CENTRE DE RECERCA MATEMÀTICA

Memòria d'Activitats
Report of Activities

2012

CENTRE DE RECERCA MATEMÀTICA

Centres de recerca de Catalunya

CENTRE DE RECERCA MATEMÀTICA

MEMÒRIA D'ACTIVITATS 2012

REPORT OF ACTIVITIES 2012

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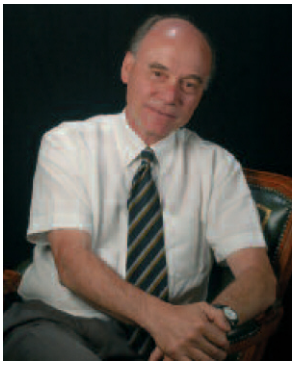
Presentació

L'any 2012 ha estat dur per al CRM perquè s'han combinat dues circumstàncies adverses. D'una banda, la retallada en el contracte-programa que el centre té amb la Generalitat per al període 2008-2013 s'ha consolidat i ha minvat la component estable del seu pressupost, de la qual depenen essencialment totes les despeses de personal. De l'altra, la finalització del projecte *Consolider-Ingenio Mathematica*, sumada a una dràstica disminució de les convocatòries a les quals el centre acudeix normalment, ha fet disminuir molt significativament la component competitiva del pressupost. En conseqüència, el full de ruta, el pla estratègic del centre, no ha pogut seguir-se al cent per cent, i particularment les expectatives de creixement que s'hi contemplaven per a l'any 2012 no s'han acomplert. En definitiva, el CRM ha estat durant el 2012 en *stand by*, podem dir que resistint l'advers escenari econòmic.

Malgrat això, en el centre hi ha hagut algunes novetats importants. Pel que fa al personal de recerca, s'han incorporat dos nous investigadors, tots dos dins el programa *Ramón y Cajal*: Alexander Roxin, en Neurociència Computacional, i Andrei Korobeinikov, en Epidemiologia Matemàtica. D'altra banda, Sergey Tikhonov, qui ja estava al centre com a investigador ICREA júnior, va obtenir a la convocatòria ICREA 2012 una plaça d'investigador sènior i s'ha adscrit al CRM. Amb aquestes incorporacions, el ventall de línies de recerca cultivades al CRM creix a vuit, completant així un espectre temàtic particularment fort en Biologia Matemàtica.

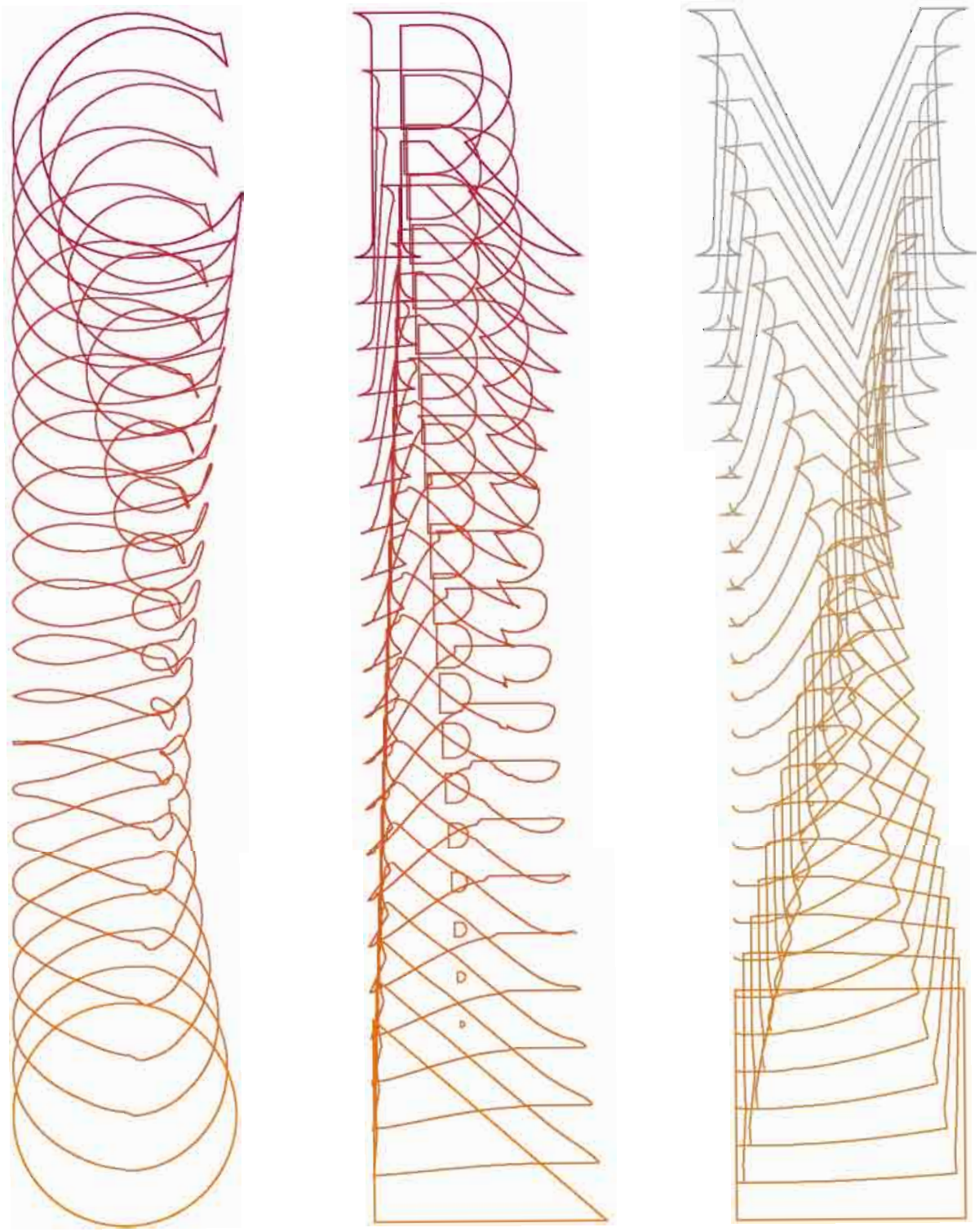
D'altra banda, hem incorporat dues noves modalitats al ventall de programes competitius que el centre té oberts per a visitants. Una és el programa *Dev-Math*, adreçat a joves investigadors de països en vies de desenvolupament, (segons la llista de l'AMS), i que es va posar en marxa en ocasió de l'entrada de l'Estat espanyol en CIMPA; amb aquest programa, el CRM acompleix també l'objectiu de destinar el 0.7% del seu pressupost a l'ajuda al desenvolupament. L'altra és el programa d'estades de recerca per a estudiants de grau o màster que volen fer estades al centre per a conèixer la recerca que s'hi desenvolupa i completar un treball de recerca sota la direcció d'un investigador del CRM.

Finalment, cal destacar que l'escenari econòmic advers ens ha servit com a estímul per a organitzar d'una manera decidida una unitat de transferència de coneixement des del CRM a les empreses i indústries en general. És prou clar que en el futur el centre ha de mirar de no ser tan depenent com ho és actualment del sector públic i ha d'obtenir recursos del sector privat. Sortosament, en el centre tenim persones amb una certa experiència en transferència i la potencialitat objectivament hi és. Aquesta unitat del CRM està formada per dues persones que dediquen tot el seu temps a fer prospecció en el sector privat i també, la qual cosa és molt important, a establir sinergies amb altres centres CERCA.



En aquesta memòria trobareu informació sobre tot plegat, informació que a la plana web del Centre (www.crm.cat) es troba més detallada en alguns aspectes.

Joaquim Bruna, Director



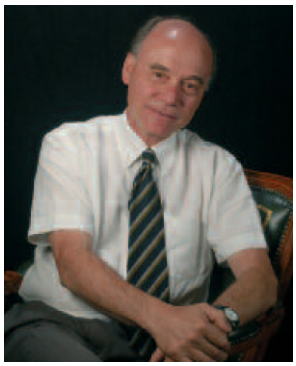
Presentation

The year 2012 has been hard for the CRM from the budgetary point of view because of the combination of two adverse circumstances. On one hand, the reduction in the contract- programme that the centre has with the Government for the period 2008-2013 has been consolidated and thus reduced the steady component of CRM's budget, from which essentially all personnel costs depend on. On the other hand, the completion of the project Consolider-Ingenio Mathematica, *jointly with a drastic reduction of the calls to which the centre usually applies, has significantly reduced the competitive component of the budget. Consequently, it has not been possible to fulfill the roadmap of the centre, its strategic plan, and particularly the growth expectations that were forecasted for 2012 have not been achieved. In short, the CRM was in 2012 in "stand by" while resisting the adverse economic scenario.*

Despite these unfavourable circumstances, some important developments have been reached. As for personal research, the CRM has incorporated two new researchers, both subsidized by the Ramón y Cajal *programme: Alexander Roxin, Computational Neuroscience, and Andrei Korobeinikov, Mathematical Epidemiology. Meanwhile, Sergey Tikhonov, who was already at the centre as ICREA junior researcher, won the 2012 ICREA senior researcher and renewed his assignment to the CRM. With these recruitments, the number of research lines cultivated in the CRM grows to eight, completing a thematic spectrum particularly strong in Mathematical Biology.*

In addition, we have created two new competitive programmes to visit the centre. On one hand, the Dev-Math, *launched on the occasion of the Spanish membership to CIMPA, addressed to young researchers from developing countries (according to the list of the AMS); with this programme, the CRM also fulfills the objective of 0.7% of their budget on development aid. On the other hand, the programme I3MR (*International Internship for Initiation in Mathematical Research*) addressed to advanced undergraduate students who want to stay in the centre to know the research being carried out and complete a research project conducted by one of the CRM researcher's.*

Finally, it is worth mentioning that the adverse economic scenario has served as an additional stimulus to decisively organize a knowledge transfer unit, from CRM to business and industry in general. Clearly, in the future the centre must try to avoid the present dependency on the public sector by raising funds from the private sector. Fortunately, part of our staff has some experience in transference and we have an objective potential to take advantage of. This CRM unit consists of two persons full-time dedicated to make prospections in the private sector and to establish synergies with other CERCA centers.



You will find information about all this in the present report; for more detailed information, please see the CRM website www.crm.cat.

Joaquim Bruna, Director

Continguts

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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 2009 es va iniciar el procés, encara no completat, per incorporar la Universitat Autònoma de Barcelona 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.

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 2009 a process started to incorporate Universitat Autònoma de Barcelona to the Consortium, which is still not completed.

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.*

- El vicepresident, que és el president de l'IEC, o persona en qui delegui.
- Tres vocals en representació de la Generalitat de Catalunya.
- Tres vocals en representació de l'IEC
- El director del CRM, que hi participa amb veu però sense vot.

El Consell de Direcció es va reunir el dia 8 de juny de 2012. 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, i el director d'i-CERCA, Lluís Rovira. L'IEC hi va estar representat pel seu president, Salvador Giner, el seu vicepresident, Joandomènech Ros, i per Joan Girbau. Carles Jaime, vicerector de Projectes Estratègics de la UAB, va assistir com a convidat a la sessió, en representació de la rectora de la UAB.

- *The vice president, who is president of the IEC, or his delegate.*
- *Three representatives of the Generalitat of Catalunya.*
- *Three representatives of the IEC*
- *The Director of CRM, who participates with a voice but not a vote.*

The Governing Board met on June 8, 2012. 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, and the director of the i-CERCA, Lluís Rovira. The IEC was represented by the president, Salvador Giner, the vice-president, Joandomènech Ros, and by Joan Girbau. Carles Jaime, the vice-rector of Strategic Projects of the UAB, assisted to the meeting as a guest, in representation of the rector of the UAB.

Generalitat de Catalunya

Institvt d'Estvdis Catalans

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 23 de gener de 2012. 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 23, 2012. 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. Contracte-programa

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. Aquest contracte-programa emana del pla estratègic del Centre, que va ser aprovat pel Consell de Direcció, i és la concreció dels eixos de desplegament continguts en el pla. L'objecte del contracte-programa és: establir un nou marc de relacions i mecanismes de coordinació entre la Generalitat de Catalunya i el CRM; dotar el CRM dels mitjans necessaris per seguir complint els seus objectius; determinar la participació de la Generalitat de Catalunya en la definició i la programació dels objectius i del finançament del CRM; i configurar-se com un instrument de planificació estratègica, de gestió de la recerca, la formació, la difusió del coneixement i la millora de la qualitat. El desenvolupament del contracte-programa s'analitza en una reunió anual d'una comissió mixta de seguiment.

1.5. Contract-programme

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 was signed for the period 2008-2013. This contract-programme stems from the CRM's strategic plan, which was approved by the Governing Board, and specifies the main axes of the strategic plan. The goal of the contract-programme is the following: to set up a new framework for relations and coordination mechanisms with the Catalan Government; to provide the CRM with the necessary resources to achieve its foundational aims; to specify the participation of the Catalan Government in the definition of the CRM's goals and financing; and to become an instrument for strategic planning, management of research, training, knowledge dissemination, and quality improvement. The development of the contract-programme is analysed and discussed in an annual meeting of a monitoring commission.

1.6. 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

1.6. 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

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.

La reunió anual d'ERCOM de 2012 tingué lloc els dies 23 i 24 de març a l'Alfréd Rényi Institute of Mathematics, a Budapest.

Per a més informació: www.ercom.org

1.7. Ingenio Mathematica

El CRM és un dels promotors i un node d'un projecte anomenat Ingenio Mathematica, finançat pel Ministeri de Ciència i Innovació durant cinc anys dins del programa Consolider-Ingenio 2010. La data d'inici d'aquest projecte va ser el 3 d'octubre de 2006. Amb data 11 de maig de 2011, el projecte Ingenio Mathematica va sol.licitar una extensió del període d'execució fins el 30 d'abril de 2012.

L'investigador coordinador del projecte és Marco Antonio López Cerdá, de la Universitat d'Alacant, i l'entitat gestora és la Universitat de Cantàbria. La direcció científica del projecte correspon a un consell de direcció format per investigadors de diverses institucions de l'estat espanyol. Els nodes del projecte són: CRM, CESGA (Centro de Supercomputación de Galicia), CIEM (Centro Internacional de Encuentros Matemáticos, Castro Urdiales), ICMAT (Instituto de Ciencias Matemáticas, Madrid) i IMUB (Institut de Matemàtica de la Universitat de Barcelona). Les activitats del projecte s'emmarquen en diverses plataformes, anomenades Future, Consulting, Computing, EDU, PMII, SARE, SAIRT i MIGS.

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.

The annual meeting of ERCOM in 2012 was held on March 23 and 24 at the Alfréd Rényi Institute of Mathematics, Budapest.

Further information: www.ercom.org

1.7. Ingenio Mathematica

The CRM is one of the promoters, and a node, of a project called Ingenio Mathematica, which is being funded by the Spanish Ministry of Science and Innovation for five years, starting October 3, 2006, within the Ministry's Consolider-Ingenio 2010 programme. On May 11, 2011, the project Ingenio Mathematica asked for an extension of the execution period until April 30, 2012.

The coordinator of the project is Marco Antonio López Cerdá, from Universitat d'Alacant, and the management centre is located at Universidad de Cantabria. The scientific direction of the project lies under the responsibility of a Governing Board formed by researchers from several Spanish institutions. The nodes of the project are: CRM, CESGA (Centro de Supercomputación de Galicia), CIEM (Centro Internacional de Encuentros Matemáticos, Castro Urdiales), ICMAT (Instituto de Ciencias Matemáticas, Madrid), and IMUB (Institut de Matemàtica de la Universitat de Barcelona). Several platforms, named Future, Consulting, Computing, EDU, PMII, SARE, SAIRT, and MIGS, provide a framework for the actions of Ingenio Mathematica.

Part de les activitats del CRM desenvolupades durant l'any 2012 (programes de recerca, congressos, cursos avançats, etc.) varen ser finançades parcialment per Ingenio Mathematica.

