicestershire*
Roger Casals	*ICMAT/CSIC Madrid*
Jeffrey Case	*Princeton University*
Alice Chang	*Princeton University*
Sagun Chanillo	*The State University of New Jersey*
Jih-Hsin Cheng	*Institute of Mathematics - Academia Sinica*
Kim Christensen	*Imperial College London*
Matteo Cozzi	*Università degli studi di Milano*
Vincent Cregan	*University of Limerick*
Jörn Davidsen	*University of Calgary*
Azahara de la Torre	*Universitat Politècnica de Catalunya*
Álvaro del Pino	*ICMAT/CSIC Madrid*
Kostiantyn Drach	*Yanka Kupala State University of Grodno*
Nguyen Thac Dung	*National Tsing Hua University*
Chiara Esposito	*Mathematisches Forschungsinstitut Oberwolfach*
Jean-Pierre Françoise	*Université Pierre et Marie Curie*
Pedro Frejlich	*Universiteit Utrecht*
Yuxim Ge	*Université Paris Est Créteil*
Heiko Gimperlein	*Leibniz Universität Hannover*
Maria del Mar González	*Universitat Politècnica de Catalunya*
Rod Gover	*University of Auckland*
Robin Graham	*University of Washington*
Colin Guillarmou	*École Normale Supérieure*
Iskandarova Gulistan	*L.N. Gumilyov Eurasian National University*
Matthew Gursky	*University of Notre Dame*
Mark Hamilton	*Mount Allison*
Kengo Hirachi	*The University of Tokyo*
Xue Hu	*The Chinese Academy of Sciences*
Andreas Juhl	*Humboldt Universität zu Berlin*
Ainur Jumabayeva	*L.N. Gumilyov Eurasian National University*
Anna Kiesenhofer	*Universitat Politècnica de Catalunya*
Seongtag Kim	*Inha University*
Alexander Kolesnikov	*University of Eastern Finland*
Iurii Kolomoitsev	*IAMM of NAS of Ukraine*
Lou Kondic	*New Jersey Institute of Technology*
Boris Kruglikov	*University of Trømso*
Robert Kusner	*University of Massachusetts at Amherst*

Santiago López de Medrano	*UNAM* (Lluís Santaló)
Jean-Pierre Marco	*Université Pierre et Marie Curie*
Ali Maalaoui	*Rutgers University*
Niels Martin	*Princeton University*
Francisco Martín	*Universidad de Granada*
Luca Martinazzi	*Rutgers University*
Alfonso Martínez	*Universitat Pompeu Fabra*
David Martínez	*Instituto Superior Técnico*
Yoshihiko Matsumoto	*The University of Tokyo*
Vladimir Matveev	*Friedrich-Schiller Universität Jena*
Stephen McKeown	*University of Washington*
William Meeks III	*University of Massachusetts at Amherst*
Mateusz Michalek	*Université Joseph Fourier*
Eva Miranda	*Universitat Politècnica de Catalunya*
Andrey Mironov	*Sobolev Institute of Mathematics*
Nicholas R. Moloney	*London Mathematical Laboratory*
Ilaria Mondello	*Université de Nantes*
Philippe Monnier	*Université Paul Sabatier*
Juan José Morales	*Universidad Politécnica de Madrid*
Patrick Munroe	*McGill University*
Christian Murray	*University of Cape Town*
Klaus Niederkruger	*Université Paul Sabatier*
E. D. Nursultanov	*L.N. Gumilyov Eurasian National University*
Dragos Oprea	*University of California at San Diego*
Jesús Pérez García	*Universidad de Granada*
Joaquín Pérez Muñoz	*Universidad de Granada*
Kamana Porwal	*Indian Institute of Science Bangalore*
Francisco Presas	*Instituto de Ciencias Matemáticas*
Jie Qing	*University of California at Santa Cruz*
Roland Rabanal	*Pontificia Universidad Católica del Perú* (Lluís Santaló)
Salomón Rebollo-Perdomo	*Universitat Autònoma de Barcelona*
Nick Reichert	*Princeton University*
Helena Ribera	*PricewaterhouseCoopers*
Manuel Ritoré	*Universidad de Granada*
Stefan Rosemann	*Friedrich-Schiller Universität Jena*
María Amelia Salazar	*IMPA*
Manel Sanchón	*Universitat de Barcelona*
Yasha Savelyev	*Centro de Investigaciones Ener. Medio y Tecno.*
Konrad Schöbel	*Friedrich-Schiller Universität Jena*
Nora Seeliger	*Max Planck Institute for Mathematics*
M. Ángeles Serrano	*Universitat de Barcelona*
Elena Shchepakina	*Samara State Aerospace University*
Jedrzej Sniatycki	*University of Calgary*
Vladimir Sobolev	*Samara State Aerospace University*
Joseé Luis Teruel	*Universidad de Granada*
Claudia Trejo	*Universitat de Barcelona*

Dmitry Treschev	*Steklov Mathematical Institute*
Vassil Tzanov	*Bristol University*
Andreas Vollmer	*Friedrich-Schiller Universität Jena*
Jonathan Weitsman	*Northeastern University*
David Wiygul	*Brown University*
Paul Yang	*Princeton University*
Ray Yang	*Courant Institute of Mathematical Sciences*
Wang Yi	*Stanford University*
Jingyang Zhong	*University of California at Santa Cruz*

En total, el CRM ha hostatjat 113 mesos d'estada d'investigadors al llarg de l'any 2014.

Summing up, the CRM has hosted 113 months of stays of researchers during 2014.

2.6. La formació en recerca

2.6. Research training

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 2014.

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 2014.

2.6.1. La Unitat de Formació Doctoral

2.6.1. The Doctoral Training Unit

El CRM ofereix la possibilitat a estudiants graduat 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 compleixi 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 Tom 'as Alarcón, amb el suport de l'equip de direcció del CRM.

The CRM offers the possibility for graduate student 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.

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

- Un cicle de cursos de perfeccionament impartits per investigadors i/o col·laboradors de les xarxes temàtiques del CRM. Aquests cursos s'integren dins de la Barcelona Graduate School of Mathematics, i, per tant,

The UFD has a programme of activities consisting of:

- *A cycle of advanced courses given by CRM researchers and/or collaborators from the thematic networks. These courses will be integrated within the Barcelona Graduate School of Mathematics, and thus made*

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 va assistir només per joves investigadors (estudiants de doctorat i postdoctorats).
- Un taller anual on els estudiants presentaran informes sobre l'estat actual de les seves tesis.

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. A continuació, enumerem els investigadors predoctorals associades a la CRM. Més informació sobre els estudiants predoctorals que han estat contractats per CRM durant 2014 es pot trobar a la Secció 2.2.5.

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. Next, we list the predoctoral researchers associated to the CRM. More information on predoctoral students that have been contracted by CRM during 2014 can be found in Section 2.2.5.

Michelle MacDevette presented her PhD thesis, supervised by Tim Myers on February 2014. Funded by CRM.

Francesc Font Martínez presented his PhD thesis, supervised by Tim Myers on July 2014. Funded by CRM.

Esther Ibáñez presented her PhD thesis, supervised by Tomás Alarcón on December 2014. Funded by CRM.

Daniel Sánchez presented his PhD thesis, supervised by Tomás Alarcón on December 2014. Funded by CRM.

Elisa Beltrán is working on her PhD thesis, supervised by Tomás Alarcón from October 2014. Funded by FPU scholarship at UB.

Carles Barril is working on his PhD thesis, supervised by Àngel Calsina (UAB) from September 2013 to September 2014. Funded by CRM (on move to a FI-AGAUR scholarship at UAB).

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

Enric Costa is working on his PhD thesis, supervised by Tomás Alarcón and Ivon Rodríguez since November 2014. Funded by CRM scholarship.

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 program.

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

Isabel Moreno is working on her PhD thesis, supervised by Álvaro Corral since September 2014. Funded by La Caixa-CRM program.

Genís Prat is working on his PhD thesis, supervised by Alex Roxin since September 2014. Funded by La Caixa-CRM program.

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

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

Narani van Laarhoven is working on her PhD thesis, supervised by Alex Roxin since November 2014. Funded by La Caixa-CRM program.