Des del projecte Consolider, i-MATH és conscient de la importància de la formació. Per aquest motiu es va crear un portal d'oferta formativa per a doctorands en Matemàtiques amb l'objectiu d'ajudar tant a estudiants com a professors en el disseny de la formació complementària durant la realització de la tesi doctoral. El CRM, com a promotor i un dels nodes del projecte i-MATH, es va adherir a l'abril de 2011 a l'Escola de Doctorat.

Part of the CRM activities during 2012, including research programmes, conferences, advanced courses, etc., were partially funded by Ingenio Mathematica.

After the experience of the Consolider project, i-MATH knows about the importance of training. To promote it, a new website containing training opportunities for PhD students in Mathematics has been created. Its goal is to help both students and supervisors in designing the complementary training activities along the pre-doctoral period. The CRM, as a promoter and on of the i-MATH nodes, joined the Doctoral School on April 2011.

1.8. Beques 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.

1.8. EPDI Fellowships

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.

1.9. 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.

1.9. 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.

1.10. Equip de Transferència de Coneixement

L'Equip de Transferència de Coneixement del CRM s'ha anat formant al llarg de l'any 2012, amb l'objectiu d'aplicar el coneixement i el saber fer adquirits en la recerca que es desenvolupa al centre, i 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.

1.10. Knowledge Transfer Team

The CRM Knowledge Transfer Team has been launched during 2012 with the purpose of applying the expertise and know-how of the CRM research groups, and giving priority to projects strongly related to their mathematical focus or clearly committed to innovation.

1.11. Estructura i administració

1.11.1. 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.

1.11. Structure and administration

1.11.1. 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.

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.

Atès que l'equip de direcció que es va nomenar a la reunió del Consell de Direcció del dia 26 de març de 2007 va haver de renunciar a les seves funcions per haver contret altres compromisos professionals, 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, el 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.

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.

Since the Team of Directors appointed at the meeting of the Governing Board on March 26, 2007, had to relinquish its duties for having contracted other professional commitments, the appointment of Antoni Guillamon as Assistant Director was 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.

Comissió Executiva / *Executive Commission*

1.11.2. Gerent

El Sr. Oriol Fernández ocupa el càrrec de gerent des de l'any 2008.

1.11.2. Manager

The CRM's Manager is Mr. Oriol Fernández since 2008.

ofernandez@crm.cat telèfon 93 586 8424

Equip d'administració / *Management team*

1.11.3. Equip d'administració

L'equip d'administració del CRM durant el 2012 ha estat format per les següents persones:

Joaquim Berenguer	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
Maria Àngels Huertos	mahuertos@crm.cat	Tel: 93 586 8496
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

1.11.3. Management team

The following people made up the management team in 2012:

1.12. 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.

1.12. 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.

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

Durant l'any 2012, 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*).

1.13. Serveis externs

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

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

During 2012, 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.*

1.13. 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. Durant el 2012, s'han anant consolidant els següents grups de recerca del CRM:

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. During 2012, the following CRM research groups continued their consolidation:

- Sistemes Complexos / *Complex Systems*
- Biologia matemàtica i computacional / *Computational & Mathematical Biology*
- Matemàtica Financera i Control de Riscos / *Financial Mathematics and Risk Control*
- Anàlisi Harmònica i Teoria de l'Aproximació / *Harmonic Analysis and Approximation Theory*
- Matemàtica Industrial / *Industrial Mathematics*
- Anàlisi Numèrica i Computació Científica / *Numerical Analysis and Scientific Computing*

Durant l'any s'han creat dos nous grups de recerca, que han comptat, d'entrada, únicament amb els seus investigadors principals, però que s'aniran ampliant durant l'any 2013:

Along this year two other groups have been started, composed initially only by the principal investigadors, but willing to enlarge during the year 2013:

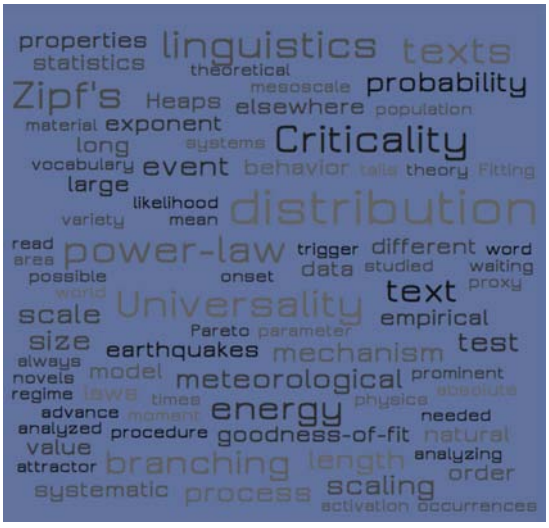
- Epidemiologia Matemàtica / *Mathematical Epidemiology*
- Neurociència Computacional / *Computational Neuroscience*

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 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.

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 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

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,

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.

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

- FIS2009-09508. *Complexity and Scaling Laws in Meteorological Phenomena, Natural Disasters and Human Language*, 2010-12. PI: Álvaro Corral.

Membres del grup
Research Team

- Álvaro Corral (team leader)
- Anna Deluca (PhD student)
- Francesc Font Clos (PhD student)

Activitats relacionades
Related Activities

- Tematic Day on Complex Systems.
- Seminars of the network complexitat.cat

Col.laboradors
Collaborators

• Josep Lluís Arcos	Institut d'Investigació en Intel.ligència Artificial (IIIA)
• Lucilla de Arcangelis	Second University of Naples
• Marián Boguñá	Universitat de Barcelona
• Gemma Boleda	University of Texas at Austin
• Ramon Ferrer i Cancho	Universitat Politècnica de Catalunya
• Martín Haro	Universitat Pompeu Fabra
• Antoni Planes	Universitat de Barcelona
• Joan Serrà	IIIA
• Antonio Turiel	Institut de Ciències del Mar
• Eduard Vives	Universitat de Barcelona

Group Activity in 2012

Last year has been devoted to the development of diverse topics. One PhD student of the group, Anna Deluca, has performed intensive research on the statistics and modelling of rainfall. She has worked on statistical procedures to test universality in rain occurrence, has explored the perspective of rainfall as a spatio-temporal event, and has employed methods of time series analysis to the prediction of rain-event sequences. She has also attended several conferences and international schools, among them the prestigious one on Complex Systems at the Santa Fe Institute. She has also enjoyed a one-month visit to the Max Planck Institute for the Physics of Complex Systems, in Dresden, under the supervision of professor Holger Kantz.

In collaboration with Antonio Turiel, from the Institut de Ciències del Mar, we have studied the energy dissipation of hurricanes in the Atlantic, paying special attention to review the previous literature related to global warming. Together with Eugenio Lippiello and Lucilla de Arcangelis, from the Second University of Naples, we have investigated the factors that influence the probability distribution of the interevent times of earthquakes. We have also performed an analysis of the differences between the use of words or lemmata as the building blocks of texts and their influence on Zipf's law, jointly with Ramon Ferrer i Cancho and Gemma Boleda, from the Universitat Politècnica de Catalunya. An analogous of Zipf's law has been obtained for the timbral descriptors of music and speech, from work perfomed with Martín Haro, Joan Serrà, and Perfecto Herrera, from the Universitat Pompeu Fabra. We have also developed statistical tests to fit and evaluate the goodness-of-fit for discrete power-law distributions.

The group has also brought a number of speakers to contribute to CRM seminars, including Oriol Pont, from INRIA, France, Salvador Pueyo, from the Institut Català de Ciències del Clima, and Joshua Garland, from the University of Colorado, and has had the visit of our long-term collaborator Lucas Lacasa, from the Universidad Politécnica de Madrid. We have also organised a first meeting of Spanish researchers working in complexity and nonlinear geoscience and have collaborated in the conferences organised by the network `complexitat.cat`.

Computational & Mathematical Biology

Àmbit de recerca

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

Research Field

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

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 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.

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

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

- Modelització de múltiples escales de creixement tumoral i angiogènesi.
- Dinàmica evolutiva de poblacions amb estruc-
  tura 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.

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

- MTM2011-29342. *Mathematical models of biological population dynamics with complex structure*, 2011. PI: Tomás Alarcón.

Membres del grup
Research Team

- Tomás Alarcón (team leader)
- Pilar Guerrero (post-doctoral researcher)
- Esther Ibáñez (PhD student)
- Daniel Sánchez (PhD student)

Activitats relacionades
Related Activities

- Computational & Mathematical Biology Seminar

Col.laboradors
Collaborators

• Helen M. Byrne	University of Nottingham
• 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 2012

During 2012, the research activity of the group has been developed along the following lines.

1.- Development of stochastic multiscale modelling of cell populations leading to the formulation of age-structured stochastic populations models with applications to tumour growth.
2.- Investigation of the stability of stochastic structured (multi-type and hierarchical populations) which has led to the formulation of new mechanism for extinction in hierarchically organised populations where delays induce extinction.
3.- Formulation of evolutionary models of the dynamics of populations with phenotype-genotype map where we are exploring, using elements from graph theory and complex network theory, the topological properties of a new description of this map based on a bipartite graph.
4.- Modelling the dynamics of latent HIV-1 infections, in particular the origins and clinical significance of the so-called viral blips
5.- Experimental investigation of rheological properties of blood at the microscale

The group has published in 2012 two papers in reputed journals of Mathematical Biology. Furthermore, the members of the group have attended several national and international conferences, workshops and summer schools, including invited talks at the joint RSME-Mexican Mathematical Society meeting and the joint RSME-Portuguese Mathematical Society meeting. We have also been the host of an internship student, Núria Folguera (mathematics undergraduate, Universitat Autònoma de Barcelona) who worked with us on stochastic modelling of invasion.

Additionally, during 2012, and in collaboration with the group of Prof. Aurora Hernández-Machado (School of Physics, Universitat de Barcelona) and the Industrial Mathematics group (CRM), we have established the Microrheology of Biofluids Laboratory, where we carry out experiments to determine the rheological properties of blood and other biological fluids at the microscale.

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. Un dels interessos particulars del nostre grup és el tractament de les equacions integrals mitjançant tècniques basades en ondetes i el càlcul eficient de les mesures de risc per avaluar les pèrdues potencials a nivell de cartera.

Alguns dels problemes que estudiem són:

- Risc de crèdit i modelització del capital econòmic. Mètodes numèrics eficients per calcular les mesures de risc a nivell de cartera.
- Mètodes de Fourier i d'ondetes en valoració d'opcions. Mètodes d'integració numèrica i la fórmula del valor esperat del *payoff* descomptat.
- Mesurament del risc de mercat en carteres no lineals. Valor-en-risc i *Expected Shortfall* per a carteres d'opcions.

Research Field

Computational Finance lies at the intersection of numerics and stochastics. An important aspect of research in this field is to further increase the performance of pricing methods. Of particular interest to our grup is the treatment of integral equations by wavelets methods and the efficient computation of risk measures to evaluate potential losses at the portfolio level.

Some of the problems that we are studying are:

- *Credit risk and economic capital modeling. Efficient numerical methods to compute the risk measures at portfolio level.*
- *Fourier and wavelet methods in option pricing. Numerical integration methods and the discounted expected pay-off formula.*
- *Market risk measurement in non-linear portfolios. Value-at-risk and Expected Shortfall for portfolios of options.*

Membres del grup *Research Team*	• Luis Ortiz	(team leader)
Activitats relacionades *Related Activities*	• Seminari de Finances Quantitatives, Xarxa temàtica del CRM. • Financial Engineering Summer School, June 2012, Bolsa de Madrid.	
Col.laboradors *Collaborators*	• Josep J. Masdemont • Cornelis W. Oosterlee	Universitat Politècnica de Catalunya Centrum voor Wiskunde en Informatica and Delft University

Harmonic Analysis and Approximation Theory

Àmbit de recerca

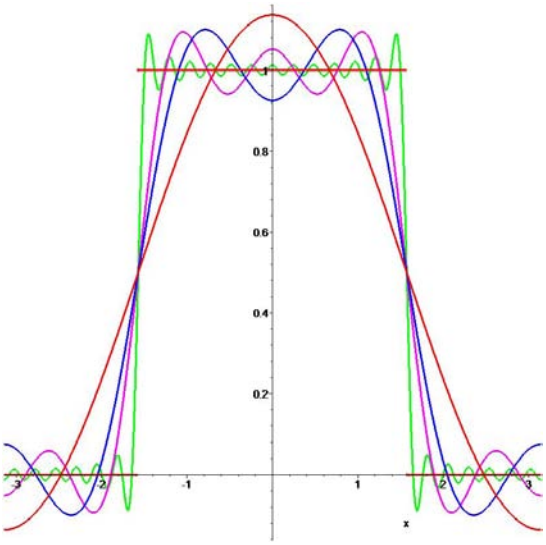
L'anàlisi harmònica estudia la representació de funcions o senyals com a superposició d'ones elementals. Avui, és un dels camps amb més aplicacions en matemàtiques, entre les quals hi ha el processament del senyal, la transmissió d'imatges, diversos camps en enginyeria, electrònica, física, probabilitat 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*, 2011-2013. PI: S. Tikhonov

Membres del grup
Research Team

- Sergey Tikhonov (team leader)
- Andrii Bondarenko (post-doctoral researcher)
- Polina Glazyrina (post-doctoral researcher)
- Nir Lev (post-doctoral researcher)
- Ainur Jumabayeva (PhD student)

Activitats relacionades
Related Activities

- Barcelona Analysis Seminar (every Monday, CRM or UB).
- Research Programme Seminar (every Monday or Tuesday; from September 2011)
- CRM Research Programme "Approximation Theory and Fourier Analysis" (September 2011 to February 2012, CRM)

Col.laboradors
Collaborators

• Feng Dai	University of Alberta
• Hrushikesh Mhaskar	California State University
• Michael Ruzhansky	Imperial College London
• Edward B. Saff	Vanderbilt University, Nashvillw
• Vladimir D. Stepanov	Peoples' Friendship University of Russia
• Walter Trebels	Technische Universität Darmstadt

Group Activity in 2012

During 2012 the members of the group studied the following topics:

Fourier series, function spaces, embedding theorems, sampling and interpolation, Riesz bases, discrepancy theory, optimal configurations on the sphere, weighted norm for integral transforms, polynomial inequalities, spherical designs, optimal codes, best packing, energy minimization.

In particular, R. Akgun studied polynomial inequalities with weights. A. Bondarenko proved the well-known conjecture of Korevaar and Meyers on existence of spherical designs with small cardinalities (to be published in the Annals of Mathematics). P. Chunaev studied the Hardy-type inequalities for some special classes of sequences. P. Glazyrina investigated Landau's inequalities for algebraic polynomials and Bernstein's inequality. A. Jumabaeva has continued working on her PhD dissertation focusing on optimal inequalities between certain constructive and structural characteristics of the generalized Liouville derivatives. N. Lev together with A. Olevskii studied N. Wiener's conjecture on cyclic vectors with results published in the Annals of Mathematics. S. Tikhonov has been working on sharp Remez and Nikol'skii inequalities and weighted norm inequalities for Fourier-type transforms.

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

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*

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.

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.

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

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

Projectes vigents
Current Projects

- PIRG06-GA-2009-256417. *Industrial applications of moving boundary problems*, 2010–2014. PI: Tim Myers
- MTM2010-17162. *Problemas de frontera móvil en presencia de capas líquidas*, 2011–2014. PI: Tim Myers

Membres del grup
Research Team

• Tim Myers	(team leader)
• Teresa Cao	(post-doctoral researcher)
• Jonathan Low	(post-doctoral researcher)
• Michelle De Decker	(PhD student)
• Francesc Font	(PhD student)
• Vicent Ribas	(MSc student)
• Anna Sßez	(MSc student)
• Helena Ribera	(research assistant)

Activitats relacionades
Related Activities

- Nanomath 2012 (organised by Tim Myers).
- GEMT workshop on Nanofluid flow (organised by Tim Myers).
- "Introduction to..." seminar series.

Col.laboradors
Collaborators

• Linda Cummings	New Jersey Institute of Technology
• James Hill	University of Adelaide
• Sarah Mitchell	University of Limerick
• Ebrahim Momoniat	University of the Witwatersrand, Johannesburg
• Vicent Ribas	Sabirmedical
• Jon Summers	University of Leeds
• Harvey Thompson	University of Leeds
• Brian Wetton	University of British Columbia

Group Activity in 2012

The IM group has primarily focussed on modelling of nano-phenomena, with a few forays into more traditional industrial problems, such as microwave defrosting and elastic deformation. Specific details of all activities are given below.

1. Research: Francesc Font focussed on phase change 'beyond the classical Stefan problem', with applications to the solidification of supercooled melts and melting of nanoparticles. Michelle MacDevette continued working on nanofluids but has recently concentrated on the application of a particular solution method. Teresa Cao worked on microwave defrosting and a nano analysis of a classical problem - the interaction of a fluid with a solid boundary.

2. Dissemination: The group published 5 journal articles this year, on topics such as contact melting, energy conservation in Stefan problems and football motion through the air. A further 5 papers were submitted (of which 3 have already been accepted). Talks on these and other topics were given at conferences and in seminar series in Ireland, Japan, South Africa, Spain, Sweden and the UK. Tim Myers initiated a seminar series entitled 'An Introduction to . . . ', where eminent mathematicians introduce an applied mathematics topic to a general audience. The ultimate goal of this initiative is to collect the lectures to form a book.

Tim Myers formed part of a team at Universitat Politècnica de Catalunya teaching a mathematical modelling course to undergraduates. He also (successfully) supervised 2 masters theses, by Vicent Ribas and Anna Sáez. A short term research visitor (who has stayed for 6 months), Helena Ribera, a graduate of Universitat de Barcelona joined the group to learn about mathematical modelling. In 2013 she will start a Masters course in Engineering Maths at Bristol. Jarrod Williams of Oxford University visited on a CRM internship to work on boundary layer flow of nanofluids.

3. Visitors: Prof. Sean Bohun of the University of Ontario Institute of Technology spent the second half of the year at CRM, working with the group primarily on defrosting. Prof. James Hill of the Nanomechanics group at the University of Adelaide spent July at the CRM, helping in student supervision and contributing greatly to the conference Nanomath. As usual, Dr Mitchell from the University of

Limerick visited to provide numerical and analytical advice in the field of phase change.

4. Meetings and related activities: In July CRM hosted Nanomath, an initiative aimed at highlighting problems in nanotechnology suitable for mathematical analysis. All group members took part in this activity. The meeting involved mathematicians, physicists, engineers and chemists from around the world. Tim Myers spent a week in April as a student mentor at the Oxford Graduate Modelling Camp.

Numerical Analysis and Scientific Computing

Àmbit de recerca

El nostre interès científic es concentra en l'àmbit dels mètodes numèrics per a equacions en derivades parcials. En particular, ens centrem en els mètodes d'elements finits de diferents tipus. Un dels principals focus de la nostra recerca és el disseny i anàlisi dels mètodes de solució eficient dels sistemes algebraics discrets resultants. Les aplicacions de les tècniques que estudiem apareixen en diversos models matemàtics en Mecànica de Fluids, Mecànica dels Medis Continus i, més recentment, en les equacions cinètiques en Física de Plasma. En particular, treballem o hem treballat:

- Mètodes d'elements finits (conforme, disconforme i mixt).
- Mètodes de Galerkin discontinus.
- Domini dels mètodes de descomposició.
- Solucionadors iteratius multinivell i multigrau.
- Aproximació numèrica d'equacions cinètiques.
- Tècniques d'estabilització en problemes d'advecció-difusió.
- Post-procés de tècniques per a equacions de Navier-Stokes en mecànica de fluids.

Research Field

Our primary scientific interest is concentrated in the field of Numerical Methods for Partial Differential Equations. In particular, our work is focused on Finite Element Methods of different types and the study of their basic properties. One of our main interests is the design and analysis of efficient solution methods for the resulting discrete algebraic systems. The applications of the techniques that we study arise in various mathematical models in Fluid Mechanics, Continuum Mechanics and, more recently, kinetic equations in Plasma Physics. In particular, we work (or have worked) in:

- *Finite element methods (conforming, non-conforming and mixed).*
- *Discontinuous Galerkin methods.*
- *Domain decomposition methods.*
- *Multilevel and multigrid iterative solvers.*
- *Numerical approximation of kinetic equations.*
- *Stabilization techniques for steady/unsteady advection-diffusion problems.*
- *Post-processing techniques for Navier-Stokes equations.*

Projectes vigents
Current Projects

- MTM2011-27739-C04-04. *Métodos Numéricos para Ecuaciones en Derivadas Parciales: Técnicas de discretización novedosas y "solvers" eficientes*, 2012–2014. PI: Blanca Ayuso de Dios

Membres del grup
Research Team

- Blanca Ayuso (Ramón y Cajal fellow)

Col.laboradors
Collaborators

• Paola F. Antonietti	MOX & Politecnico di Milano
• Franco Brezzi	IMATI–CNR & IUSS, Pavia
• José Antonio Carrillo	ICREA & Universitat Autònoma de Barcelona
• L. Donatella Marini	Università degli Studi di Pavia
• Michael Holst	University of California at San Diego
• Johannes Kraus	RICAM, Linz
• Chi-Wang Shu	Brown University
• Yunrong Zhu	University of California at San Diego
• Ludmil T. Zikatanov	Penn State University

Mathematical Epidemiology

Àmbit de recerca

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

Research Field

The mathematical modelling of infectious diseases of the humans, domestic and wild animals and plants is a rapidly expanding and a highly practically relevant area of research, and the aim of the newly established Mathematical Epidemiology Research Group is to study the emergence and spread of infectious diseases from a mathematical point of view. The group is working towards a number of directions of research such as the emergence of new pathogens, the 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 emerging infections, in the stability and persistence of a pathogen, as well

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.

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)

Computational Neuroscience

Àmbit de recerca

El grup de neurociència computacional es va iniciar el maig de 2012. En aquest moment, està format només pel Dr. Alex Roxin però es preveuen noves incorporacions per al 2013. La neurociència computacional és un subcamp de la neurociència en el qual els models computacionals s'utilitzen per aprendre com funciona el sistema nerviós. Es tracta d'un camp molt ampli, que comprèn una diversitat de models, des dels estadístics o probabilístics fins a models d'equacions diferencials. Atès que el treball experimental en neurociència acostuma a requerir un cert grau de modelatge, encara que sigui només d'anàlisi de dades, no hi ha una clara divisió entre neurociència experimental i computacional. Per tant, és important que hi hagi una estreta col.laboració entre teòrics i experimentalistes. Si més no, el treball de modelatge ha d'estar limitat per les dades experimentals.

La tasca del grup de Neurociència Computacional del CRM se centra 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

Research Field

The group of Computational neuroscience was started in May 2012. At this moment, it is formed only by Dr. Alex Roxin but new incorporations are forecasted for the year 2013. Computational neuroscience is a sub-field of neuroscience proper in which computational models are used to learn something about how the nervous system works. It is a broad field, encompassing many different types of models, from statistical or probabilistic models, to differential equations. As most experimental work in neuroscience already requires some degree of modeling, if only at the level of data analysis, there is no clear divide between experimental and computational neuroscience. This means that close collaboration between theorists and experimentalists is important. At the very least, modeling work must be constrained by experimental data.

In the Computational Neuroscience group at the CRM, I focus mainly on the dynamics of cortical microcircuits, that is ensembles of hundreds or thousands of neurons in the cerebral cortex. In particular, I study the role of the recurrent connectivity in shaping spontaneous activity in models of cortical microcircuits. This is a timely

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.

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.

Membres del grup
Research Team

- Alexander Roxin (team leader)

Col.laboradors
Collaborators

- Albert Compte IDIBAPS
- Jaime de la Rocha IDIBAPS
- Duane Nykamp University of Minnesota

Group Activity in 2012

The group was started new in May of 2012. Since then, I have been working on models of so-called connectivity motifs in cortical microcircuits. Motifs are patterns of connections between a small number of neurons. Examples include reciprocal connections between pairs of neurons, or chains between three neurons. Experimental work, in which connections between neurons in cortical slices are determined directly through electro-stimulation and recording, show that such motifs do not occur at rates one would expect if the network were a simple Erdos-Renyi (ER) graph. This means that some additional structure must be present.

Some have speculated this might indicate the presence of clustering, for which the network is composed of several groups of neurons. The connectivity within a group would be higher than between groups. This can, indeed, lead to a difference in the rates of certain motifs compared to a simple, uniform ER graph. An alternative hypothesis is that the network statistics are simply more complex than in an ER graph, which is completely determined by a single statistic, the probability of a connection between any two nodes. I have looked at the example of networks which are parameterized by the degree distributions of the nodes, i.e. the distributions of in-coming and out-going connections. In this case, one can show that the rates of certain motifs are affected by the higher-order moments of these distributions, e.g. the variances and covariances. This is work I have been doing with Duane Nykamp and the University of Minnesota.

2.2. 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 Sèniors

2.2.1. Senior Researchers

Tomás Alarcón

During 2012, my research activity has been devoted to further four research lines already opened during 2011, namely, development of stochastic multiscale modelling of cell populations leading to the formulation of age-structured stochastic populations models with applications to tumour growth, investigating of the stability of stochastic structured populations leading to the formulation of new mechanism for extinction in hierarchically organised populations, the formulation of evolutionary models of the dynamics of populations with phenotype-genotype map where we are exploring, using elements from graph theory and complex network theory, the topological properties of a new description of this map based on a bipartite graph, and, modelling the dynamics of latent HIV-1 infections, in particular the origins and clinical significance of the so-called viral blips. Additionally, I have opened a new research line consisting of an experimental investigation of rheological properties of blood at the microscale.

Regarding research output, I have published in 2012 two papers in reputed Mathematical Biology journals. I have also been invited to several national and international conferences, workshops and summer schools, including invited talks at the joint RSME-Mexican Mathematical Society meeting and the joint RSME-Portuguese Mathematical Society meeting.

Additionally, during 2012, and in collaboration with the group of Prof. Aurora Hernández-Machado (School of Physics, Universitat de Barcelona) and the Industrial Mathematics group (CRM), we have established the Micro-rheology of Biofluids Laboratory, where we carry out experiments to determine the rheological properties of blood and other biological fluids at the microscale.

□ Publications

Articles

- T. Alarcón and H. J. Hensen, *Invasion in multi-type populations: The role of robustness and fluctuations*, IMA J. Math. Med. Biol. **29**, 3–20 (2012).
- Y. Nakata, Ph. Getto, A. Marciniak-Czochra, T. Alarcón, *Stability analysis of multi-compartment models for cell production systems*, J. Biol. Dyn. **6 (Supp. 1)**, 2–18 (2012).

Preprints

- L. Willis, T. A. Graham, T. Alarcón, I. P. M. Tomlinson, K. M. Page, *What can be learnt about disease progression in breast cancer dormancy from disease-free survival data?*, submitted *to PLoS One*.

Books or chapters

- H. Perfahl, H. M. Byrne, T. Chen, V. Estrella, T. Alarcón, A. Lapin, R. A. Gatenby, R. J. Gillies, M. C. Lloyd, P .K. Maini, M. Reuss, M. R. Owen, *Multiscale Modelling of Angiogenesis and Vascular Tumour Growth*, in *Nano and Micro Flow Systems for Bioanalysis* (2012).

□ Research projects

- *Mathematical modelling of biological populations with complex structure,* MICINN, MTM2011-29342. From 2012 to 2014. Principal investigator: Tomás Alarcón.
- *Mathematical modelling and analysis of discrete and continuous structured population dynamics,* BCAM. From 2011 to 2013. Principal investigator: Tomás Alarcón (when awarded; no longer a member of the project).
- *Grup de Recerca Consolidat en Equacions en Derivades Parcials i Aplicacions de la UAB-UPC-UdG,* Catalan government within the programme: Grup de recerca consolidat en el marc del IV Pla de Recerca de Catalunya (2009-2013), 2009SGR345. From 2009 to 2013. Principal investigator: José Antonio Carrillo de la Plata, Departament de Matemàtiques, Universitat Autonòma de Barcelona.

□ Activity in research training

Supervision of research students

Undergraduate project supervision

- Núria Folguera-Blasco, Mathematics, Universitat Autònoma de Barcelona. September 2012 – November 2012 (CRM internship).

PhD supervision

- Esther Ibáñez-Marcelo (CRM). *Dynamics of cell populations with genotype-phenotype map*, from January 2011. Funded by the CRM.
- Daniel Sánchez-Taltavull (CRM). *Evolutionary dynamics of hierarchically-structured cell populations*, from January 2011. Funded by the CRM.

Postdoc supervision

- Pilar Guerrero (CRM). *Stochastic multi-scale modelling of micro-metastases in tumour dormancy*, from January 2011. Funded by the CRM.

□ Diffusion activity

- Participation in outreach activities organised by CRM to present the research activities of the Computational & Mathematical Biology Group to Biotechnology undergraduates (UAB) and, in the context of the Science Week, to students of the Mathematics & Physics degree (UAB).

Teaching activity

• Module on Stochastic Modelling in Population Dynamics as part of the course on Mathematical Models in Biology of the Master in Advanced Mathematics & Mathematical Engineering, Universitat Politècnica de Catalunya, 2012–2013.

Scientific activities

Organisation

• Organiser and member of the scientific committee of the *Joint CRM–Imperial College Advanced Course on Complex Systems* to be held in the Centre de Recerca Matemàtica, Bellaterra, Barcelona, April 2013.

• Organiser of the *CRM Colloquim on Mathematical Biology and Biophysics*, Centre de Recerca Matemàtica, December 2012.

Participation

Invited lectures in conferences

• T. Alarcón, *Stochastic multi-scale modelling of small metastasis*, Mathematical Biology session of the joint meeting of the Royal Spanish Mathematical Society and the Mexican Mathematical Society, Málaga, January 2012.

• T. Alarcón, *Hybrid τ-leaping methods for simulation of multiscale stochastic models of cell populations*, Mathematical Biology session of the 4th Iberian Mathematical meeting (joint meeting of the Royal Spanish Mathematical Society and the Portuguese Mathematical Society), Valladolid, October 2012.

• T. Alarcón, *From invasion to latency: Intracellular noise and cell motility as key controls of the competition between resource-limited cellular populations*, Workshop on Cancer Modelling: Evolutionary issues and Radiotherapy Methods, Universidad de Granada, December 2012.

Seminars

• T. Alarcón, *Tackling biomedical problems using mathematical models of cell population dynamics*, Institute for the Research on Applied Mathematics and Systems (IIMAS), Universidad Autónoma Nacional de México, March 2012.

• T. Alarcón, *Stochastic multi-scale modelling of cell populations*, Lyon Biomathematics Working Group Seminar, Lyon, June 2012.

Research stays

• Visiting Scientist, IIMAS – Instituto de Invesitigaciones en Matemática Aplicada y Sistemas, Universidad Autónoma Nacional de México (UNAM), February 2012.

• OCCAM Visiting Fellow, Oxford Centre for Collaborative Applied Mathematics, Mathematical Institute, University of Oxford, May 2012 – June 2012.

Other activities

• Thesis committee: "DifFUZZY: A novel clustering algorithm for systems biology", by Ornella Cominetti Allende (University of Oxford, May 2012).

• Establishment of *CRM Lab for Microrheology of Biofluids*. The CRM Lab for Microrheology of Biofluids is an experimental research unit based at CRM.

• Member of the scientific committee of the workshop on *Mathways into cancer*, Almagro, June 2012.

Blanca Ayuso

My research has focused on two main lines; design and analysis of Discontinuous Galerkin (DG) methods, and the development and analysis of efficient solvers.

We have studied in the issue of optimality/sub-optimality of the nonsymetric and incomplete Interior Penalty methods (NIPG and IIPG) for elliptic problems.

We have developed efficient Schwarz preconditioners for the solution of the linear systems that arise from the (already) preconditioned Weakly Overpenalized Symmetric Interior Penalty methods (WOPSIP).

We have considered the issue of developing and analyzing preconditioners (based on classical DD methods) for the solution of some non-symmetric but definite systems arising in DG discretizations.