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

A més de la tasca de direcció de tesi, durant el 2014 també es va tutoritzar un treball final de grau:

Apart from the PhD supervision tasks, the next Bachelor's Degree Thesis was also supervised during 2014:

Manuel Carbonell Nuñez, *Power laws: From linguistics to music*, supervised by Álvaro Corral, CRM.

Sergi Soto, *L'adaptació de models de terratrèmols a la formació de pluja*, supervised by Álvaro Corral, CRM.

2.6.2. Curs de màster

El Màster de Matemàtiques per als Instruments Financers es va impartir per setzena vegada el 2014 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

2.6.2. Master's Course

The CRM master's course on Financial Mathematics was held for the fifteenth time in 2014 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

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 2014 han acabat el màster 15 alumnes.

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 2014 a total of 15 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 2014, un total de 16 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 2014, 16 students visited the CRM within this program:

- Ahmed Abdeljawad (Anàlisi Harmònica i Teoria de l'Aproximació / *Harmonic Analysis and Approximation Theory*)
- Albert Aloy (Neurociència computacional/*Computational Neuroscience*)
- Juan Carlos Cantero (Epidemiologia Matemàtica / *Mathematical Epidemiology*)
- George Paul Cribari (Neurociència computacional/*Computational Neuroscience*)
- Roger Domingo Roca (Biologia matemàtica i computacional/*Computational & Mathematical Biology*)

- Marc Galí (Matemàtica Industrial/*Industrial Mathematics*)
- Rosalba García Millán (Sistemes Complexos/*Complex Systems*)
- Sergio González (Matemàtica Industrial/*Industrial Mathematics*)
- Barry Iyare (Epidemiologia Matemàtica / *Mathematical Epidemiology*)
- Marc Lagunas (Matemàtica Financera i Control de Riscos / *Financial Mathematics and Risk Control*)
- Mauro Martínez (Neurociència computacional/*Computational Neuroscience*)
- Carles Pérez (Matemàtica Financera i Control de Riscos / *Financial Mathematics and Risk Control*)
- Carles Riera (Matemàtica Industrial/*Industrial Mathematics*)
- Albert Senén (Anàlisi Harmònica i Teoria de l'Aproximació / *Harmonic Analysis and Approximation Theory*)
- Claudia Toral (Epidemiologia Matemàtica / *Mathematical Epidemiology*)
- Jarrod Williams (Matemàtica Industrial/*Industrial Mathematics*)

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*. Durant el 2014, a més, es van organitzar una sèrie d'actes relacionats amb el 30è aniversari del CRM.

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. Moreover, during 2014, the CRM celebrated its 30th anniversary through a series of events that are also explained below.

El 30è aniversari del CRM

El CRM va ser fundat pel Prof. Manuel Castellet el 1984 com a centre de l'Institut d'Estudis Catalans (IEC), dins les instal·lacions de la Universitat Autònoma de Barcelona (UAB). Per commemorar el 30è aniversari, el CRM va programar, durant el 2014, alguns actes i una exposició explicant la trajectòria del centre:

CRM's 30th anniversary

The CRM was established by Prof. Manuel Castellet in 1984 as a centre of the Institut d'Estudis Catalans (IEC, the Catalan Academy), in the premises of the Universitat Autònoma de Barcelona (UAB). To commemorate the 30th anniversary the centre has scheduled some events and has prepared a panel exhibition explaining the CRM trajectory. Academic session at IEC:

- El primer dels tres esdeveniments va consistir en una sessió acadèmica a la seu de l'IEC, celebrada el 27 de maig. Va ser presidida pel president de l'IEC, Joandomènec Ros, i el director del CRM, Joaquim Bruna. L'acte va incloure la inauguració de l'exposició "Creixer en Matemàtiques, fer país" les conferències "Mathematical Modeling in Developmental Biology", a càrrec d'Angela Stevens (Münster Universität) i "Patterns in Primes and Dynamics of Nilmanifolds", per part de Tamar Ziegler (Hebrew University and Technion).
- El 13 de juny va tenir lloc un acte institutional al Palau de la Generalitat. Va ser presidit pel Conseller d'Economia i Coneixement i president del Consell de Direcció del CRM, Honorable Andreu Mas-Colell. L'acte va culminar amb una ponència del Prof. Jean-Pierre Bourguignon, president de l'European Research Council, i antic director de l'Institut des Hautes Études Scientifiques, sobre política científica a escala europea.
- L'exposició "Créixer en Matemàtiques, fer país" va ser ideada i organitzada pel Dr. Manuel Castellet; se'n pot fer una visita virtual a

- *The first of these events was an academic session at the headquarters of the IEC, held on May 27th. It was chaired by the president of the IEC Joandomènec Ros and the director of CRM, Joaquim Bruna. The event included the presentation of the panel exhibition, Çreixer en Matemàtiques, fer país" and the talks "Mathematical Modeling in Developmental Biology", by Angela Stevens (Münster Universität) and "Patterns in Primes and Dynamics of Nilmanifolds", by Tamar Ziegler (Hebrew University and Technion).*
- *On June 13th, an institutional event was held at the Palau de la Generalitat. It was chaired by the Conseller of Economy and Knowledge and president of the Board of Governors of the CRM, Honorable Andreu Mas-Colell. L'acte va culminar amb una ponència del Prof. Jean-Pierre Bourguignon, president de l'European Research Council, i antic director de l'Institut des Hautes Études Scientifiques, sobre política científica a escala europea.*
- *The panel exhibition "Créixer en Matemàtiques, fer país" was conceived and organized by Dr. Manuel Castellet, and is accessible from*

http://www.crm.cat/en/Activities/Curs_2013-2014/Documents/Plafons.pdf.

Pòster de l'exposició "Créixer en matemàtiques, fer país", en ocasió del 30è aniversari del CRM.

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.

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

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.

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

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.

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 2014. 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 2014 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 Central Configurations, Periodic Orbits and Beyond in Celestial Mechanics

January 15 to July 15, 2014

Coordinators	Jaume Llibre	Universitat Autònoma de Barcelona
	Josep Maria Cors	Universitat Politècnica de Catalunya
	Montserrat Corbera	Universitat de Vic

Summary

The study of the dynamics of n point masses interacting according to Newtonian gravity is usually called the n-body problem. It can be considered as old as the history of the science and has influenced most of the areas in mathematics. However, most of the problems in Celestial Mechanics are beyond the present limits of the knowledge and many natural questions are difficult or impossible to solve when the number of bodies n is larger than 2.

In order to make progress against such complexity one must look for specific objects. From a geometrical point of view a key point consists in trying to understand the structure of the phase space looking for the equilibrium points, periodic orbits, invariant tori, ... The stable and unstable manifolds associated to these objects form a kind of network of connections, which together with the previous invariants objects constitute a big part of the main skeleton of the system.

One of the main ingredients of the phase space are the periodic orbits. Over the years, many authors have contributed to study the periodic orbits of a wide variety of n-body problems from different points of view. A particular interesting type of periodic orbit in the planar n-body problem is one in which the particles remain in the same shape relative to one another. The possible configurations for the particles in such orbits are called central configurations.

The purpose of this research programme is finding new approaches to the main open questions in the following topics: First to central configurations (mainly for few bodies), and second to periodic orbits of the n-body problem and their bifurcations.

All program information can be found at:
`http://www.crm.cat/en/Activities/Pages/ActivityFoldersAndPages/Curs%202013-2014/RPCentral%20Configurations/RP-Central-Configurations.aspx`

Visiting Researchers

Alain Albouy (IMCCE-CNRS-UMR), Martha Alvarez (Universidad Autonoma de Mexico-Iztapalapa), Julian Barbour (Oxford University), Esther Barrabés (Universitat de Girona), Antonio Carlos (Centro Brasileiro de Pesquisas Físicas), Montserrat Corbera (Universitat de Vic), Josep Maria Cors (Universitat Politècnica de Catalunya), Amadeu Delshams (Universitat Politècnica de Catalunya), Florin Diacu (University of Victoria), Martin Eduardo Frías (Universidad de Sonora), Toshiaki Fujiwara (Kitasato University), Jorge Galan (Universidad de Sevilla), Antonio Garcia (Universidad Autonoma de Mexico-Iztapalapa), Vassili Gelfreich (University of Warwick), Marian Gidea (Yeshiva University), Charles Jaffe (West Virginia University), Angel Jorba (Universitat de Barcelona), Jaume Llibre (Universitat Autonòma de Barcelona), Yiming Long (Chern Institute of Mathematics and LPMC), Tere Martínez-Seara (Universitat Politècnica de Catalunya), Richard Moeckel vUniversity of Minnesota), Daniel Offin (Queen's University), Merce Olle (Universitat Politècnica de Catalunya), Arturo Olvera (Universidad Nacional Autónoma de México), Jesús F. Palacián (Universidad Pública de Navarra), Ernesto Pérez-Chavela (Universidad Autonoma de Mexico-Iztapalapa), Kenneths R. Meyer (University of Cincinnati), Clark Robinson (Northwestern University), Donald Saari (University of California at Irvine), Manuele Santoprete (Wilfrid Laurier University), Carles Simó (Universitat de Barcelona), Cristina Stoica (Wilfrid Laurier University), Clàudia Valls (Instituto Superior Técnico Lisboa), Claudio Vidal (Universidad del Bío Bío), Kesheng Wu, Patricia Yanguas (Universidad Pública de Navarra), Xiang Zhang (Shanghai Jiao Tong University).

Activities

• Weekly Seminar

Speakers

Sundus Zafar, Universitat Autònoma de Barcelona
Periodicities, rational and elliptic fibrations in some birational maps of C^2
June 30, 2014.

Julian Barbour, Oxford University
A Gravitational Origin of an Arrow of Time
May 27, 2014.

Montserrat Corbera, Universitat de Vic
Central configurations of the 4-body problem with masses $m1 = m2 > m3 = m4 = m > 0$ *with* m *small*
May 19, 2014.

Martha Alvarez–Ramírez, Universidad Nacional Autonoma de Mejico
Dynamical aspects of the trapezoidal 4-body problem
May 12, 2014.

Rafael Ortega, Universidad de Granada
Stable fixed points for a class of planar mappings
May 12, 2014.

Dzmitry Budzko, Brest State University
Lyapunov stability analysis of equilibrium positions in restricted four-body problem
May 5, 2014.

Jaume Llibre, Universitat Autònoma de Barcelona
The Kaplan and Yorke method for studying the periodic solutions of some delay
differential equations
May 5, 2014.

Carles Simó, Universitat de Barcelona
Obstructions to integrability of Hamiltonian systems using high order variational
April 28, 2014.

Martin Eduardo Frias, University of Sonora
On isochronous polynomial fields
April 22, 2014.

Donald Saari, University of California
Mathematics and the "Dark Matter" Mystery from Astronomy
April 7, 2014.

Ernesto Pérez-Chavela, Autonomous Metropolitan University
Relative equilibria in the curved N-body problem with negative curvature
March 31, 2014.

Armengol Gasull, Universitat Autònoma de Barcelona
Approximating Mills ratio
March 31, 2014.

Johanna García, Universitat Autònoma de Barcelona
Some results about the harmonic balance method
March 24, 2014.

Rafel Prohens, Universitat de Les Illes Balears
Configurations of limit cycles in Liénard equations
March 17, 2014.

Patricia Yanguas, Universidad Pública de Navarra
Invariant tori in the spatial 3-body problem by averaging and reduction
March 10, 2014.

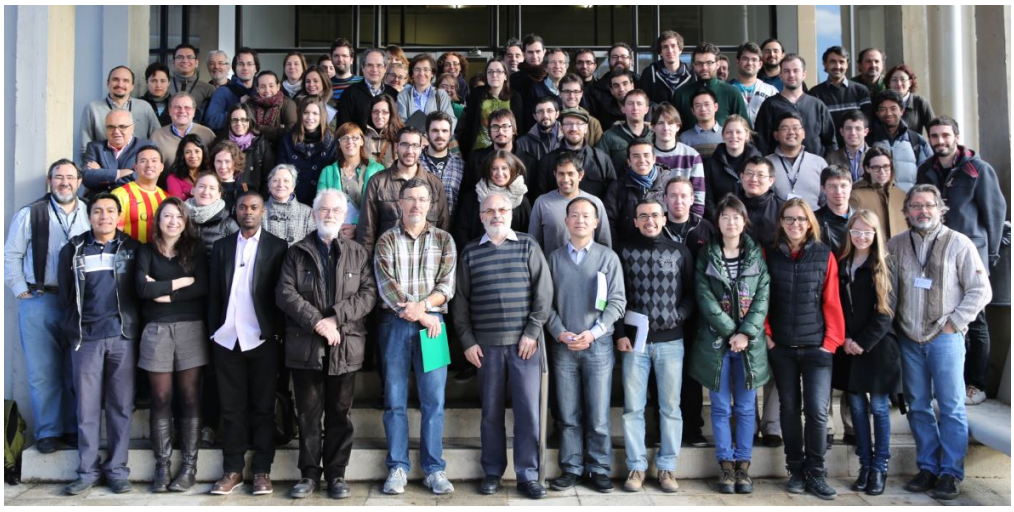
Jesús Palacian, Universidad Pública de Navarra
Nonlinear Stability of a Hamiltonian System in a Degenerate Case
March 3, 2014.

Márcio Ricardo Alves Gouveia, Universidade Estadual Paulista (UNESP)
Dynamics of some dissipative gap maps
February 24, 2014.

Anna Geyer, Universitat Autònoma de Barcelona
Traveling surface waves of moderate amplitude in shallow water
February 17, 2014.

Kesheng Wu, Shanghai JiaoTong University
Analytic normal form of analytic dynamical systems on tori with small perturbations
February 10, 2014.

Xiang Zhang, Shanghai Jiaotong University
Inverse Jacobian multipliers and Hopf bifurcation on center manifolds
January 20, 2014.



• **Advanced course: Central Configurations, Periodic Orbits and Beyond in Celestial Mechanics**

January 27 to 31, 2014.

Participants: 87

Lecturers

Jaume Llibre, Universitat Autònoma de Barcelona
Periodic solutions via averaging theory.

Richard Moeckel, University of Minnesota
Central configurations of the newtonian N-body Problem.

Carles Simó, Universitat de Barcelona
Dynamical properties in Hamiltonian systems.

• **Conference: Hamiltonian Systems and Celestial Mechanics 2014 (HAMSYS2014).**

June 2 to 6, 2014

Participants: 78

Speakers

Alain Albouy (IMCCE-CNRS-UMR), Esther Barrabés Vera (Universitat de Girona), Antonio Carlos Fernandes (Universidade Federal de Itajubá), Amadeu Delshams (Universitat Politècnica de Catalunya), Florin Diacu (University of Victoria), Toshiaki Fujiwara (Kitasato University), Jorge Galán Vioque (Universidad de Sevilla), Antonio García (Universidad Autónoma de Madrid), Vassili Gelfreich (University of Warwick), Marian Gidea (Northwestern University), Charles Jaffé (West Virginia University), Àngel Jorba (Universitat de Barcelona), Yiming Long (Chern Institute of Mathematics and LPMC),

Tere Martínez-Seara (Universitat Politècnica de Catalunya), Kenneths R. Meyer (University of Cincinnati), Richard Moeckel (University of Minnesota), Daniel Offin (Queen's University), Mercè Ollé (Universitat Politècnica de Catalunya), Arturo Olvera Chavez (Universidad Nacional Autónoma de México), Jesús F. Palacián (Universidad Pública de Navarra), Manuele Santoprete (Wilfrid Laurier University), Carles Simó (Universitat de Barcelona), Cristina Stoica (Wilfrid Laurier University), Claudio Vidal (Universidad del Bío Bío).

Contributed

John Alexander Arredondo, Sihem Blaha, Dzmitry Budzko, Renato C. Calleja, Alex Carlucci, Laszlo Czismadia, Abraham De la Rosa, Marcelo Domingos, Ariadna Farrés, Marina Gonchenko, Riccardo D. Jadanza, Joanna Janczewska, Lanouar Lazrag, Ingrid Meza, Narcís Miguel, Simone Paleari, Alessandro Portaluri, Slawomir Rybicki, Patricia Sánchez-Martín, Adrià Simon, Anoop Sivansankaran, Arturo Vieiro, José Antonio Villa Morales, Elizabeth Zollinger.

This program research was also supported by the Clay Mathematics Institute (to enhance the visits of 5 senior researchers and support the participation of 12 doctoral students and post-doctoral researchers) and the DANCE network, which covered lodging expenses for junior participants.