We construct and analyze substructuring preconditioners for a Nitsche type method (conforming approximation inside the subdomain and DG for the matching) for elliptic problems. We have studied the classical and original BPS preconditioner for this type of method, studying the h and p versions of it.

We have considered second order elliptic problems with large jumps in the diffusion coefficient and we have carried the verification and validation of the numerical schemes introduced.

We have proposed uniform and efficient preconditioners for an H(div)-DG discretization of the Stokes problem. We also present the analysis of the discretization methods (which involves proving a new discrete Korn inequality).

We proposed and analyzed a family of semi-discrete DG schemes for the approximation of the multi dimensional kinetic periodic Vlasov-Poisson system. Such work is the first one in literature that provides error and convergence analysis of an Eulerian method for approximating the Vlasov Poisson system (in dimension higher that 1).

Publications

Articles

- B. Ayuso de Dios, F. Brezzi, O. Havle and L. D. Marini, *L^2-error analysis of the IIPG-0 method*, Numerical Methods for Partial Differential Equations **28**, 1440–1465 (2012).
- P. F. Antonietti, B. Ayuso de Dios, S. C. Brenner and Li-yeng Sung, *Schwarz methods for a preconditioned WOPSIP method for elliptic problems*, Computational Methods in Applied Mathematics (CMAM) **12**, 241–272 (2012).
- B. Ayuso de Dios, J. A. Carrillo and C. W. Shu, *Discontinuous Galerkin Methods for the Multidimensional Vlasov-Poisson system*, Mathematical Models and Methods in Applied Sciences (M3AS) **22**, 45 pages (2012).
- B. Ayuso de Dios, M. Holst, Y. Zhu and L. T. Zikatanov, *Multilevel Preconditioners for Discontinuous Galerkin discretizations of jump-coefficient problems*, to appear in Mathematics of Computation.

Preprints

- B. Ayuso de Dios, A. Barker and P. Vassilevsky, *A Combined Preconditioning Strategy for Nonsymmetric Systems*, Technical report: arXiv:1208.4544v1.
- B. Ayuso de Dios and S. Hajian, *Energy preserving and high order discontinuous Galerkin methods for the Vlasov-Poisson system*, Technical report: arXiv:1209.4025v2.
- B. Ayuso de Dios, F. Brezzi , L. D. Marini, J. Xu and L.T. Zikatanov, *A simple Preconditioner for a Discontinuous Galerkin Method for the Stokes problem*, Technical report: arXiv:1209.5223v1.
- P. F. Antonietti, B. Ayuso de Dios, S. Bertoluzza and M. Penacchio, *Substructuring preconditioners for an h-p Nitsche-type method*, Technical report: $17-$ PV$-12/16/0$ Istituto Enrico Magenes, IMATI-CNR, Pavia.

Conference proceedings

- B. Ayuso de Dios, A. Lombardi, P. Pietra and L. T. Zikatanov, *A block solver for the exponentially fitted IIPG-0 method*, Domain Decomposition Methods in Science and Engineering XX. Lecture Notes in Computational Science and Engineering vol. 91 (2013).

- B. Ayuso de Dios, M. Holst, Y. Zhu and L. T. Zikatanov, *Multigrid Preconditioner for Nonconforming Discretization of Elliptic Problems with Jump Coefficients*, Domain Decomposition Methods in Science and Engineering XX. Lecture Notes in Computational Science and Engineering vol. 91 (2013).

□ Research projects

- *Métodos Numéricos para Ecuaciones en Derivadas Parciales: Técnicas de discretización novedosas y "solvers" eficientes,* MINECO, Ministerio de Economía y Competitividad, MTM2011-27739-C04-04. From January 1st, 2012, to December 31st, 2014. Principal investigator: Blanca Ayuso de Dios.
- *Grup de Recerca Consolidat en Equacions en Derivades Parcials i Aplicacions de la UAB-UPC-UdG,* Catalan government within the programme: Grup de recerca consolidat en el marc del IV Pla de Recerca de Catalunya (2009-2013), 2009SGR345. From 2009 to 2013. Principal investigator: José Antonio Carrillo de la Plata, Departament de Matemàtiques, Universitat Autonòma de Barcelona.

□ Activity in research training

Supervision of research students

- Saverio Castelanelli, Mathmods Master's Student. *Application of the Sparse grid technique to Discontinuous Galerkin methods: some simple hyperbolic problems.* Master's Thesis defended at Universitat Autònoma de Barcelona, September 2012.

□ Teaching activity

- February 2012–Jun 2012: Advanced Course on Partial Differential Equations (course for the Master of Science in Advanced Mathematics and Mathematical Engineering (MAMME)), Universitat Politècnica de Catalunya (60 hours, taught with X. Cabré).

Lectures and short courses

• *Finite Element Methods* Intensive Course in the Phd Program within the Department of Applied Mathematics at Universidad Carlos III, Madrid.

☐ Scientific activities

Organisation

• *Solvers for Discontinuous Galerkin Methods*, at DD21, Rennes, France, June 2012 (8 speakers). Co-organiser:S.C. Brenner.

Participation

Invited lectures in conferences

• *Some Solvers for Discontinuous Galerkin Methods*, Invited plenary talk at the 21st International Conference on Domain Decomposition Methods (DD21), June 25th–29th, 2012, University of Rennes, France.

• *A simple preconditioner for an $H(div;\Omega)$-DG method for the Stokes problem*, Invited talk at the Workshop on Discontinuous Galerkin Methods, Oberwolfach, February 19th–25th, 2012.

• *Finite Element Discontinuous Galerkin Methods for Vlasov-type systems*, invited talk in Minisymposia: "Mathematical Aspects of Recent Discretization Schemes", organized by F. Brezzi, L. Franca & L.D. Marini, World Congress of Computational Mechanics, WSCC 2012, July 2012.

• *Energy preserving and High Order Discontinuous Galerkin Methods for the Vlasov-Poisson system*, invited talk in Minisymposia: "High-order methods for hyperbolic problems", organized by C. Parés & S. Mishra, ECCOMAS 2012, September 2012.

Seminars

• *Preconditioning Discontinuous Galerkin Methods via FE decompositions*, Dipartimento di Matematica, Università di Bologna, December 2012.

• *Discontinuous Galerkin Methods for the Vlasov-Poisson system*, Departamento de Matemáticas, Universidad de Buenos Aires, July 2012.

Research stays

• November -December 2012: Instituto de Matematica Applicata e Tecnologie Informatiche del C.N.R., IMATI-CNR, Pavia (2.5 weeks).

• July 2012: Departamento de Matemáticas, Universidad de Buenos Aires (2 weeks).

• June 2012: Basque Center for Applied Mathematics (5 days).

• May 2012: Invited Researcher at Instituto de Matematica Applicata e Tecnologie Informatiche del C.N.R., IMATI-CNR, Pavia (2 weeks).

☐ Other activities

• Reviewer and Panelist of ANEP (Agencia Nacional de Evaluación y Prospectiva) for 1 project in the area of Mathematics, *Plan Nacional I+D*.

Álvaro Corral

In collaboration with the group of Eduard Vives and Antoni Planes, from the Universitat de Barcelona, we have investigated the statistical properties of fractures in porous media, and have compared them with those of earthquakes. Together with Joan Serrà and Josep Lluís Arcos, from the Institut d'Investigació en Intel.ligència Artificial, and Marián Boguñá, from the Universitat de Barcelona, we have developed a network approach to study the transitions of pitch, timbre, and loudness in musical discourse. We have also performed an analysis of the differences between the use of words or lemmata as the building blocks of texts and their influence on Zipf's law, jointly with Ramon Ferrer i Cancho and Gemma Boleda, from the Universitat Politècnica de Catalunya. We have also extended our progress on statistical tests to fit and evaluate the goodness-of-fit for discrete power-law distributions.

□ Publications

Articles

- M. Haro, J. Serrà, P. Herrera and A. Corral, *Zipf's Law in Short-Time Timbral Codings of Speech, Music, and Environmental Sound Signals*, PLoS ONE **7**, e33993 (2012).
- J. Serrà, A. Corral, M. Boguñà, M. Haro and J. L. Arcos, *Measuring the Evolution of Contemporary Western Popular Music*, Scientific Reports **2**, 521 (2012).
- E. Lippiello, A. Corral, M. Bottiglieri, C. Godano and L. de Arcangelis, *Scaling behavior of the earthquake intertime distribution: Influence of large shocks and time scales in the Omori law*, Physical Review E **86**, 066119 (2012).

Preprints

- J. Barò, A. Corral, X. Illa, A. Planes, E. K. H. Salje, W. Schranz, D. E. Soto-Parra and E. Vives, *Statistical similarity between the compression of a porous material and earthquakes*, to appear in *Physical Review Letters*.
- A. Corral and F. Font-Clos, *Criticality and self-organization in branching processes: application to natural hazards*, to appear in *Self-Organized Critical Processes*.
- A. Deluca and A. Corral, *Scale Invariant Events and Dry Spells for Medium Resolution Local Rain Data*, submitted to *Nonlinear Processes in Geophysics*.
- A. Corral and A. Deluca, *Fitting and goodness-of-fit test of non-truncated and truncated power-law distributions*, submitted to *Acta Geophysica*.
- A. Corral, A. Deluca and R. Ferrer-i-Cancho, *A practical recipe to fit discrete power-law distributions*, submitted.

Books or chapters

- A. Corral and A. Turiel, *Variability of North Atlantic Hurricanes: Seasonal versus Individual-event Features*, in Extreme Events and Natural Hazards: The Complexity Perspective, AGU Monographs (2012).

Conference proceedings

- M. Haro, J. Serrà, A. Corral and P. Herrera, *Power-law Distribution in Encoded MFCC Frames of Speech, Music, and Environmental Sound Signals*, Proc. Int. World Wide Web Conf., Workshop on Advances in Music Information Research (AdMIRe), Lyon (2012).

Research projects

• *Complexity and Scaling Laws in Meteorological Phenomena, Natural Disasters and Human Language,* Ministerio de Ciencia y Tecnología, FIS2009-09508. From 2010 to 2012. Principal investigator: Álvaro Corral.
• *Consolidated Research Group on Statistical Physics,* Generalitat de Catalunya, 2009SGR-164. From 2009 to 2013. Principal investigator: David Jou i Mirabent.

Activity in research training

Supervision of research students

Master's project supervision
• Oliver Planes Osorio (UAB), *Ajuste de la Disipación y la Energía de los Ciclones Tropicales*, September 2012.

PhD supervision
• Anna Deluca Silberberg, PhD student (CRM).
• Francesc Font Clos, PhD student (CRM).

Diffusion activity

• The paper about "Measuring the Evolution of Contemporary Western Popular Music" appeared in *Scientific Reports*, see above, has had a broad impact in the media. Interviews and articles have appeared on television news programs (TVE, Antena3), radio magazines (Cadena SER, RNE, Onda Cero) and international newspapers and magazines (La Vanguardia, El País, Scientific American, The Economist, Reuters, CNet, The Guardian, Daily Mail, The Telegraph, The Australian, Hindustan Times, Die Welt, Stern, Corriere della Sera, France TV Info). Links to this media material have been collected at `http://www.crm.cat/Researchers/acorral/Pages/MassMedia.aspx`.

Scientific activities

Organisation

• Member of the organizing committee of the *II Jornada complexitat.cat*. Barcelona, May 2012.
• Member of the scientific committee of the *International Course of Mathematical Models in Seismology, SeismMath*. L'Aquila, June 2012.
• Member of the organising committee of the *School and International Workshop on Complex Systems*, CRM, April 2013.
• Member of the scientific committee of the *GEFENOL (Grupo Especializado en Física Estadística y Nolineal) Doctorate School*.
• Chairman of the organising committee of *European Conference on Complex Systems*, Barcelona, September 2013.
• Chairman of the scientific committee of the network *complexitat.cat*.

Participation

Communications in conferences

- A. Deluca, R. Ferrer-i-Cancho, and A. Corral, *A practical recipe to fit power-law distributions*, II Jornada complexitat.cat, University of Barcelona, May 2012.
- J. Serrà, A. Corral, et al., *Quantifying the Evolution of Popular Music*, Nolineal 2012, University of Zaragoza, June 2012.
- A. Deluca, R. Ferrer-i-Cancho, and A. Corral, *A practical recipe to fit power-law distributions*, Nolineal 2012, University of Zaragoza, June 2012.

Seminars

- A. Corral, *Branching processes, criticality and self-organization in natural hazards*, Centre de Recerca Matemàtica, Barcelona, June 2012.

□ Other activities

- Reviewer of book proposals for Wiley VCH.
- Reviewer of the journals Physical Review Letters, Physical Review E, and Nonlinear Processes in Geophysics.

Tim Myers

My activities during 2012 have been primarily split between research, teaching and supervision and organisation. This year, my research and that of the group has focussed on nano applications: with Francesc Font I have investigated the melting of nanoparticles as well as the solidification of a supercooled melt; with Michelle MacDevette I have investigated the flow of nanofluids. As part of this work we have developed a model for the anomalous increase in the thermal conductivity of nanofluids. This topic has been aided by a research assistant, Helena Ribera, from the University of Barcelona, and an exchange student, Jarrod Williams, from Oxford University. With the new post-doc Teresa Cao I have started work on defrosting of food. This is a follow on to a problem presented at an Industrial Mathematics workshop held in Santiago de Compostela in January 2012. This research topic was aided by Prof. Sean Bohun from Ontario who visited CRM during the second half of the year.

In July I organised a meeting, Nanomath, which was held at the CRM. The meeting brought together mathematicians, engineers, physicists and chemists with the role of identifying where maths could be of use in the field of nanotechnology. The meeting was spearheaded by Prof. James Hill, Head of the Nanomechanics group at the University of Adelaide, who gave 7 hours of lectures on a wide variety of relevant topics.

During the second half of the year I taught, as part of a team, a course on mathematical modelling at the Universitat Politècnica de Catalunya. This was a new form of course within the FME at UPC, where undergraduate students worked in teams on practical applied topics, very much in the industrial mathematics workshop style. Prof. Bohun also presented a problem for this course. I undertook a new initiative this year, a series of lectures, entitled "An Introduction to ...", where a guest lecturer gave a brief introduction to an applied mathematics topic. It is hoped that each lecturer will write up the talk and the talks will then be collected together to produce a book. The first three lectures in the series were given to the students on the modelling course. These lectures were An Introduction to Industrial Mathematics; Perturbation methods applied to industrial mathematics; Stochastic methods in mathematical biology. Lectures so far scheduled

for the coming year are Alex Roxin (CRM) on Neuroscience and Prof. Lou Kondic (NJIT) on thin films.

In the meantime I became a full council member of the European Consortium for Mathematics in Industry (replacing the previous Spanish representative José A. Carrillo) and joined the editorial board of the journal Applied Mathematical Modelling.

□ Publications

Articles

- M. M. MacDevette, T. G. Myers, *Contact melting of a three-dimensional phase change material on a flat substrate*, International Journal of Heat and Mass Transfer **55**, 6798-6807 (2012).
- T. G. Myers, S. L. Mitchell, F. Font, *Energy conservation in the one-phase supercooled Stefan problem*, International Communications in Heat and Mass Transfer **39**, 1522-1525 (2012).
- T. G. Myers, S. L. Mitchell, *A mathematical analysis of the motion of an in-flight soccer ball*, Sports Engineering **October**, 13 pages (2012).
- E. Momoniat, T. G. Myers, M. Banda, J. P. F. Charpin , *Differential Equations with Applications to Industry*, International Journal of Differential Equations **doi:10.1155/2012/491874**, 2 pages (2012).
- T. G. Myers, S. L. Mitchell, *Application of Heat Balance Integral Methods to One-Dimensional Phase Change Problems*, International Journal of Differential Equations **doi:10.1155/2012/187902**, 22 pages (2012).

Preprints

- T. G. Myers, V. Ribas Ripoll, A. Sáez de Tejada, S. L. Mitchell, M.J. McGuinness, *Modelling the cardiovascular system for automatic interpretation of the blood pressure curve*, submitted to *J. Biomech*.
- J. Low, T. G. Myers, *Modelling the solidification of a power-law fluid flowing through a narrow pipe*, submitted to *Int. J. Thermal Sci*.
- F. Font, S. L. Mitchell, T. G. Myers, *One-dimensional solidification of supercooled melts*, submitted to *Int. J. Heat Mass Trans*.
- F. Font, S. L. Mitchell, T. G. Myers, *One-dimensional solidification of supercooled melts*, submitted.
- T. G. Myers, S. L. Mitchell, *Mathematical modelling of phase change with a flowing thin film*, CRM Preprint 1099.
- T. G. Myers, S. L. Mitchell, F. Font, *Energy conservation in the one-phase supercooled Stefan problem*, CRM Preprint 1120.
- F. Font, S. L. Mitchell, T. G. Myers, *One-dimensional solidification of supercooled melts*, CRM Preprint 1126.
- T. G. Myers, A. Sáez de Tejada, V. Ribas, S.Mitchell, M. J. McGuinness, *Modelling the cardiovascular system for automatic interpretation of the blood pressure curve*, CRM Preprint 1129.

Books or chapters

- A. Alabert, T. G. Myers, J. Saludes (editors), Grups d'Estudi de Matemàtica i Tecnologia Barcelona, July 2010, in *CRM Documents Vol. 12* (2012).
- T. G. Myers, S. L. Mitchell, *Mathematical modelling of phase change with a flowing thin film*, in Progress in Industrial Mathematics at ECMI 2010 (2012).

Scientific reports

- A. Bermúdez, J. C. González, T. G. Myers and F. Pena, *Microwave thawing*, *IV Jornada de consulta matematica para empresas e instituciones*, Santiago de Compostela.

Conference proceedings

- M. M. MacDevette, T. G. Myers, B. Wetton and F. Font, *Are nanofluids the next-generation coolant?*, *The 17th European Conference on Mathematics for Industry 2012* Springer (2012).
- F. Font, T. G. Myers and M. M. MacDevette, *A mathematical model for the melting of spherical nanoparticles.*, *The 17th European Conference on Mathematics for Industry 2012* Springer (2012).
- T. G. Myers, M. Bruna, J. Solà-Morales, *Analysis of the Baroreflex Model for Automatic Interpretation of the Plethysmograph*, *Grups d'Estudi de Matemàtica i Tecnologia Barcelona, July 2010* A Alabert; T. G. Myers; J. Saludes (2012).
- T. G. Myers, M. McGuinness, S. L. Mitchell, *Modelling the Cardiovascular System for Automatic Interpretation of the Blood Pressure Curve*, *Grups d'Estudi de Matemàtica i Tecnologia Barcelona, July 2010* A Alabert; Tim G. Myers; J. Saludes (2012).
- F. Font, T. G. Myers and M. MacDevette, *A mathematical model for the melting of spherical nanoparticles*, *Proceedings of the 17th European Conference on Mathematics for Industry* (2012).
- M. MacDevette, T. G. Myers and F. Font, *Are nanofluids the next-generation coolant?*, *Proceedings of the 17th European Conference on Mathematics for Industry* (2012).

□ Research projects

- *Industrial applications of moving boundary problems,*
PIRG06-GA-2009-256417. From 2010 to 2014. Principal investigator: Tim G. Myers.
- *Problemas de frontera móvil en presencia de capas líquidas,*
MTM2010-17162. From 2011 to 2014. Principal investigator: Tim G. Myers.
- *Grup de Recerca Consolidat en Equacions en Derivades Parcials i Aplicacions de la UAB-UPC-UdG,* within the IV Pla de Recerca de Catalunya (2009-2013), 2009SGR345. From 2009 to 2013. Principal investigator: José Antonio Carrillo de la Plata, UAB.

□ Activity in research training

Supervision of research students

Undergraduate project supervision

- Jarrod Williams, I3MR intern from Oxford University: *Boundary layer flow of nanofluids*, Dec. 2012 (CRM internship).
- Helena Ribera Ponsa, Research Assistant, graduate of U. Barcelona: *Modelling the effective conductivity of a nanofluid*, started Oct. 2012 (CRM internship).

Master's project supervision

- Anna Sáez de Tejada Cuenca, Master's thesis: *Mathematical modelling of the blood pressure signal*, Sept. 2012.
- Vicente J. Ribas Ripoll, Master's thesis: *Study of the Prognosis in the Intensive Care Unit*, June 2012.

PhD supervision

- Michelle M. MacDevette, PhD project: *Mathematical modelling of the convective transport and thermal properties of nanofluids*, started Feb. 2011.
- Francesc Font Martinez, PhD project: *Beyond the classical Stefan problem*, started Sept. 2010.

Postdoc supervision

- Maria Teresa Cao, Post-doc project: *Microwave defrosting of food*, started Sept. 2012.

□ Teaching activity

- Models Matemàtics de la Tecnologia, Undergraduate mathematics degree, Universitat Politècnica de Catalunya, September-December 2012.

□ Scientific activities

Organisation

- Member of the scientific committee of the *European Consortium for Mathematics in Industry conference*, Lund, July 2012.
- Main organiser Nanomath 2012, CRM July 2012.
- Organiser of "An introduction to"seminar series, where experts in a field give an introductory lecture to a general audience, 2012.

Participation

Invited lectures in conferences

- T. G. Myers. *Does the football really matter.* Invited talk at 9th Mathematics in Industry Study Group. African Institute for Mathematical Sciences, Cape Town, Jan. 2012.
- T. G. Myers. *Mathematics and Nanotechnology.* Invited talk at Maths and Chemistry, http://iuma.unizar.es/maths_chemistry/. Universidad de Zaragoza, July 2012.
- T. G. Myers. Invited expert at 9th Mathematics in Industry Study Group. African Institute for Mathematical Sciences, Cape Town, Jan. 2012.

Communications in conferences

- T. G. Myers, *Enhanced water flow in carbon nanotubes and the Navier slip condition*, The 17th European Conference on Mathematics for Industry 2012, Lund, July 2012.

Seminars

- T. G. Myers. *Footballs, phase change and nanotubes: practical applications of mathematics.* Seminar at the Department of Mechanical Engineering, University of Leeds, Feb. 2012.
- T. G. Myers. *Footballs, phase change and nanotubes: practical applications of mathematics.* Seminar at the Basque Centre for Applied Mathematics, April 2012.

• T. G. Myers. *Footballs, phase change and nanotubes: practical applications of mathematics.* Seminar at the Laboratori de Càlcul Numèric, Universitat Politècnica de Catalunya May 2012.
• T. G. Myers. *Footballs, phase change and nanotubes: practical applications of mathematics.* Seminar at the Laboratori de Càlcul Numèric, Universitat Politècnica de Catalunya May 2012.
• T. G. Myers. *Footballs, phase change and nanotubes: practical applications of mathematics.* Seminar at the Departamento de Matemática Aplicada, Universidad Complutense de Madrid, June 2012.
• T. G. Myers. *Footballs, phase change and nanotubes: practical applications of mathematics.* Seminar at Facultat de Matemàtiques, Universitat de Barcelona, Oct. 2012.
• T. G. Myers. *An introduction to perturbation methods applied to industrial mathematics.* Seminar at Departament de Matemàtica Aplicada, Universitat Politècnica de Catalunya, Nov. 2012.

□ Other activities

• Member of Editorial board, Applied Mathematical Modelling.
• Member of Editorial Board, Mathematics in Industry Case Studies.
• Council member, European Consortium for Mathematics in Industry.
• External examiner, University of Limerick applied mathematics undergraduate courses, 2011-2013.
• Referee for Applied Mathematics and Computing; Applied Mathematical Modelling; Journal of Fluid Mechanics; Maths in Industry Case Studies.

Andrei Korobeinikov

I joined the CRM in July of 2012 as a Ramón y Cajal Fellow and Mathematical Epidemiology group leader. During 2012, I continued my research in Mathematical Medicine and Biology, working in directions of the following research lines: (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 variety 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. In 2012, I formulated a model of pathogen evolution within a host which, I believe, can serve as a basis for further studying of viral and bacterial evolution. (iii) The third direction of my research in 2012 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).

I also work on a number of industrial problems, which, apart from the mentioned problem of the optimal control for waste water biotreatment, include optimization of energy use in industrial processes.

In 2012 I establish a collaboration with the Samara State University and the Samara Airspace University (Prof. V. Sobolev has been visiting the CRM for 6 weeks working with the group of mathematical Epidemiology on a problem of apparent disappearance). I believe that these newly established collaborations will be as fruitful as my existing collaborations are.

□ Publications

Articles

- E. V. Grigorieva, N. V. Bondarenko, E. N. Khailov and A. Korobeinikov, *Three-dimensional nonlinear optimal control model of wastewater biotreatment*, Neural, Parallel, and Scientific Computations **20**, 23–36 (2012).
- G. Huang, Y. Takeuchi and A. Korobeinikov, *HIV evolution and progression of the infection to AIDS*, Journal of Theoretical Biology **307**, 149–159 (2012).
- S. M. O'Regan, T. C. Kelly, A. Korobeinikov, M. J. A. O'Callaghan and A. V. Pokrovskii, *Chaos in a seasonally perturbed* SIR *model: avian influenza in a seabird colony as a paradigm*, Journal of Mathematical Biology (published online) , 1–35 (2012).
- A. Pimenov, T. C. Kelly, A. Korobeinikov, M. J. A. O'Callaghan, A. V. Pokrovskii and D. Rachinskii, *Memory effects in population dynamics: spread of infectious disease as a case study*, Mathematical Modelling of Natural Phenomena **7**, 204–226 (2012).

Preprints

- T. Zhelev, K. Semkov, E. Mooney, T. Majozi and A. Korobeinikov, *Industrial heat utilisation through water management*, to appear in *Heat Transfer Engineering* (2012).
- A. V. Melnik and A. Korobeinikov, *Lyapunov functions and global stability for SIR and SEIR models with age-dependent susceptibility*, to appear in *Mathematical Biosciences and Engineering* (2012).
- E. V. Grigorieva, N. V. Bondarenko, E.N. Khailov, A. Korobeinikov, *Analysis of optimal control problems for the process of wastewater biological treatment*, to appear in *Revista de Matemática: Teoría y Aplicaciones* (2012).
- C. Vargas-De-León and A. Korobeinikov, *Global stability of a population dynamics model with inhibition and negative feedback*, to appear in *Mathematical Medicine and Biology: A Journal of the IMA* (2012).
- C. Dempsey and A. Korobeinikov, *A continuous strain-space model of viral evolution within a host*, CRM Preprint.

Books or chapters

- E. Grigorieva, N. Bondarenko, E. Khailov and A. Korobeinikov, *Finite-Dimensional Methods for Optimal Control of Autothermal Thermophilic Aerobic Digestion*, in Industrial Waste (2012).

□ 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, 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.
- Member of SIAM.

Luis Ortiz

My field of research is Computational Finance. This subject lies in the intersection of numerics and stochastics. I am mainly interested in the efficient application of numerical techniques to risk measurement and pricing problems by means of the wavelets theory. State of the art techniques rely on PDE methods and Fourier expansions. However, the density functions that we encounter have discontinuities, are highly peaked or fat-tailed. When these situation arise, some families of wavelets can deal properly with the problem.

After my Ph.D. defence last year, one of my aims was to get funding to do a research stay with a world leading group in my topic of research. My wish was to work with Professor C.W. Oosterlee at CWI. His methods for rapidly price financial contracts are currently state of the art, even in the financial industry. Another objective was starting to cooperate with financial companies in technology transfer issues. In the meantime, I got an accepted paper, submitted another one and disseminated my Ph.D. research work in seminars and international conferences.

Finally, I got a one-year ERCIM/Marie Curie grant to do a research stay at CWI in The Netherlands under the supervision of Professor C.W. Oosterlee, who is the team leader of the group Scientific Computing. I started my research stay on October 1st, 2012.

□ Publications

Preprints

- L. Ortiz-Gracia, J. J. Masdemont, *Credit Risk Contributions under the Vasicek One-Factor Model: a Fast Wavelet Expansion Approximation*, to appear in *Journal of Computational Finance* (2012).

- L. Ortiz-Gracia, J. J. Masdemont, *Peaks and Jumps Reconstruction with B-Splines Scaling Functions*, submitted to *Applied Numerical Mathematics*.

□ Teaching activity

• Assistant Professor (*Professor Associat*) (3 hours/week). Eines Informàtiques per les Matemàtiques, Universitat Autònoma de Barcelona, 02/2012-09/2012.

□ Scientific activities

Participation

Invited lectures in conferences

• L. Ortiz-Gracia. *Name concentration and the wavelet approximation method.* Invited talk at the European Congress on Computational Methods in Applied Sciences and Engineering. TU Wien, September 2012.

Seminars

• L. Ortiz-Gracia. *Credit Portfolio Losses and the Wavelet Approximation Method.* Seminar at Centre de Recerca Matemàtica, April 2012.

Research stays

• October–December, 2012: Researcher at CWI - Centrum voor Wiskunde en Informatica of The Netherlands, Amsterdam (3 months).

Courses attended

• Financial Engineering Summer School. Madrid, June 19–June 22, 2012.

□ Other activities

• 1-year Post-Doctoral ERCIM/Marie Curie grant to develop a research project at CWI-Centrum voor Wiskunde en Informatica, Amsterdam, under the supervision of Professor Cornelis W. Oosterlee.

Alex Roxin

I joined the CRM in May of 2012 as a Ramón y Cajal Fellow and Computational Neuroscience group leader. I have been working on models of neuronal networks. Specifically, I am interested in studying how the patterns of synaptic connectivity affect dynamical properties of the network, including spontaneous activity states. At the present moment I have developed, in collaboration with Duane Nykamp from the department of mathematics at the University of Minnesota, a meanfield description of network activity which takes into account the degree distributions at the nodes, i.e. the number of in-coming and out-going connections. In addition, I have begun to explore how Hebbian learning processes shape these degree distributions during spontaneous activity.

Finally, experimental data on the patterns of synaptic connectivity in cortical circuits has focused on so-called motifs, essentially connectivity patterns between small number of cells, e.g. reciprocal connections between pairs of cells. I am investigating to what extent these motifs can be related to degree distributions, how they might come about due to on-going plasticity, and ultimately how they can be related to network dynamics.

□ Activity in research training

Supervision of research students

- M. Vegué, PhD student (CRM).

Lectures and short courses

- *Cortical microcircuits: connectivity and dynamics*. Two-hours lecture delivered at the Master of Science in Applied Mathematics and Mathematical Engineering, Universitat Politècnica de Catalunya, Barcelona. November 2011.

□ Scientific activities

Participation

Invited lectures in conferences

- A. Roxin. *The role of higher order connectivity statistics in shaping neuronal network dynamics*. Invited talk at the Ddays conference. Red temática DANCE, Benicàssim, October 2012.
- A. Roxin. *Models of cortical microcircuits: connectivity and some dynamics*. Invited talk at the Hertie Winter School. FENS-IBRO-Hertie winter school, Obergurgl, December 2012.

Sergey Tikhonov

During 2012, I have been involved in several scientific activities. First, in 2011-2012, our group organized the research program in CRM on Harmonic analysis and Approximation theory. I have been a main coordinator of this program and responsible for the weekly seminar on Approximation theory at CRM. Second, I have served as a supervisor for three PhD students: Petr Chunaev, Ainur Jumambaeva and Daulet Nurakhmetov. Petr Chunaev studied Hardy's inequalities for sequences of monotonic type. Ainur Jumabaeva continues working on her PhD and investigates the Liouville derivatives. Daulet Nurakhmetov successfully defended his PhD in November (I am a co-director of his thesis with Professor B. Kanguzhin). Third, I have been an editor of three books to be published in the series Advanced Courses in Mathematics CRM Barcelona, Birkhauser. I have also joined the Editorial Board of the journal Abstract and Applied Analysis. Fourth, I have given several talks in different conferences in Belgium, France, Finland, Israel, Spain, including two Colloquium talks in Giessen and Stuttgart. In October, November, December, I have been invited to Erwin Schrödinger Institute (Austria) and Mathematisches Forschungsinstitut Oberwolfach (Germany) to conduct research and participate in the research programs.