3.1.2. CRM Research Programme on Mathematics of Machine Learning (MATHML)

April to July, 2014

Coordinators	Sébastien Bubeck	Princeton University
	Nicolò Cesa-Bianchi	Università degli Studi di Milano
	Alexander Rakhlin	University of Pennsylvania
Scientific Committee	Peter Bartlett, UC Berkeley	
	Luc Devroye	McGill University
	Ricard Gavaldà	Universitat Politècnica de Catalunya
	Gàbor Lugosi	Universitat Pompeu Fabra
	Yishav Mansour	Tel Aviv University
	Alexander Tsybakov	CREST, Univ. Paris 6

Summary

Learning theory lies at the intersection of probability, statistics, computer science, and optimization. This mathematical theory is concerned with theoretical analysis of machine learning algorithms. Over the last decade the statistical learning approach has been successfully applied to many problems of interest in machine learning, such as bioinformatics, computer vision, speech processing, robotics, and information retrieval. This success story crucially relies on a strong mathematical foundation. Over the past several decades, learning theory has studied inherent complexities of learning problems, both from the statistical and computational points of view. The dialogue between computation and statistics has been key to the enormous advances and growth in the field.

The main goal of this research program is to impulse further these advances by bringing together experts from fields spanning the full broad range of modern learning theory. Core topics include links between learning theory and optimization; trade-offs between computational efficiency and data efficiency; and the theory of sequential prediction and optimization.

The program will host various full-time visitors at any given time during the program.

During the program, a five-day international workshop on the Mathematical Foundations of Learning Theory will be organized.

This event is a natural follow-up to similar events previously organized in Barcelona (2004), Paris (2006) http://www.math.ens.fr/~stoltz/MFLT2.htm, Hong-Kong (2008) http://homes.di.unimi.it/~cesabian/FOCM/, Dagsthul (2011) http://www.dagstuhl.de/en/program/calendar/semhp/?semnr=11291 and Budapest (2011) http://homes.di.unimi.it/~cesabian/FOCM2011/.

In addition, one or two smaller three-day international workshops will also be organized.

The 7th Journées Statistiques du Sud will also be held as a part of the research program (from June 9 to 13, 2014).

All program information can be found at:
http://www.math.univ-toulouse.fr/jss2012/
http://math.unice.fr/~reynaudb/journeesdusud
Additional information:
http://stat.wharton.upenn.edu/~rakhlin/crm/

Visiting Researchers

Dimitrios Achlioptas (University of California at Santa Cruz), Pierre Alquier (Scoil na nEolaiochtai Matamaitice UCD), Sanjeev Arora (Princeton University), Peter Auer (University of Leoben), Francis Bach (INRIA Paris-Rocquencourt Research Centre), Gérard Biau (Université Pierre et Marie Curie), Sébastien Bubeck (Princeton University), Alejandra Cabaña (Universitat Autonòma de Barcelona), Rui Castro (Technische Universiteit Eindhoven), Nicolò Cesa-Bianchi (Università degli studi di Milano), Amit Daniely (The Hebrew University of Jerusalem), Ofer Dekel (Microsoft Research (Redmont)), Pedro Delicado (Universitat Politècnica de Catalunya), Luc Devroye (McGill University), Vitaly Feldman (IBM Research), Maria Florina (Carnegie Mellon University), Gersende Fort (Telecom Paris Tech), Aurélien Garivier (Université Paul Sabatier), Ricard Gavaldà (Universitat Politècnica de Catalunya), Peter Grünwald (Centrum voor Wiskunde en Informatica), Laszlo Györfi (Technical University of Budapest), Elad Hazan (Technion Israel Institute of Technology), Matthias Hein (Universität des Saarlandes), Daniel Hsu (Columbia University), Satyen Kale (Yahoo! Labs), Irem Ersoz Kaya (Mersin University), Tamas Linder (Queen's University), Gábor Lugosi (Universitat Pompeu Fabra), Stephane Mallat (École Polytechnique), Yishay Mansour (School of Computer Science), Catherine Matias (CNRS), Ankur Moitra (Massachusetts Institute of Technology), Ayca C. Pehlivanli (Mimar Sinan University), Alexander Rakhlin (The Wharton School), Benjamin Recht (University of California at Berkeley), Philippe Rigollet (Princeton University), lorenzo rosasco (Massachusetts Institute of Technology), Ohad Shamir (Weizmann Institute of Science), Karthik Sridharan (Toyota Technological Institute at Chicago), Csaba Szepesvari (University of Alberta), Ruediger Urbanke (École Polytechnique Fédérale de Lausanne), Ulrike von Luxburg (Universität Hamburg), Volodya Vovk (University of London), Martin Wainright (University of California at Berkeley), Robert Williamson (Australian National University).

Activities

- **Weekly Seminar**

Speakers

Sundus Zafar, Universitat Autònoma de Barcelona
Periodicities, rational and elliptic fibrations in some birational maps of C^2
June 30, 2014.

Stephane Mallat, Ecole Normale Superieure
Analyzing Deep Neural Networks for Learning
June 11, 2014.

Alexander Rakhlin, The Wharton School
A Tale of Three Regression Problems
June 5, 2014.

Amit Daniely, The Hebrew University of Jerusalem
From average case complexity to improper learning complexity
June 6, 2014.

Ohad Shamir, Weizmann Institute of Science
Information Trade-offs in Machine Learning
May 27, 2014.

Yishay Mansour, Tel Aviv University
Robust Bayesian Inference
May 22, 2014.

Sébastien Bubeck, Princeton University
On the influence of the seed graph in the preferential attachment model
May 8, 2014.

Balázs Kégl, CNRS-University of Paris
Learning to discover: signal/background separation and the Higgs boson challenge
April 30, 2014.

Francis Bach, INRIA Paris-Rocquencourt Research Centre
Beyond stochastic gradient descent for large-scale machine learning
April 23, 2014.

- **7th Journées Statistiques du Sud**

June 9 to 11, 2014.
Participants: 54

Speakers

Pierre Alquier, University College Dublin
Bayesian estimation of low-rank matrices

Francis Bach, INRIA - École Normale Supérieure
Beyond stochastic gradient descent for large-scale machine learning

Alejandra Cabaña, Universitat Autònoma de Barcelona
Modeling stationary data by classes of generalized Ornstein-Uhlenbeck processes.

Pedro Delicado, Universitat Politècnica de Catalunya
Optimal representation of bivariate density functions by level sets

Luc Devroye, McGill University
TBA

Gersende Fort, Telecom Paris Tech
Sampling multimodal densities on large dimensional space

Aurélien Garivier, Université Toulouse III - Paul Sabatier
Empirical likelihood upper confidence bounds for bandit models

Catherine Matias, Université d'Évry Val d'Essonne
Modeling heterogeneity in random graphs

Martin Wainright, University of California at Berkeley
Statistical minimax with constraints

• **Conference on Learning Theory (COLT).**
June 13 to 15, 2014
Participants: 127

Program Chairs	Maria-Florina Balcan (Georgia Institute of Technology), Csaba Szepesvári (University of Alberta).
Local Chairs	Sébastien Bubeck (Princeton University), Gábor Lugosi (ICREA and Pompeu Fabra University).
Publication	Vitaly Feldman (IBM Almaden Research Center).
Speakers	Joseph Anderson, Morteza Alamgir, Sébastien Bubeck, Evgeny Burnaev, Constantine Caramanis, Karthekeyan Chandrasekaran, Moses Charikar, Amit Daniely, Ofer Dekel Pierre Gaillard Sudipto Guha Prateek Jain, Michael Jordan, Gautam Kamath, Varun Kanade, Emilie Kaufmann, Matthäus Kleindessner, Pravesh Kothari, Chansoo Lee, Kfir Y. Levy, Stefan Magureanu, Yishay Mansour, Laurent Massouile, Andreas Maurer, Shahar Mendelson, Aditya Menon, Ankur Moitra, Joe Neeman, Francesco Orabona, Alexander Rakhlin, Harish G. Ramaswamy, Samira Samadi, Rahim Samei, Aleksandrs Slivkins, Ingo Steinwart, Ilya O. Tolstikhin, Ruth Urner, Tim van Erven, Benjamin Weitz, Mary Wootters, Se-Young Yun, Yuchen Zhang.

• **Workshop on the Mathematical Foundations of Learning Theory.**
June 17 to 19, 2014
Participants: 50

Speakers

Emmanuel Abbe (Princeton University), Jake Abernethy (University of Michigan), Dimitrios Achlioptas (University of California at Santa Cruz), Ery Arias-Castro (University of California at San Diego), Sanjeev Arora (Princeton University), Rui Castro (Technische Universiteit Eindhoven), Ofer Dekel (Microsoft Research, Redmont), Vitaly Feldman (IBM Research), Peter Grünwald (Centrum voor Wiskunde en Informatica), Elad Hazan (Technion Israel Institute of Technology), Matthias Hein (Universitt des Saarlandes), Daniel Hsu (Columbia University), Aryeh Kontorovich (Ben-Gurion University of the Negev), Shie Mannor (Technion Israel Institute of Technology), Ankur Moitra (Massachusetts Institute of Technology), Ben Recht (University of California at Berkeley), Lorenzo Rosasco (Massachusetts Institute of Technology), Ohad Shamir (Weizmann Institute of Science), Ruediger Urbanke (École Polytechnique Fédérale de Lausanne), Sergio Verdú (Princeton University), Ulrike von Luxburg (Universitt Hamburg), Volodya Vovk (University of London).

This program research was also supported by the *National Science Foundation*, *Laboratoire de Statistique Théorique et Appliquée*, *Laboratoire J. A. Dieudonné*, *Google*, *Microsoft Research*, *IBM Research* and *Dept. of Operations Research & Financial Engineering, Princeton Univ*.

3.2. Congressos i Workshops

En aquest apartat es detallen els congressos i *workshops* que va organitzar el CRM durant l'any 2014 al marge dels programes de recerca.

3.2. Conferences and Workshops

This section lists the congresses and workshops organised by CRM during 2014 not included in research programmes.

Polynomials over Finite Fields: Functional and Algebraic Properties

May 19 to 24, 2014
Participants: 54

Organisers	Joachim von zur Gathen (Universität Bonn), Jaime Gutiérrez (Universidad de Cantabria), Alina Ostafe (University of New South Wales), Daniel Panario (Carleton University), Alev Topuzoglu (Sabanci University).
Speakers	Omran Ahmadi (IPM, Teheran), Sudhir Ghorpade (Indian Institute of Technology), Guillermo Matera (Universidad Nacional General Sarmiento), Antonio Rojas (Universidad de Sevilla), Ivelisse Rubio (Universidad de Puerto Rico), Eric Schost (University of Western Ontario), Igo Shparlinski (University of New South Wales), Martin Sombra (Universitat de Barcelona), Henning Stichtenoth (Sabancy University), Qiang Wang (Carleton University), Arne Winterhof (Austrian Academy of Sciences), Konstantin Ziegler (Universität Bonn).

Barcelona Computational and Systems Neuroscience (BARCSYN) 2014

June 16 to 17, 2014
Participants: 68

Organisers	Marc Ramon Bohigas (IDIBAPS), Lluis Fuentemilla (UB), Gemma Huguet (UPC), Etienne Hugues (UPF), Ruben Moreno-Bote (FSJD), Juan Pablo Ramirez Mahaluf (IDIBAPS), Alex Roxin (CRM), Aureli Soria-Frisch (Starlab), Núria Tort (IDIBAPS).

Keynote Speakers

Christian Doeller, Donders Center for Cognitive Neuroimaging, Nijmegen
Mapping memories

Jason Kerr, Center of advanced european studies and research, Bonn
Imaging neuronal activity in the freely moving animal: from the eye to the cortex

Speakers

Mohit H. Adhikari (Universitat Pompeu Fabra), Iñigo Arandia (Fundació Sant Joan de Déu), Alessandro Barardi (Universitat Pompeu Fabra), Irune Fernández-Prieto (Fundació Sant Joan de Déu and IR3C) Rikkert Hindriks (Universitat Pompeu Fabra), Josep Marco (Universitat de Barcelona, IDIBELL), Gabriela Mochol (IDIBAPS), Ernest Montbrió (Universitat Pompeu Fabra), Lorena Pérez Mendez (IDIBAPS), Alessandro Principe (Hospital del Mar), Juan Pablo Ramírez (IDIBAPS), Aureli Soria-Frisch (Starlab Barcelona SL), Catalina Vich (Universitat de les Illes Balears), Klaus Wimmer (IDIBAPS), Gorka Zamora (Universitat Pompeu Fabra).

Workshop on Virus Dynamics and Evolution

June 30 to July 4, 2014
Participants: 21

Organiser

Àngel Calsina (Universitat Autònoma de Barcelona), Silvia Cuadrado (Universitat Autònoma de Barcelona), Santiago F. Elena (Instituto de Biología Molecular y Celular de Plantas (CSIC-UPV)), Yoh Iwasa (Kyushu University), Andrei Korobeinikov (Centre de Recerca Matemàtica), Elena Lara (Institut de Ciències del Mar), Elisabet Sa (Institut de Ciències del Mar), Dolors Vaqué (Institut de Ciències del Mar).

Scientific Committee

Nick Barton (Institute of Science and Technology, Austria), Vladimir Sobolev (Samara Airspace University), Greame Wake (Massey University).

Speakers: Stephanie Bedhomme (University of Münster), Esteban Domingo ("Severo Ochoa", CSIC-UAM), Santiago Elena (IBMCP), Esther Ibañez (CRM), Tuija Kekarainen (CReSA), Tanja Laske (Otto-von-Guericke University Magdeburg), Susanna Manrubia (CSIC), Miguel A Martinez (Fundació irsiCaixa, Hospital Germans Trias i Pujol), Simone Pigolotti (UPC), Jordi Ripoll (Universitat de Girona), Daniel Sanchez (CRM), Sergi Valverde (Universitat Pompeu Fabra), Narani van Laarhoven (CRM), Graeme Wake (Massey University @ Auckland).

3.3. Cursos avançats

En aquest apartat es detallen els cursos avançats que va organitzar el CRM durant l'any 2014 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 2014.

A Short Introduction to Statistical Physics

May 5 to 22, 2014
Participants: 18

Organisers: Tomás Alarcón (CRM), Álvaro Corral (CRM), Alex Roxin (CRM).

Lecturers:

Tomás Alarcón (CRM)
Dynamics of the Ising model with conserved (Kawasaki) and non-conserved (Glauber) order parameter

Álvaro Corral (CRM)
Introduction to Statistical Physics, equilibrium ensembles and critical phenomena

Alex Roxin (CRM)
Applications to neuroscience: Attractor models of memory

Advanced Course on Mathematical Methods of Biological Evolution

June 23 to 27, 2014
Participants: 8

Organisers: Andrei Korobeinikov (CRM).

Lecturers:

Tomas Alarcón (CRM)
Introduction to stochastic modelling in Mathematical Biology

Introduction to stochastic modelling in Mathematical Biology: Noise effects on competition and extinction

Nick Barton (Institute of Science and Technology, Austria)

Santiago F. Elena (Instituto de Biología Molecular y Celular de Plantas (CSIC-UPV))

Virology in a nutshell, quasispecies and experimental virus evolution

Yoh Iwasa (Kyushu University, Japan)
Modeling adaptation in evolutionary ecology

Andrei Korobeinikov (CRM)
Mathematical modelling of viral evolution

Summer School in Theoretical and Computational Neuroscience

July 7 to 11, 2014
Participants: 39

Instructors	Albert Compte (IDIBAPS), Gustavo Deco (UPF), Ruben Moreno-Bote (FSJD), Jaime de la Rocha (IDIBAPS), Alex Roxin (CRM), Nava Rubi (UPF).

2nd Barcelona Summer School on Stochastic Analysis

July 7 to 11, 2014
Participants: 52

Organisers	Lluís Quer-Sardanyons (Universitat Autònoma de Barcelona), Marta Sanz-Solé (Universitat de Barcelona), Frederic Utzet (Universitat Autònoma de Barcelona), Josep Vives (Universitat de Barcelona).
Scientifc Committee	Dave Applebaum (University of Sheffield), Robert Dalang (École Polytechnique Fédérale de Lausanne), Marta Sanz-Solé (Universitat de Barcelona), Frederic Utzet (Universitat Autònoma de Barcelona).