My research activities include the following topics. I continue investigating, with Andrey Bondarenko, weighted Bernstein's inequalities. Jointly with Feng Dai I have finished the project on the fractional Bernstein inequality. Together with Polina Glazyrina, I studied Landau's inequalities for algebraic polynomials. Jointly with Amiran Gogatishvili, Mirek Opic, Walter Trebels I proved sharp Ulyanov's inequalities for moduli of smoothness in the Lorentz spaces. Together with Alexander Kolesnikov, I investigated regularity problems of the Monge-Ampère equation in Besov's spaces. Moreover, together with Maria Zeltser, I continue the investigation of properties of weak monotonicity functions.

□ Publications

Articles

• D. Gorbachev, S.Tikhonov, *Moduli of smoothness and growth properties of Fourier transforms: two-sided estimates*, Journal of Approx. Theory **Vol. 164, Is. 9**, 1283–1312 (2012).

• E. Liflyand, S. Tikhonov, *Two-sided weighted Fourier inequalities*, Annali della Scuola Normale Superiore. Classe di Scienze **(5) Vol. XI**, 341–362 (2012).

• H. Mhaskar, S. Tikhonov, *Wiener type theorems for Jacobi series with nonnegative coefficients*, Proc. Amer. Math. Soc **140**, 977–986 (2012).

• M. I. Dyachenko, S. Tikhonov, *Trigonometric series with lacunary-monotone coefficients*, Eurasian Math. J. **3:2**, 31–52 (2012).

Preprints

• M. Dyachenko, E. Nursultanov, S. Tikhonov, *Global and local smoothness of the Hilbert transforms*, to appear in *Proc. Steklov Inst. Math.*.

• E. Nursultanov, S. Tikhonov, *A sharp Remez inequality for trigonometric polynomials*, to appear in *Constructive Approximation*.

• M. Potapov, B. Simonov, S. Tikhonov, *Mixed moduli of smoothness in* L_p, $1 < p < \infty$*: A survey*, to appear in *Surveys in Approximation Theory*.

• A. Kolesnikov, S. Tikhonov, *Regularity of the Monge-Ampère equation in Besov's spaces*, submitted to *Calculus of Variations and Partial Differential Equations*; arXiv: 1203.3457.

Books or chapters

• S. Tikhonov, M. Zeltser, *Weak monotonicity concept and its applications*, in *Fourier Analysis and Pseudo-Differential Operators. Trends in Mathematics (to appear)* (2013/2014).

□ Research projects

• *Análisis Armónico, Teoría de Aproximación y Problemas Extremales,* Ministerio de Ciencia e Innovación Grant, MTM2011-27637. From 2011 to 2012. Principal investigator: S. Tikhonov.

• *Grup de Teoria de Funcions de la UB/UAB,* Generalitat de Catalunya, Support to research groups of quality, type B, 2009SGR-1303. From 2009 to 2012. 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).
- Daulet Nurakhmetov (doctorate student at the Al-Farabi Kazakh National University; co-directed with B. Kanguzhin, the date of defence: 09/11/2012).

Postdoc supervision

- Ramazan Akgün (CRM Post-Doc, supported by Tubitak).
- Andrii Bondarenko (Beatriu de Pinós post-doc, supported by the Catalan Goverment).
- Polina Glazyrina (CRM Post-Doc, supported by the CRM).

□ Scientific activities

Organisation

- Main organiser of the Research programme "Approximation Theory and Fourier Analysis" in the Centre de Recerca Matemàtica, September 2011-February 2012.
- Coordinator of Approximation Theory Seminar in the Centre de Recerca Matemàtica.

Participation

Invited lectures in conferences

- S. Tikhonov. *Sharp Remez inequalities.* Invited talk at the New Trends in Approximation Theory, Ein-Gedi, January 2012.
- S. Tikhonov. *Moduli of smoothness and Fourier transforms.* Invited talk at the Fourier Analysis and Pseudo-Differential Operators, Aalto University, Helsinki, June 2012.
- S. Tikhonov. *Two-sided weighted Fourier inequalities.* Invited talk at the Analyse Harmonique et Probabilités. Université d'Angers, September 2012.

Colloquium talks

- S. Tikhonov. *Weighted Fourier inequalities and applications* Mathematisches Institut, Justus-Liebig-Universität Giessen, April 2012.
- S. Tikhonov. *Measure of smoothness and Fourier transfroms* Universität Stuttgart, November 2012.

Seminars

- S. Tikhonov. *Weighted norm inequalities* Gumilyov Eurasian National University, Astana, April 2012.
- S. Tikhonov. *Local norm inequalities* Barcelona Analysis Seminar, UAB, UB, CRM, May 2012.

Research stays

- April, 2012: Visiting Professor, Gumilyov Eurasian National University, Astana (2 weeks).
- October, 2012: Invited Researcher at the Erwin Schrödinger Institute for Mathematical Physics, Wien (9 days).
- November–December, 2012: Invited Researcher in the framework of Oberwolfach Leibniz Program, Mathematisches Forschungsinstitut Oberwolfach, (2 weeks).

□ 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.
- Member of Editorial board, Abstract and Applied Analysis.
- Member of Editorial board, Bulletin of Mathematical Analysis and Applications.
- Member of International Society for Analysis, its Applications, and Computation.

2.2.2. Professors Visitants

2.2.2. Visiting Professors

Laurent Meersseman

I am temporally on leave from Université de Bourgogne to run the Marie Curie project DEFFOL "Complex Manifolds, Foliations and Deformations" at the CRM. My research activity shapes up around three themes: complex geometry, toric topology, and theory of deformations. The objects I consider are compact complex manifolds and their generalizations, such as holomorphic foliations, foliations by complex leaves and CR-structures. My main actual goal is to construct local moduli spaces for some of these geometric structures, keeping in mind the Kuranishi's space of a compact complex manifold as a prototype. Theories involved to attain this objective are classical deformation theory of Kodaira-Spencer and Kuranishi, Donaldson's construction of moduli spaces in differential geometry as well as basics of foliation theory and several complex variables.

Publications

Articles

- L. Meersseman, *Feuilletages par variétés complexes et uniformisation*, Panoramas & Synthèses **34–35**, (2012).

Preprints

- L. Meersseman, *Kuranishi type moduli spaces for CR submersions fibering over the circle*, not yet submitted.
- L. Meersseman, *Variétés CR polarisées et G-polarisées*, not yet submitted.

Research projects

- *Complex Manifolds, Foliations and Deformations,* ERC, Marie Curie IEF. From 09/01/11 to 08/31/13. Principal investigator: Laurent Meersseman.

Scientific activities

Participation

Invited lectures in conferences

- L. Meersseman *Polarized CR structures*. Invited talk at the conference "Holomorphic Foliations and Complex Dynamics", Independent University of Moscow, June 11–15, 2012.

Seminars

- L. Meersseman *Polarized CR manifolds*. Seminar at the Pacific Institute for Mathematical Sciences, University of British Columbia, Vancouver, July 6, 2012.
- L. Meersseman *Polarized CR manifolds*. Seminar at the Instituto de Matemáticas, Unidad Cuernavaca, Universidad Autónoma de México, Cuernavaca, August 22, 2012.
- L. Meersseman *Variedades CR polarizadas y G-polarizadas*. Seminar at the Centre de Recerca Matemàtica, Barcelona, December 5, 2012.

Research stays

- July, 2012: Research stay at the Pacific Institute for Mathematical Sciences, Vancouver (1 week).
- August 2012: Research stay at the Instituto de Matemáticas, Unidad Cuernavaca, Universidad Autónoma de México, Cuernavaca (1.5 weeks).

Other activities

- Participation in a PhD committee, Marseille, December 10th, 2012.
- Participation in a PhD committee, Vannes, December 13th, 2012.

Andrii Bondarenko

My research mainly focuses on the investigation of optimal configurations on the sphere applying methods of Approximation Theory, Harmonic Analysis and Discrete Mathematics. This includes spherical designs, optimal codes, best packing, energy minimization and other topics related to them. I work on both asymptotic and exact problems. Recently, we have proved the well-known conjecture of Korevaar and Meyers on existence of spherical designs with small cardinalities. I am also interested in different questions in Approximation Theory, Harmonic Analysis, and Graph Theory. In May 2012, my Beatriu de Pinós grant at CRM finished and I moved to the National Taras Shevchenko University, in Kyiv.

□ Publications

Articles

- A. Bondarenko, D. Leviatan, A. Prymak, *Pointwise estimates for 3-monotone approximation*, Journal of Approximation Theory **164**, 1205–1232 (2012).
- A. Bondarenko, D. Gorbachev, *Minimal Weighted 4-Designs on the Sphere S^2*, Mathematical Notes **91**, 787–790 (2012).

Preprints

- A. Bondarenko, D. Radchenko, and M. Viazovska, *On optimal asymptotic bounds for spherical designs*, to appear in Annals of Math (2013).
- A. Bondarenko, D. Radchenko, *On a family of strongly regular graphs with $\lambda = 1$*, submitted to *Journal of Combinatorial Theory, Series B* (2012).
- A. Bondarenko, A. Prymak, D. Radchenko, *On concentrators and related approximation constants*, to appear in Journal of Mathematical Analysis and Applications (2013).

□ Research projects

- *Optimal configurations on spheres,* Mathematisches Forschungsinstitut Oberwolfach. From 2012 to 2013. Principal investigator: A. Bondarenko.
- Ministerio de Ciencia e Innovación grant MTM2011-2763 (for more detailed information see the report of S. Tikhonov).

□ Scientific activities

Participation

Invited lectures in conferences

- A. Bondarenko. *Spherical designs. Proof of the Korevaar-Meyers conjecture and beyond.* Invited talk at International conference dedicated to 120th anniversary of Stefan Banach. Ivan Franko National University of Lviv, September 17–21, 2012.

Research stays *Department of Mathematical Analysis, National Taras Shevchenko University*, Kyiv. Jan. 1–9, March 29–April 17, Jul. 13–31 2012.
Mathematisches Forschungsinstitut, Oberwolfach. Nov, 19–30 2012.

Abed Bounemoura

From September 2012 to December 2012, I have been pursing my research on the stability and instability properties of Hamiltonian systems close to integrable at the CRM. In a joint work with Stéphane Fischler, we introduced new tools from Diophantine approximation and we used them to develop a new approach to the perturbation theory of quasi-periodic solutions, dealing only with periodic approximations and avoiding small divisors problem. Then I used this method to give a new construction of resonant normal forms for Hamiltonian systems close to integrable which are only Gevrey regular or finitely differentiable, generalizing previous results which were valid for analytic Hamiltonians. I also gave applications to the problems of stability of the action variables and splitting of invariant manifolds for hyperbolic tori.

□ Publications

Preprints

- A. Bounemoura, S. Fischler, *A Diophantine duality applied to the KAM and Nekhoroshev theorems*, to appear in *Mathematische Zeitschrift*.
- A. Bounemoura, *Normal forms, stability and splitting of invariant manifolds I. Gevrey Hamiltonians*, CRM preprint series 1132, submitted to *Regular and Chaotic Dynamics*.
- A. Bounemoura, *Normal forms, stability and splitting of invariant manifolds II. Finitely differentiable Hamiltonians*, CRM preprint series 1133, submitted to *Regular and Chaotic Dynamics*.

□ Other activities

- Referee for the journal Communication in Mathematical Physics.
- Referee for the Natural Sciences and Engineering Research Council of Canada.

Maria Teresa Cao

I joined the CRM group in Industrial Mathematics in September 2012, with a postdoctoral fellowship funded by the CRM. I have been working on two main themes: the numerical simulation of defrosting of food with microwaves and thin film flows. The defrosting problem is a follow on to a problem presented at the *IV Jornadas de Consulta Matemática para Empresas e Instituciones* held in Santiago de Compostela in January 2012, that aims to optimize the intensity and frequency of microwaves in order to defrost food without cooking it. The numerical simulation has been performed considering a one-dimensional problem, and a finite

differences code implemented in MATLAB. The thin flow problem I am studying is aimed to analyze de behaviour of the flow considering a depletion layer and matching this model with slip-length boundary conditions.

Since my incorporation to the center I have also been collaborating in the organization of the seminar series "The CRM Applied Mathematical and Physics (CAMP) Seminars".

Pilar Guerrero

I am a CRM postdoctoral fellow in the Computational and Mathematical Biology Group, under the supervision of Tomás Alarcón.

During 2012 we have been working on the formulation, analysis and stochastic simulation of models focused on multi-scale tumor growth. More specifically we have made a study of population dynamics involving issues such as competition between normal and malignant cells in cancer for space and resources, the interaction between immune cells and infected cells in viral infections, and the development of drug resistance. The aim of this work is to illustrate how the concepts and techniques of mathematical population dynamics can be used to treat and further on a number of important issues in biomedical contexts.

During this year I have collaborated in organizing the seminar "The CRM Applied Mathematical and Physics (CAMP) Seminars" held in the CRM. I have participated with different posters in several congress: the conference named "Applied Partial Differential Equations in Physics, Biology and Social Sciences: Classical and Modern Perspectives", at the Centre Recerca Matemàtica; the "II Jornada complexitat.CAT", in Barcelona and also in "Present Challenges of Mathematics in Oncology and Biology of Cancer: Modelling and Mathematical Analysis", in CIRM, Luminy. I presented a talk at the conference on "Mathways into Cancerïn Almagro (Ciudad Real) and also in the "Trobada d'equacions en derivades parcials i aplicacionsïn Girona. I also stayed from September 15th to December 12th in the OCCAM (Mathematical Institute) like a Visiting Postdoctoral Resarch Assistantship in Oxford, collaborating with Helen Byrne and Philip Maini.

This year, the CRM has allowed me to develop into the biological concepts and learned to handle with ease specific techniques in the field of stochastic modeling and simulation. With this new knowledge I have gained and the good relationship with both my peers and my supervisor, I can face new professional challenges with confidence and investigations which I hope to contribute now.

□ Publications

Articles

- P. Guerrero, J. Montejo-Gámez, J. L. López, J. Nieto, *Wellposedness of a nonlinear, logarithmic Schrödinger equation of Doebner-Goldin type modeling quantum dissipation*, Journal of Nonlinear Science **22**, 631-663 (2012).
- J. Campos, P. Guerrero, O. Sánchez, J. Soler, *On the analysis of travelling waves to a nonlinear flux limited reaction-diffusion equation*, Ann. Inst. H. Poincaré Anal. Non Linéaire **30**, 141–155 (2013).

Research projects

- *Modelización y análisis matemático de fenómenos no lineales en teoria cinética de EDP's con origen en Biomedicina (dinámica tumoral y vías de señalización) y Astrofisica,* P08-FQM-04267. From 2009 to 2012. Principal investigator: Juan Segundo Soler-Vizcaíno.
- *Mathematical modelling of biological populations with complex structure,* MTM2011-29342. From 01-01-2012 to 31-12-2014. Principal investigator: Tomás Alarcón.

Scientific activities

Organisation

- Co-organiser of The CRM Applied Mathematical and Physics (CAMP) seminars.

Participation

Communications in conferences

- P. Guerrero, *Nonlinear flux limited equation with applications in biology: traveling waves analysis*, Applied Partial Differential Equations in Physics, Biology and Social Sciences: Classical and Modern Perspectives, Centre de Recerca Matemàtica, Barcelona, September 2–7, 2012.
- P. Guerrero, *Stochastic multi-scale models of cell population*, Mathways into Cancer, Almagro (Ciudad Real), June 4–6, 2012.
- P. Guerrero, *Stochastic multi-scale models of cell population with age-structure*, Trobada d'equacions en derivades parcials i aplicacions, Girona, May, 2012.
- P. Guerrero, *Stochastic multi-scale models of cell population*, II Jornada complexitat.CAT, Barcelona, May, 2012.
- P. Guerrero, *Stochastic multi-scale models of cell population*, Present Challenges of Mathematics in Oncology and Biology of Cancer: Modelling and Mathematical Analysis, CIRM, Luminy, Marseille, March 19–23, 2012.

Seminars

- P. Guerrero. *Stochastic multi-scale models of cell population with age-structured* CAMP seminar at Centre de Recerca Matemàtica, Barcelona, June 2012.