Lecturers

Davar Khoshnevisan (University of Utah)
Invariance and comparison results in stochastic partial differential equations

René Schilling (TU Dresden)
From Lévy to Lévy-type processes: characterization, construction, properties

3.4. Jornades temàtiques

El CRM promou també trobades intensives de recerca sota la denominació de "jornades temàtiques". El 2014 es van celebrar les següents:

3.4. Thematic Days

The CRM also promotes intensive research meetings generically named "thematic days". In 2014 the following have been hosted:

- *CRM Colloquium: Industrial Mathematics: A Case Study Approach*, March 27, 2014

  Speakers: Huaxiong Huang (York University, Toronto, Canada).

- *CRM Colloquium: La base de dades SIDIAP: com donar valor a les dades clíniques per a la recerca*, December 19, 2014

  Speakers: Bonaventura Bolíbar (IDIAP, Jordi Gol), Maria del Mar García (IDIAP, Jordi Gol).

- *2es Jornades CRM-Empresa sobre Finances Quantitatives*, June 10, 2014

  Plenary Speakers: Santiago Carrillo Menéndez (Universidad Autónoma de Madrid), Carlos Vázquez Cendón (Universidade da Coruña).

  Speakers: Llorenç Badiella (Servei d'Estadística Aplicada-UAB), Javier Calvo (Management Solutions), Eduard Gimenez (La Caixa), Fernando Valles (PricewaterhouseCoopers), Raquel Guardia (AIS).

  Organisers: Luis Ortiz (CRM), Joan del Castillo (UAB), Joaquim Berenguer (CRM).

3.5. Activitats divulgatives

El CRM promou activitats de divulgació en l'àmbit de la matemàtica, a diferents nivells formatius. Durant el 2014 es van oferir les següents activitats:

- El 24 de febrer de 2015, Anton Aubanell va impartir la conferència "Geometria amb bombolles de sabó".

3.5. Dissemination Activities

The CRM promotes dissemination activities around mathematics, at different specialization levels. During 2014, the following activities were offered:

- *On February 24th, Anton Aubanell lectured on "Geometria amb bombolles de sabó".*

- Presentació de la versió catalana de la web multilingüe "ExperiencingMaths", celebrada el 14 de novembre de 2014 a l'IEC, dins la Setmana de la Ciència. "ExperiencingMaths" és una exposició virtual interactiva, que s'ha elaborat amb el suport de la UNESCO. La traducció al català s'ha fet a iniciativa de la Comissió Nacional Andorrana per a la UNESCO, i ha comptat amb el suport del CRM i el Departament de Matemàtiques de la UAB. Es pot visitar a

- *Presentation of the Catalan version of the multilingual website "ExperiencingMaths". It was held on November 14th, 2014, at the IEC premises, within the Setmana de la Ciència (science week). "ExperiencingMathsïs an interactive visual exhibition, supported by UNESCO. The translation into Catalana is an initiative of the Comissió Nacional Andorrana per a la UNESCO (Andorra National Committee for the UNESCO), with the support of the CRM and the Mathematics Departament from UAB. It is open for visit at*

http://www.experiencingmaths.org/.

- "Què vol dir fer recerca en Matemàtiques?". Sessió per difondre la recerca entre estudiants de grau i preuniversitaris, celebrada el 17 de novembre de 2014, dins la Setmana de la Ciència. La imatge social del matemàtic professional pateix molts estereotips bastant allunyats de la realitat. En aquesta activitat es pretenia no solament mostrar quina recerca es fa i perquè és útil, sinó també de com és la vida de cada dia d'un investigador jove i de com encaren el procés (creatiu) de completar una tesi doctoral. La presentació va anar a càrrec del col·lectiu d'estudiants doctorals del CRM.

- *"Què vol dir fer recerca en Matemàtiques?". A session to disseminate research among college and undergraduate students, that was held on November 17th, 2014, within the Setmana de la Ciència (science week). The social image of mathematicians supports many stereotypes which are far from reality. The goal of this activity was not only showing the type of research performed by mathematicians and why it is useful, but also visualizing the day to day life of a young researcher, and how do they face the (creative) process of completing a doctoral thesis. The presentation was offered by the team of CRM PhD students.*

- "Què poden fer les Matemàtiques a la recerca en Biotecnologia?", a càrrec de Tomás Alarcón i Ivón Rodríguez (CRM). Sessió per difondre la recerca entre estudiants de grau, celebrada el 19 de novembre de 2014, dins la Setmana de la Ciència. Enmarcada dins de l'any de la biotecnologia, la conferència tenia per objectiu mostrar com el poder modelitzador i de simulació de la tecnologia matemàtica s'està convertint en un complement molt important en la recerca en biologia. Els assistents van poder visitar el laboratori experimental de Microreologia de Biofluids del CRM.

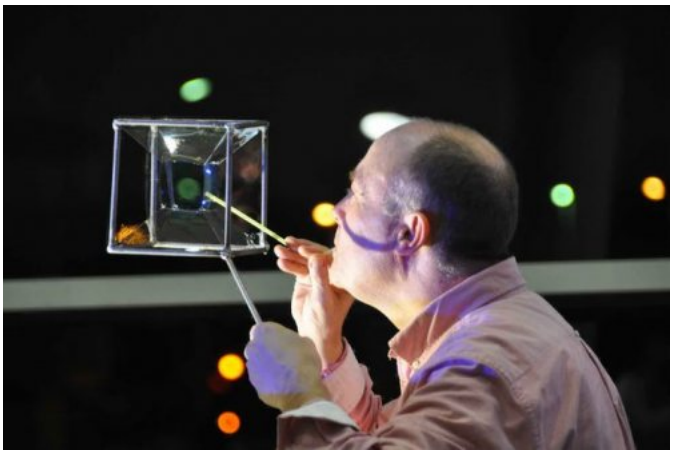
- *Lecture "Què poden fer les Matemàtiques a la recerca en Biotecnologia?", by Tomás Alarcón and Ivón Rodríguez (CRM). A session to disseminate research among undergraduate students, that was held on November 19th, 2014, within the Setmana de la Ciència (science week). In the fram of the Year of the Biotechnology, the lecture aimed at showing how the modelling and simulating power of the mathematical technology is becoming an extremely important tool in research in biology. The lecture was completed with a visit to the experimental CRM lab for Microrheology of Biofluids.*

- El CRM participa en el "Programa de formació científica tecnològica i matemàtica (CTM) per a professors", dirigit a professorat de secundària. El desembre de 2014, el Dr. Alex Roxin (CRM) va impartir una sessió sobre Matemàtiques i Neurociència.

- L'exposició "Créixer en matemàtiques, fer país", ideada en motiu del 30è aniversari del CRM i a cura del Dr. Manuel Castellet, s'ha exhibit a: Institut d'Estudis Catalans, maig de 2014; Universitat Autònoma de Barcelona (Biblioteca de Ciències), novembre de 2014; Universitat de Barcelona (Claustre de Ciències de la Facultat de Matemàtiques), del 24 de novembre al 19 de desembre.

- *The CRM is involved in the "Programa de formació científica tecnològica i matemàtica (CTM) per a professors", addressed to high-school teachers. On December 2014, Dr. Alex Roxin (CRM) lectured on Mathematics and Neuroscience.*

- *The exhibition "Créixer en matemàtiques, fer país", designed to mark the 30th anniversary of the CRM, whose commisioner was Dr. Manuel Castellet, was shown at: Institut d'Estudis Catalans, May 2014; Universitat Autònoma de Barcelona (Sciences Library), November 2014; Universitat de Barcelona (Claustre de Ciències de la Facultat de Matemàtiques), from November 24th to December 9th.*



3.6. Actes commemoratius

A més de la celebració del 30è aniversari del centre, destacat a l'inici d'aquest capítol d'activitats, el CRM també va participar en l'organització de l'acte amb motiu de la jubilació del Dr. Manuel Castellet Solanas, Director del CRM des de la seva creació fins a 2007 i actual Director Honorari. L'acte es va celebrar el 27 de juny a les instal·lacions de l'IEC.

3.6. Commemorative events

Besides the celebration of the 30th anniversary of the centre, mentioned at the beginning of this chapter of activities, the CRM also participated in the organization of the event on the occasion of the retirement of Dr. Manuel Castellet Solanas, director of the CRM from its foundation to 2007 and current Honorary Director. The event took place on June 27th, at the premises of IEC.

3.7. 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*: Esther Ibáñez (CRM).

23/01/2014. Luis Ortíz, CRM, *A wavelet look to the discounted expected payoff pricing formula*.

30/01/2014. Fèlix Campelo, Centre de Regulació Genòmica, *A mechanism by which proteins sense and modify the geometry and topology of intra-cellular membranes*.

20/02/2014. Toni Guillamon, Departament de Matemàtica Aplicada I, Universitat Politècnica de Catalunya, *Predicting phase and amplitude variation in transient neuronal states*.

06/03/2014. Marta Ibañes, UB, *Patterning the embryo: Cooperation and competition*.

13/03/2014. Édgar Roldán, ICFO, *Thermodynamics of symmetry breaking*.

19/03/2014. Nicholas R. Moloney, London Mathematical Laboratory, *On the Kolmogorov-Smirnov and related distribution in statistical physics*.

20/03/2014. Maria Chiricotto, University of Rome, *Droplets spreading under contact-line friction*.

27/03/2014. Huaxiong Huang, York University of Canada, *Immersed boundary methods for problems with moving interfaces*.

10/04/2014. Marina Martinez-Garcia, UPF, *Causal correlation paths across cortical areas in decision-making*.

22/05/2014. Panagiota Theodoni, CRM, *Fluctuations in perceptual decisions*.

23/05/2014. Carlos Ruiz, Monterrey, Mexico, *Anestesia, ¿física o farmacia?*.

24/07/2014. Alexander Pimenov, Weierstrass Institute, Berlin, *Population models and the effects of hysteresis*.

25/09/2014. Isabel Serra, CRM, *Statistical models for tails and applications*.

09/10/2014. Simone Pigolotti, UPC, *Thermodynamics of biological copying*.

06/11/2014. Mariusz Bialecki, Polish Academy of Sciences, *Motzkin numbers out of an earthquake cellular automaton model*.

20/11/2014. Rafael Barrio, Universidad Nacional Autónoma de México, *The Social Brain Hypothesis and the effect of deception in social interactions*.

05/12/2014. Victor Martinez de Albeniz, IESE, *Estimating and optimizing the impact of inventory on consumer choices in a fashion retail setting*.

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).

14/02/2014. Eric Shea-Brown, University of Washington, *Neural integrators – what's optimal and what can we get away with?*.

21/03/2014. Srdjan Ostojic, École Normale Superieure, *Two types of asynchronous activity in networks of excitatory and inhibitory spiking neurons*.

10/04/2014. Kenneth Harris, University College London, *The Neural Marketplace*.

12/05/2014. N. Alex Cayco Gajic, Washington University, *Coordinated activity and implications for coding in neural circuits*.

15/05/2014. Diego Pazó, Instituto de Física de Cantabria, *Collective synchronization: from fireflies to cells*.

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).

07/03/2013. Francisco Manuel Mejías Ruiz, Banc de Sabadell, *Introducción Crédito Single Names*.

30/01/2014. Elisa Alòs, UPF, *On the closed-form approximation of short-time random strike options*.

08/04/2014. Karel in't Hout, Antwerp University, *ADI schemes for pricing American options under the Heston model?*.

05/06/2014. Montserrat Guillén, UB, *Uplift models for predictive modelling in insurance*.

25/09/2014. Jaume Belles Sampere, UB, *Medición de riesgos y GlueVaR*.

04/12/2014. Thorsten Rheinlander, Vienna University of Technology, *On the distribution of flash crashes*.

Seminari d'EDPs i aplicacions

Joint seminar of the Universitat Autònoma de Barcelona, Universitat de Girona, Universitat Politècnica de Catalunya and Centre de Recerca Matemàtica. The CRM has participated in its organization through Blanca Ayuso. To see the complete activity, please visit `http://www-ma2.upc.es/~{}edps/`.

3.8. Altres activitats

- El CRM va col·laborar en la celebració de la "Jornada d'Investigadors Predoctorals Interdisciplinària", que tingué lloc el 6 de febrer de 2014.

- El dia 22 d'abril, la Prof. Veronique Fischer (Imperial College London) i el Prof. Michael Ruzhansky (Imperial College London), guanyadors del Premi Ferran Sunyer i Balaguer 2014, van impartir la conferència titulada "Noncommutative phase space and its applications".

- El dia 25 d'abril, el Prof. Magnus Fontes, de l'Institut Pasteur de París, va impartir la conferència "Dimensional reduction and estimation in exploratory high dimensional data analysis".

- El CRM va col·laborar en la celebració dels "Encuentros de Análisis Real y Complejo (EARCO2014)", que van tenir lloc a Girona del 22 al 24 de maig de 2014.

3.8. Other activities

- *The CRM gave support to in the meeting "Jornada d'Investigadors Predoctorals Interdisciplinària", that was held on February 6th, 2014.*

- *On April 22nd,, Prof. Veronique Fischer (Imperial College London) and Prof. Michael Ruzhansky (Imperial College London), winners of the Ferran Sunyer i Balaguer Prize 2014, lectured at CRM on "Noncommutative phase space and its applications".*

- *On April 25th, Prof. Magnus Fontes (Institut Pasteur, Paris), lectured at the CRM on "Dimensional reduction and estimation in exploratory high dimensional data analysis".*

- *The CRM gave support to the meeting "Encuentros de Análisis Real y Complejo (EARCO2014)", that was held in Girona from May 22nd to May 24th, 2014.*

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 2014, 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 2014.

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 2014, 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 2014.

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

The volumes of this series, published by the Swiss publishing company Birkhäuser, cover the content of some of the advanced courses taught by

de les notes prèvies lliurades als participants i reelaborades pels mateixos autors. Es tracta de llibres de text, especialment adreçats a estudiants de doctorat avançats i a joves investigadors postdoctorals.

specialists at the CRM. They are based on notes handed out to students and later reworked by the authors. These volumes are especially addressed to advanced doctoral and young post-doctoral students.

Des de setembre de 2008 fins a finals de 2013, l'editor responsable d'aquesta sèrie va ser Carles Casacuberta (UB) qui va substituir en aquest càrrec a Manuel Castellet (UAB), que va iniciar la sèrie l'any 2001. Des de principis de 2014, el nou editor de la sèrie és Enric Ventura (UPC).

From 2008 to 2013, the responsible editor of this series was Carles Casacuberta (UB); he replaced Manuel Castellet (UAB), who started the series in 2001. Starting in 2014, the new editor of this series is Enric Ventura (UPC).

L'any 2014 han aparegut dos volums d'aquesta sèrie:

The following two volumes of this series were published in 2014:

- Feng Dai and Yuan Xu, *Analysis on h-Harmonics and Dunkl Transforms*, edited by Sergey Tikhonov. Advanced Courses in Mathematics CRM Barcelona, vol. 23, Birkhäuser, Basel, 2014. ISBN 978-3-0348-0886-6
- Vladimir Temlyakov, *Sparse Approximation with Bases*, edited by Sergey Tikhonov. Advanced Courses in Mathematics CRM Barcelona, vol. 24, Birkhäuser, Basel, 2014. ISBN 978-3-0348-0889-7

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,

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,

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*. Durant el 2014 s'han publicat ja el tercer i el quart volums de la sèrie:

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. During 2014 the third and the fourth volumes have been published:

- *Extended Abstracts Fall 2013: Geometrical Analysis; Type Theory, Homotopy Theory and Univalent Foundations*, edited by Maria del Mar González, Paul Yang; Joachim Kock, Nicola Gambino. Research Perspectives CRM Barcelona, vol. 3, in *Trends in Mathematics* Birkhäuser, Basel, 2014. ISBN 978-3-319-05487-2
- *Extended Abstracts Spring 2014: Hamiltonian Systems and Celestial Mechanics; Virus dynamics and evolution*, edited by Montserrat Corbera, Josep M. Cors, Jaume Llibre; Andrei Korobeinikov. Research Perspectives CRM Barcelona, vol. 4, in *Trends in Mathematics* Birkhäuser, Basel, 2014. ISBN 978-3-319-05487-2

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

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 2014 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 2014:*

- Jaume Llibre, Richard Moeckel, Carles Simó. *Advanced Course on Central Configurations, Periodic Orbits and Beyond in Celestial Mechanics (DANCE Winter School)*, Vol. 68, Gener 2014.
- Davar Khoshnevisan, René Schilling. *2nd Barcelona Summer School on Stochastic Analysis*, Vol. 69, July 2014.