Research stays

- September 15th–December 12th, 2012: Visiting Postdoctoral Research Assistantship at OCCAM (Mathematical Institute) of Oxford University (3 months).

Nir Lev

After obtaining a position at Bar-Ilan University, in April 2012 he left his Marie Curie fellowship starting March 2012 at CRM. His research develops in the area of harmonic analysis, and concerns some problems on several subjects in this area: translation-invariant subspaces in function spaces, the uniqueness theory of trigonometric series expansions, sampling and interpolation of band-limited functions and Riesz bases of exponentials, and the theory of discrepancy and irregularities of distribution.

□ Publications

Articles

- N. Lev, *Riesz bases of exponentials on multiband spectra*, Proceedings of the American Mathematical Society **140**, 3127–3132 (2012).

Preprints

- N. Lev, J. Ortega-Cerdà, *Equidistribution estimates for Fekete points on complex manifolds*, preprint http://arxiv.org/abs/1210.8059.
- N. Lev, S. Grepstad, *Multi-tiling and Riesz bases*, preprint http://arxiv.org/abs/1210.8059.

Jonathan Low

I have been enjoying a CRM fellowship in the group of Industrial Mathematics until July 2012, working in two areas of fluid mechanics: fluid flows in microchannels and fluid-boundary interaction in nanofluidics. On microfluidics, the first part is deriving a mathematical model to simulate the flow and freezing process of a power-law fluid through a microchannel. The second part is solving the full model on fluid freezing in microchannels using computational fluid dynamics.

On nanofluidics, my research has focused on carrying out into the possible physical mechanisms that can explain the non-conventional property that, at the nano-scale, the fluid flow through a channel is many times faster than its counterpart at the macro-scale.

Vivek Mallick

Mirror symmetry is a very intriguing subject. Though it has its roots in physics, it has caught attention of mathematicians due to its prediction of Gromov-Witten invariants. Since then the subject evolved extensively and led to a few new fields and also a renewed interest in a few fields in algebraic geometry including complexified Kähler moduli space of Calabi-Yau threefolds, quantum cohomology, Givental's notion of quantum partial differential equations, Kontsevich's notion of a stable map. Kontsevich's conjecture about mirror symmetry relates the derived category of coherent sheaves on an algebraic variety to a triangulated category constructed out of the Fukaya category of the dual pair. In the process of understanding the derived category, we got interested in the question of reconstructing a variety from its derived category. Paul Balmer's Spec construction is an important tool for the reconstruction. We studied the Spec construction more deeply and constructed the Spec of a few tensor triangulated categories coming from algebraic geometry. This work was done jointly with Dr. Umesh Dubey from Indian Institute of Mathematical Sciences. Presently I am trying to prove results about mirror symmetry in a few open cases including an attempt to generalize Batyrev's work on toric varieties to T-varieties of complexity one. This is work in progress with Professor José Ignacio Burgos Gil, ICMAT Madrid, Professor Joan Carles Naranjo and Professor Martín Sombra of Universitat de Barcelona.

□ Publications

Articles

- Umesh V. Dubey, Vivek M. Mallick, *Spectrum of some triangulated categories*, Journal of Algebra **364**, 90–118 (2012).
- Umesh V. Dubey, Vivek M. Mallick, *Reconstruction of a superscheme from its derived category*, Journal of Ramanujan Mathematical Society **27**, 411-424 (2012).

□ Scientific activities

Participation

Courses attended

- Workshop "Periods and Motives", ICMAT Madrid, July 2–6, 2012.
- Short Summer School "The derived category of cubic hypersurfaces", Barcelona, July 18–20, 2012..

Radu Saghin

I left the CRM in July 2012 after completing my Marie Curie fellowship. I did research in the area of Dynamical Systems. I have been working with Jaume Llibre both linking the index of a fixed point of a smooth vector field or map with the jet at that point and in analytic integrability of special ODEs. Together with Edson Vargas we studied the invariant measures of a specific kind of flows on surfaces, namely Cherry flows. During my stay at CRM I also completed a part of a study on the relationship between entropy, volume growth and Lyapunov exponents for C^1 partially hyperbolic diffeomorphisms.

□ Publications

Articles

- J. Llibre, R. Saghin and X. Zhang, *On the analytic integrability of the 5-dimensional Lorenz system for the gravity-wave activity*, to appear in Proceedings of the AMS.
- R. Saghin and E. Vargas, *Invariant measures for Cherry flows*, Communications in Mathematical Physics **317**, 55–67 (2013).

Preprints

- R. Saghin, *Volume growth and entropy for C^1 partially hyperbolic diffeomorphisms*, submitted.

Marc Thurley

I have enjoyed a Marie Curie fellowship at CRM until March 2012. My work focused on the algorithmic and complexity theoretic aspects of constraint satisfaction problems (CSP). These problems form a general framework for formulating algorithmic problems connecting with problems like propositional satisfiability (SAT), graph colorability, planning problems or Ising models, and research areas like database theory, artificial intelligence and statistical physics.

2.2.4. Col.laboradors Científics

Al llarg de l'any 2012, tres investigadors pertanyents a altres institucions s'han incorporat a la comunitat del CRM com a Col.laboradors Científics: Aurora Hernández-Machado i Ivón Rodríguez Villarreal, 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

2.2.4. Scientific Collaborators

During the year 2012, three researchers belonging to external institutions have joined the CRM community as Scientific Collaborators: Aurora Hernández-Machado and Ivón Rodríguez Villarreal, 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

i Matemàtica Industrial; i de Vicent Ribas, de l'empresa Sabirmedical, que col.labora amb el grup de Matemàtica Industrial. Aquesta darrera col.laboració, que cobreix les àrees de models algebraics, *machine learning* i intel.ligència artificial, ha donat lloc ja a una prepublicació conjunta:

Industrial Mathematics groups; and Vicent Ribas, from the company Sabirmedical, who collaborates with the Industrial Mathematics groups. This last collaboration, which covered the areas of Algebraic Models, Machine Learning and Artificial Intelligence, has lead to a first joint preprint:

- T. G. Myers, V. Ribas Ripoll, A. Sáex de Tejada, S. L. Mitchell, M. J. McGuiness, *Modelling the cardiovascular system for automatic interpretation of the blood pressure curve*, preprint.

2.2.5. Visitants de llarga durada

2.2.5. Long-term visitors

Ramazan Akgün

I am Associate Professor at Balıkesir University, currently visiting the CRM group of Harmonic Analysis and Approximation Theory since 17th September 2012 thanks to a Tübitak (The Scientific and technological research council of Turkey) research fellowship. My research area is Harmonic Analysis and Approximation Theory. In 2012 I have been studying:

1. Direct and Inverse inequalities of trigonometric approximation in weighted Orlicz spaces, generated by a quasi convex Young function.

2. Fractional modulus of smoothness and main inequalities of trigonometric approximation in weighted variable exponent Lebesgue spaces.

3. Approximation by trigonometric polynomials in rearrangement invariant quasi Banach function spaces.

4. Generalized derivatives and inequalities of trigonometric approximation of (ψ, β)-differentiable functions in variable order Lebesgue spaces.

□ Publications

Articles

- R. Akgün, *Approximating polynomials for functions of weighted Smirnov-Orlicz spaces*, J. Funct. Spaces Appl. **2012**, 1-41 (2012).
- R. Akgün and Hüseyin Koç, *Approximation by interpolating polynomials in weighted symmetric Smirnov spaces*, Hacettepe journal of mathematics and statistics **41**, 643–649 (2012).
- R. Akgün, *Approximation by polynomials in rearrangement invariant quasi Banach function spaces*, Banach J. Math. Anal. **6**, 113–131 (2012).
- R. Akgün, *Approximation of Functions of Weighted Lebesgue and Smirnov Spaces*, Mathematica (Cluj) **54(77)**, 25–36 (2012).
- R. Akgün and V. Kokilashvili, *The refined estimates of trigonometric approximation for functions with generalized derivatives in weighted variable exponent Lebesgue spaces*, Georgian Math. J. **19**, 611–626 (2012).

• R. Akgün and V. Kokilashvili, *Some Approximation Problems for (α, ψ)-differentiable functions in weighted variable exponent Lebesgue spaces*, J. Math. Sci. **186**, 139–152 (2012).
• R. Akgün and V. Kokilashvili, *Approximation by trigonometric polynomials of functions having (α, ψ)- derivatives in weighted variable exponent Lebesgue spaces*, J. Math. Sci. **184**, 371–382 (2012).

Preprints

• R. Akgün, *Polynomial approximation in Bergman spaces*, submitted.
• R. Akgün, *Jackson and inverse inequalities in rearrangement invariant Banach function spaces on Dini smooth domains*, submitted.
• R. Akgün, *Exact inequalities for trigonometric approximation in weighted Orlicz spaces*, submitted.

Polina Yu. Glazyrina

I am a postdoctoral fellow funded by CRM from September2011 to February 2012, in the CRM research group of Harmonic Analysis and Approximation Theory.

I have been working on the development of transplantation theorem for Jacobi series. This leads to new Ul'yanov type inequality for moduli of smoothness on an interval (joint work with S. Tikhonov) . A second research line has been extremal properties of polynomials, in particular, I have studied sharp estimates of integral functionals for operators on the set of real trigonometric polynomials in terms of the uniform norm of the polynomials and similar questions for algebraic polynomials on the unit circle of the complex plane.

□ Publications

Articles

• V. V. Arestov, P. Yu. Glazyrina, *Sharp integral inequalities for fractional derivatives of trigonometric polynomials*, Journal of Approximation Theory **164**, 1501–1512 (2012).

• V. V. Arestov, P. Yu. Glazyrina, *Integral Inequalities for Algebraic and Trigonometric Polynomials*, Doklady Mathematics **85**, 104–108 (2012).
• A. N. Enyashin, P. Yu. Glazyrina, *On the Crystallization of Polymer Composites with Inorganic Fullerene-like Particles*, Physical Chemistry Chemical Physics **14**, 7104–7111 (2012).

□ Research projects

• *Extremal properties of algebraic and trigonometric polynomials,* Russian Foundation for Basic Research (RFBR), Project's code 12-01-31495. From 2012 to 2013. Principal investigator: P. Glazyrina.

□ Scientific activities

Organisation

- Member of the organising committee of *Summer School on Function Theory (Stechkin's Conference)*, Miass, August 2012.

Participation

Communications in conferences

- P. Yu. Glazyrina, *Ul'yanov type inequalities for Ditzian-Totik modulus of smoothness on an interval*, Theory of approximation of functions and its applications, Kamianets-Podilsky, Ukraina, May-June, 2012.

2.2.6. Estudiants de doctorat

Mostrem a continuació l'activitat més rellevant dels estudiants de tesi dels grups de recerca del CRM.

2.2.6. CRM PhD Students

Next we summarize the most relevant activity of the PhD students of the CRM research groups.

Petr Chunaev
(Harmonic Analysis)

Anna Deluca
(Complex Systems)

Francesc Font C.
(Complex Systems)

Francesc Font M.
(Industrial Mathematics)

Esther Ibáñez
(Mathematical Biology)

Michelle MacDevette
(Industrial Mathematics)

Daniel Sánchez
(Mathematical Biology)

□ Publications

Articles

- **P. Chunaev**, *Extrapolation of analytic functions by sums of the form* $\sum_k \lambda_k h(\lambda_k z)$, Math. Notes **92 (5)**, 136–139 (2012).
- **F. Font-Clos**, F. A. Massucci and I. P. Castillo, *A weighted belief-propagation algorithm for estimating volume-related properties of random polytopes*, J. Stat. Mech. **11**, P11003 (2012).
- T. G. Myers, S. L. Mitchell, **F. Font Martínez**, *Energy conservation in the one-phase supercooled Stefan problem*, International Communications in Heat and Mass Transfer **39**, 1522-1525 (2012).

Preprints

- **P. Chunaev**, *On extrapolation of analytic functions by h-sums*, In: Complex Analysis and Its Applications: Abstracts (Petrozavodsk, 2012), pp. 79–82, Petrozavodsk State Univ. Press.
- **A. Deluca** and A. Corral, *Scale Invariant Events and Dry Spells for Medium Resolution Local Rain Data*, submitted to *Nonlinear Processes in Geophysics*.
- A. Corral and **A. Deluca**, *Fitting and goodness-of-fit test of non-truncated and truncated power-law distributions*, submitted to *Acta Geophysica*.
- A. Corral, **A. Deluca** and R. Ferrer-i-Cancho, *A practical recipe to fit discrete power-law distributions*, preprint.
- **F. Font Martínez**, S. L. Mitchell, T. G. Myers, *One-dimensional solidification of supercooled melts*, preprint.
- T. G. Myers, S. L. Mitchell, **F. Font Martínez**, *Energy conservation in the one-phase supercooled Stefan problem*, preprint.

Books or chapters

- A. Corral and **F. Font-Clos**, *Criticality and self-organization in branching processes: application to natural hazards*, in Self-organized critical systems (2012).

Conference proceedings

- **F. Font Martínez**, T. G. Myers and **M. MacDevette**, *A mathematical model for the melting of spherical nanoparticles*, *Proceedings of the 17th European Conference on Mathematics for Industry* (2012).
- **M. MacDevette**, T. Myers, B. Wetton and **F. Font Martínez**, *Are nanofluids the next-generation coolant?*, Proceedings of The 17th European Conference on Mathematics for Industry 2012 Springer (2012).

□ Research projects

- *Interpolation and Approximation of Analytic Functions by Amplitude and Frequency Sums,* Russian Foundation for Basic Research, 12-01-31471. From 2012 to 2012. Principal investigator: **P. Chunaev**.

□ Activity in research training

- PhD thesis proposal: "Evolutionary dynamics of populations with genotype-phenotype map", July 2012. (**E. Ibáñez**)
- PhD thesis proposal: "Beyond the classical Stefan problem", July 2012. (**F. Font Martínez**)
- PhD thesis proposal: "Are nanofuids the coolest: a mathematical approach", July 2012. (**M. MacDevette**)

□ Scientific activities

Participation

Invited lectures in conferences

- **M. MacDevette**, *Are nanofluids the coolest?* Invited talk at the Jornada SCM de Joves Investigadors en Matemátiques. Societat Catalana de Matemátiques, Barcelona, October 2012.

• **D. Sánchez-Taltavull**, *Stability of Stochastic Models of hierarchical cell populations*. Contributed talk at the Third workshop dynamical systems applied to biology and natural sciences. CMAF, Lisbon, February 2012.

Communications in conferences

• **P. Chunaev**, *On extrapolation of analytic functions by h-sums*, The 6th International Conference on Complex Analysis and Its Applications, Petrozavodsk, July 2012.

• **A. Deluca**, *Statistical observational constrains for the onset of convection and a simple stochastic model*, Concepts for Convective Parameterizations in Large-Scale Models, Max Planck Institute for Meteorology, May 2012.
• **A. Deluca**, R. Ferrer-i-Cancho, and A. Corral, *A practical recipe to fit power-law distributions*, II Jornada complexitat.cat, Barcelona, May 2012.
• **A. Deluca**, R. Ferrer-i-Cancho, and A. Corral, *A practical recipe to fit power-law distributions*, Nolineal 2012, Zaragoza, June 2012.

• **F. Font-Clos**, *Using belief propagation to model metabolic networks in 5 minutes*, II Gefenol Summer School on Statistical Physics of Complex and Small Systems, Benasque, Sept. 2012.
• **F. Font-Clos**, *A weighted message-passing algorithm to estimate reaction fluxes in metabolic networks*, Nolineal 2012, Zaragoza, June 2012.
• **F. Font-Clos**, *A weighted belief-propagation algorithm to estimate volume-related properties of random polytopes*, II Jornades Complexitat.cat, Barcelona, May 2012.
• **F. Font Martínez**, T. G. Myers and **M. MacDevette**, *A mathematical model for the melting of spherical nanoparticles*, 17th European Conference on Mathematics for Industry, Lund, July 2012.