4.4. Preprints

La sèrie de prepublicacions del CRM s'ha incrementat amb els 20 títols següents durant l'any 2014:

The CRM preprint series grew with the following 20 issues in 2014:

- S. Rebollo-Perdomo. *Poincaré–Pontryagin–Melnikov functions for a class of perturbed planar Hamiltonian equations*, preprint no. 01/2013
- T. Jin, A. Maalaoui, L. Martinazzi, J. Xiong. *Existence and asymptotics for solutions of a non-local Q-curvature equation in dimension three*, preprint no. 02/2013
- K. Drach. *Some sharp estimates for convex hypersurfaces of pinched normal curvatures*, preprint no. 03/2013
- F. Balacheff. *Measurements of Riemannian two-disks and two-spheres*, preprint no. 04/2013
- F. Font, T.G. Myers, S.L. Mitchell. *Mathematical model for the melting of nanoparticles with a density jump*, preprint no. 05/2013
- A. Borisenko, K. Drach. *Comparison theorems for support functions of hypersurfaces*, preprint no. 06/2013
- K. Drach. *About an isoperimetric property of λ-convex lunes on the Lobachevsky plane*, preprint no. 07/2013
- O. Sagarra, F. Font-Clos, C.J. Pérez-Vicente, A. Díaz-Guilera. *The effect of fixing node strengths on multi-edge networks*, preprint no. 08/2013
- L. Ortiz-Gracia. *Efficient wavelets-based valuation of synthetic CDO tranches*, preprint no. 09/2013
- A. Korobeinikov, A. Archibasov, V. Sobolev. *Order reduction for an RNA virus evolution model*, preprint no. 10/2013
- L. Shaikhet, A. Korobeinikov. *Stability of a stochastic model for HIV-1 dynamics within a host*, preprint no. 11/2013
- B. Alarcón, R. Rabanal. *Hopf bifurcation at infinity and dissipative vector fields of the plane*, preprint no. 12/2013
- A. Korobeinikov, E.V. Grigorieva, E.N. Khailov. *Optimal control for an epidemic in a population of varying size*, preprint no. 13/2013
- M.A. Salazar, D. Sepe. *Contact isotropic realisations of Jacobi manifolds*, preprint no. 14/2013
- A. Pimenov, A. Korobeinikov, D. Rachinskii. *Adaptive behaviour in a predator-prey model leads to multiple equilibrium states*, preprint no. 15/2013
- A. Deluca, N.R. Moloney, A. Corral. *Data-driven prediction of thresholded time series of rainfall and SOC models*, preprint no. 16/2013
- A. Corral. *Scaling in the timing of extreme events*, preprint no. 17/2013
- F. Font-Clos, G. Pruessner, A. Deluca, N.R. Moloney. *The perils of thresholding*, preprint no. 18/2013
- R. Antoine, F. Perera H. Thiel. *Tensor products and regularity properties of Cuntz semigroups*, preprint no. 19/2013
- R. Garcia-Millan, F. Font-Clos, A. Corral. *Finite-size scaling of survival probability in branching processes*, preprint no. 20/2013

4.5. Other publications

Les altres sèries editades pel CRM (tesis doctorals, treballs de recerca de màster i materials de divulgació) es troben en format electrònic a la secció de Publicacions de la web del Centre. En aquesta memòria, podeu trobar el llistat de tesis doctorals de treballs de recerca de màster a la Secció 2.5.

The rest of series edited by CRM (PhD theses, master's research projects and popularization materials) can be found in electronic format at the Publications section of the CRM website. In this report, PhD theses and master's research projects are listed in Section 2.5.

www.crm.cat/en/Publications/Pages/

Destaquem finalment l'aparició del llibre "Ments abstractes", que recull el material fotogràfic de l'exposició que, sota el mateix títol, el CRM ha anat exhibint. Les fotografies del llibre són de Francesc Creixell i Fernando Rascón, i conté a més contribucions de pensadors i científics com Joan Barril, Salvador Cardús i Ros, Daniel Giralt-Miracle, David Jou, Adolf Tobeña and Jorge Wagensberg. El llibre ha estat editat per l'Institut d'Estudis Catalans (ISBN-10: 849965214X, ISBN-13: 978-8499652146).

Finally, we mention the publication of the book "Ments abstractes" ("Abstract minds"), made after the CRM photographical exhibition with the same name. The book contains photographs by Francesc Creixell and Fernando Rascón and written contributions of thinkers and scientists like Joan Barril, Salvador Cardús i Ros, Daniel Giralt-Miracle, David Jou, Adolf Tobeña i Jorge Wagensberg. It has been edited by the Institut d'Estudis Catalans (ISBN-10: 849965214X, ISBN-13: 978-8499652146).

5

Resum econòmic

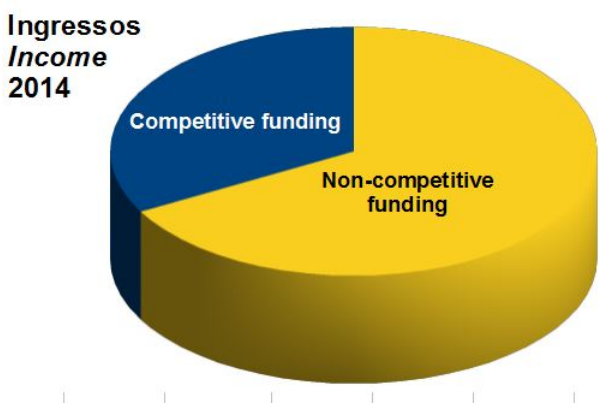
Financial Summary

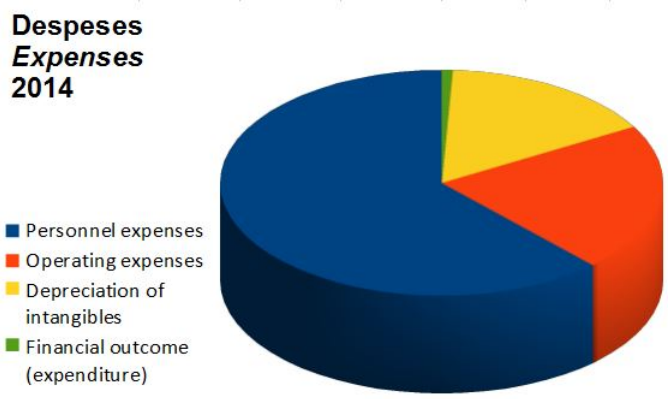
5.1 Ingressos — 5.1. Income

Ingressos competitius *Competitive funding*	483.113,37 €
Ingressos no competitius *Non-competitive funding*	978.215,00 €
TOTAL	**1.461.328,37 €**

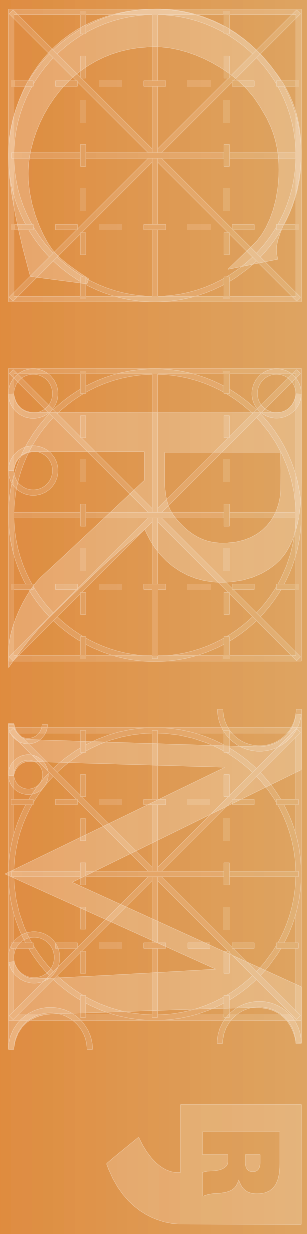
5.2 Despeses — 5.2. Expenses

Despeses de personal *Personnel expenses*	945.998,79 €
Despeses d'explotació *Operating expenses*	325.514,99 €
Altres despeses *Other expenses*	44.366,85 €
Amortització immobilitzat *Depreciation of intangibles*	242.918,40 €
Resultat financer (despesa) *Financial outcome (expenditure)*	12.261,84 €
Resultat exercici *Annual profit*	-109.732,50 €
TOTAL	**1.461.328,37 €**





CENTRE DE RECERCA MATEMÀTICA



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