• **F. Font Martínez**, T. G. Myers, *A new mathematical approach for the melting process of nanoparticles*, ESF-JSPS Conference on Mathematics for Innovation, Japan, March 2012.
• **E. Ibáñez**, *Robustness and evolvability of gene regulatory networks*, Present Challenges of mathematics in oncology and biology of cancer: Modeling and Mathematical Analysis, Marseille, March 2012.
• **E. Ibáñez**, *Robustness and evolvability of gene regulatory networks*, Jornada Complexitat.cat, Barcelona, May 2012.
• **E. Ibáñez**, *Genetic Networks*, II Gefenol Summer School on Statistical Physics of Complex and Small Systems, Benasque, Sept. 2012.
• **E. Ibáñez**, *Robustness and evolvability of gene regulatory networks II*, Evolution of Structural and Functional Complexity in Biology, Cambridge, Sept. 2012.
• **M. MacDevette**, *Convective transport of nanofluids: what makes the next-generation coolant?*, Mathematics for Innovation: Large and Complex Systems, Tokyo, 28 February - 4 March 2012.
• **M. MacDevette**, *Are nanofluids the next-generation coolant?*, The 17th European Conference on Mathematics for Industry, Lund, July 2012.

Seminars

• **A. Deluca**. *Analysis of the predictability of local rain records from different climates.* CAMP Seminar, CRM, February 2012.

• **F. Font-Clos**. *Von Neumann's model for production economies applied to metabolic networks.* CAMP Seminar, CRM, March 2012.
• **M. MacDevette**. *Industrial Mathematics.* Seminar "Modelització en Salut, Biologia i Desastres Naturals", CRM, November 2012.

Research stays

• June–July 2012: Visiting Researcher at Instituto de Ciências Exatas, Universidade Federal de Minas Gerais (4.5 weeks). (**A. Deluca**)
• May 2012: Visiting Research Scholar at Department of Mathematics, King's College London (2 weeks). (**F. Font-Clos**)

Courses attended

• Introduction to Embedding Theory. Institut de Matemàtica de la Universitat de Barcelona, November, 2012. (**P. Chunaev**)
• II Gefenol Summer School on Statistical Physics of Complex and Small Systems. Benasque, Sept. 3rd–Sept. 14th, 2012. (**F. Font-Clos**, **E. Ibáñez**, **D. Sánchez-Taltavull**)
• Stochastic Modelling in Biological Systems Winter School on Mathematics. Oxford, 18-23 March, 2012.(**D. Sánchez-Taltavull**)
• Functional Itô Calculus and Malliavin Calculus for Lévy Processes Summer School on Mathematics. Bellaterra, 23-27 July, 2012.(**D. Sánchez-Taltavull**)
• Present Challenges of mathematics in oncology and biology of cancer: Modeling and Mathematical Analysis. Marseille, March 19–March 23, 2012. (**E. Ibáñez**)
• Evolution of Structural and Functional Complexity in Biology. Cambridge, Sept. 17th–Sept. 19th, 2012. (**E. Ibáñez**)
• Simulación dinàmica de fluidos con OpenFOAM. Universidade de Santiago de Compostela, October, 2012. (**M. MacDevette**)
• 2012 NanoMaths. CRM, July, 2012. (**F. Font Martínez**, **M. MacDevette**)
• Summer School on Statistical Inference, Information Theory & Applications in Complex Systems. Warwick, May 14th–May 16th, 2012. (**A. Deluca**, **F. Font-Clos**)
• First LINC School, Learning about Networks in Climate. Mallorca, Sept. 10th – Sept. 12th, 2012. (**A. Deluca**)

□ Technology transfer

• Contributed to the *IV Jornadas de Consulta Matemática para Empresas e Instituciones*, held in Santiago de Compostela in February 2012, for the problem *Descongelación rápida en microondas* presented by the company 2Mares. (**F. Font Martínez**)

□ Other activities

• Member of Societat Catalana de Matemàtiques. (**E. Ibáñez**)
• Member of the Core Group on Theoretical Studies of the Convection Parameterization Problem, Research Network founded by the European COST program, ES0905. (**A. Deluca**)
• Referee for Europhysics Letters. (**A. Deluca**)

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 la 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, 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 directed 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

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

incentius i recursos de manera que els investigadors de les àrees més tradicionals o els 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.

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.

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 qual típicament inclouen un seminari estable. El CRM dóna suport financer i administratiu a cada xarxa temàtica.

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.

Les xarxes temàtiques actuals al CRM són les següents:

The current list of CRM Thematic Networks is the following:

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

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

Les activitats d'aquestes xarxes poden veure's a

The activities of these networks can be checked at

www.crm.cat/en/Research/Pages/ThematicNetworks.aspx

2.5. Investigadors visitants

2.5. List of visitors

Diversos investigadors fan estades temporals al CRM durant el curs acadèmic. La majoria d'aquests investigadors són participants invitats als programes de recerca del CRM i la resta s'acullen a les convocatòries públiques del CRM per a estades de recerca per a col.laborar amb matemàtics/ques de les universitats catalanes, que són:

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

- Estades de recerca al CRM.

- *Visiting the CRM.*

- Estades de recerca en col.laboració.
- Places "Lluís Santaló" per a visitants d'Amèrica llatina.

- *Research in pairs at CRM.*
- *"Lluís Santaló" visiting positions for Latin-American researchers.*

El llistat de visitants de 2012 es detalla a continuació. Aquest llistat no inclou el personal investigador propi del CRM ni els visitants que hagin fet estades inferiors a dues setmanes. La plaça "Lluís Santaló" va ser ocupada enguany pel Prof. Santiago López de Medrano.

The list of 2012 visitors is the following. This list does not include CRM staff researchers nor visitors whose stay was shorter than two weeks. The "Lluís Santaló" visiting position was held by Prof. Santiago López de Medrano.

Marta Aguilera	*Universidad de Sevilla*
Luis Alvarez-Cónsul	*ICMAT/CSIC Madrid*
Yago Antolin	*Yago Antolin Pichel*
Javier Aramayona	*University of Ireland at Galway*
Lluis Bacardit	*Universitat Autonòma de Barcelona*
John Baez	*National University of Singapore*
Thomas Baier	*Universidade do Porto*
Yuri Bakhtin	*Georgia Institute of Technology*
Christopher Sean Bohun	*University of Ontario*
Steven Bradlow	*University of Illinois at Urbana-Champaign*
Leticia Brambila	*CIMAT A.C.*
Ugo Bruzzo	*International School for Advanced Studies (SISSA)*
Montserrat Casals-Ruiz	*Oxford University*
Chris Cashen	*Universität Wien*
Julian Cifuentes	*Universitat Politècnica de Catalunya*
Laura Ciobanu	*University of Fribourg*
Matt Clay	*University of Arkansas*
Christina Cobbold	*University of Glasgow*
Georgios Daskalopoulos	*Brown University*
Laura De Carli	*Florida International University*
Jordi Delgado	*Universitat Politècnica de Catalunya*
Savin Diana	*Ovidius University*
Volker Diekert	*Universität Stuttgart*
Borislav Draganov	*Institute of Mathematics and Informatics*
David Fernández Álvarez	*ICMAT/CSIC Madrid*
Carlos Florentino	*Instituto Superior Técnico*
Stefano Francaviglia	*Università di Bologna*
Clément Fromenteau	*Université de Rennes*
Oscar García-Prada	*CSIC*
François Gautero	*Université de Nice Sophia Antipolis*
William Goldman	*University of Maryland*
Eduardo Gonzalez	*University of Massachusetts*
Juan González-Meneses	*Universidad de Sevilla*
Albert Guillén	*Universitat Pompeu Fabra*
Funda Gültepe	*University of Oklahoma*

Jochen Heinloth	*University of Amsterdam*
Arnaud Hilion	*Université P. Cézanne - Aix Marseille III*
Victoria Hoskins	*Oxford University*
Lou Jost	*South American Explorers Club*
Burglind Juhl-Jöricke	*Weizmann Institute of Science*
Ilya Kazachkov	*Oxford University*
Kirill Kopotun	*University of Manitoba*
Herbert Lange	*Emmy-Noether-Zentrum*
Chris Leininger	*University of Illinois at Urbana-Champaign*
Tom Leinster	*University of Glasgow*
Dany Leviatan	*Tel Aviv University*
Gilbert Levitt	*Université de Caen*
Santiago López de Medrano	*Universidad Nacional Autónoma de México*
Eric López Platón	*Universitat Politècnica de Catalunya*
Jérome Los	*Centre de Mathématiques et Informatique*
Martin Lustig	*Université d'Aix-Marseille 3*
Cristina Martinez	*Universitat Autonòma de Barcelona*
Alfonso Martínez	*Universitat Pompeu Fabra*
Armando Martino	*University of Southampton*
Gregor Masbaum	*Institut de Mathématiques de Jussieu*
Louise Matthews	*University of Glasgow*
Ignasi Mundet	*Universitat de Barcelona*
James Murray Hill	*The University of Adelaide*
Hossein Namazi	*Texas A&M University*
Madumbai S. Narasimhan	*Indian Institute of Science*
Peter Newstead	*University of Liverpool*
Hiraku Nozawa	*Universidade de Santiago de Compostela*
André Gama Oliveira	*Centre of Mathematics of UTAD*
Dragos Oprea	*University of California at San Diego*
Andreas Ott	*Max Planck Institute for Mathematics*
Sandrine Pavoine	*Muséum National d'Histoire Naturelle*
Alexandra Pettet	*Oxford University*
Catherine Pfaff	*Bard College at Simon's Rock*
Andriy V. Prymak	*University of Manitoba*
Sundararaman Ramanan	*Chennai Mathematical Institute*
Salomón Rebollo	*Universitat Autonòma de Barcelona*
Richard Reeve	*University of Glasgow*
Claudia Reynoso	*Universidad de Guanajuato*
Darío Sánchez	*Universidad de Salamanca*
Florent Schaffhauser	*Universidad de Los Andes*
Saul Schleimer	*University of Warwick*
Alexander Schmitt	*Freie Universität Berlin*
Paul Schupp	*University of Illinois at Urbana-Champaign*
William Sherwin	*University of New South Wales*
Vladimir Sobolev	*Samara State University*
Juan Souto	*The University of British Columbia*

Jing Tao	*University of Utah*
Constantin Teleman	*University of California at Berkeley*
Domingo Toledo	*University of Utah*
Xavier Tolsa	*Universitat Autonòma de Barcelona*
Dolores María Valladares	*Universidad de Sevilla*
Clàudia Valls	*Universidade Técnica de Lisboa*
Enric Ventura	*Universitat Politècnica de Catalunya*
Richard A. Wentworth	*University of Maryland*
Simon Willerton	*University of Sheffield*
Conan Wu	*Princeton University*
Peter Zograf	*Steklov Mathematical Institute*

En total, el CRM ha hostatjat 224 mesos d'estada d'investigadors al llarg de l'any 2012.

Summing up, the CRM has hosted 224 months of stays of researchers during 2012.

2.6. La formació en recerca al CRM

Hi ha dos vessants de formació al CRM: doctoral i a nivell de màster.

2.6.1. Formació doctoral

El CRM atorga beques doctorals destinades a la realització de tesis doctorals en les especialitats especificades en el pla estratègic del Centre. Per gaudir d'una beca doctoral del CRM és indispensable matricular-se en un programa de doctorat d'una universitat catalana. A continuació, es detalla la llista de becaris predoctorals vinculats al CRM; en l'apartat 2.2.6 hi ha informació més detallada d'aquells estudiants predoctorals que han estat contractats pel CRM durant aquest any.

2.6. Research Training at CRM

There are two aspects in training: at doctoral and master's level.

2.6.1. Doctoral Training

The CRM awards doctoral grants for PhD theses on topics specified in the CRM strategic plan. To benefit from a CRM PhD grant it is required to be registered in a PhD programme at a Catalan University. Next, we list the predoctoral researchers associated to the CRM. More information on predoctoral students that have been contracted by CRM during 2012 can be found in Section 2.2.6.

Pedro E. García presented his PhD thesis, supervised by Gustavo Deco and Antoni Guillamon Noise-induced reversals in bistable visual perception. Funded by UPF.

Lidia Almazán is working on her PhD thesis, supervised by José Antonio Carrillo since September 2009. Funded by CRM, UAB and i-MATH.

Michelle De Decker is working on her PhD thesis, supervised by Tim Myers since February 2010. Funded by CRM.

Anna Deluca is working on her PhD thesis, supervised by Álvaro Corral since September 2009. Funded by CRM.

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

Francesc Font Martínez is working on his PhD thesis, supervised by Tim Myers since September 2010. Funded by CRM.

Esther Ibáñez is working on her PhD thesis, supervised by Tomás Alarcón Since January 2011. Funded by CRM.

Daniel Sánchez is working on his PhD thesis, supervised by Tomás Alarcón Since January 2011. Funded by CRM.

2.6.2. Treballs de recerca de fi de màster

El CRM va repetir la convocatòria per promoure, entre els estudiants de màster en Matemàtiques de les universitats catalanes, l'elaboració de treballs de recerca en temes interdisciplinaris i aplicats. L'any 2012 s'han presentat els treballs següents:

2.6.2. Master's Research Projects

The CRM has maintained the call to sponsor research projects in interdisciplinary applied areas addressed to master's students in Mathematics at Catalan Universities. In 2012 the following have been completed:

Sandra Álvarez, *Semi-Analytical Implementation for the Name Concentration Measurement in a Credit Portfolio*, supervised by Luis Ortiz, CRM.

Nina Asadipour, *Modelling of Non-linear Viscoelastic Tissues with Bar Elements*, supervised by José Javier Muñoz Romero, UPC.

Abhishek Awasthi, *Clustering algorithms for anti-money laundering using graph theory and social network analysis*, supervised by Roc Alabern, Lluís Alsedà, AIA, UAB.

Saverio Castelanelli, *Application of the Sparse grid technique to Discontinuous Galerkin methods: some simple hyperbolic problems*, supervised by Blanca Ayuso, CRM.

Julián Cifuentes, *Stochastic optimal bid to electricity markets with environmental risk constraints*, supervised by Javier Heredia, UPC.

Carles Llensa, *Analysis of a SIRS model with rewiring*, supervised by Joan Saldaña, UdG.

Oliver Planes, *Disipación y energía de los ciclones tropicales: ajustes y test de bondad de ajuste*, supervised by Álvaro Corral, CRM.

2.6.3. Curs de màster

El Màster de Matemàtiques per als Instruments Financers es va impartir per quinzena vegada el 2012 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,

2.6.3. Master's Course

The CRM master's course on Financial Mathematics was held for the fifteenth time in 2012 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,

Estadística i Economia Espanyola de la UB, juntament amb destacats especialistes que treballen en contacte directe amb els mercats. Les empreses col.laboradores que hi donen suport, mitjançant les beques per a la realització de pràctiques, aporten el component necessari d'aprenentatge pràctic. Així, s'estableix una línia directa de col.laboració entre els mons acadèmic i professional, que permet desenvolupar i ensenyar les últimes tècniques de valoració de productes financers derivats, càlcul d'estratègies de cobertura i avaluació i control de riscos.

El màster està estructurat en tres etapes: dues de teòriques (cadascuna amb 120 hores de docència) i una tercera etapa pràctica en una empresa de finances. La responsabilitat del màster recau en una Comissió Acadèmica i un Comitè Executiu. L'any 2012 han acabat el màster 18 alumnes.

Applied Economics, and Business Economics of the UAB, the Department of Econometrics, Statistics and Spanish Economy of the UB, and several outstanding specialists who work in direct contact with the markets. The collaborating companies promote practical training opportunities to the students by offering them grants. This facilitates a direct contact between the academic world and the professional world, allowing them to develop and teach innovative techniques about the valuation of derived financial products, calculation of coverage strategies, risk assessment and risk control.

The course is structured in three terms, two theoretical, each with 120 hours of teaching, and a third practical in a financial company. The master's responsibility lies on an Academic Commission and an Executive Committee. In 2012 a total of 18 students completed the master's course.

2.6.4. 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 2012, els següents estudiants van participar en aquest programa:

2.6.4. Internship 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 2012, the following students visited the CRM within this program:

- Núria Folguera (Biologia matemàtica i computacional/*Computational & Mathematical Biology*).
- Helena Ribera (Matemàtica Industrial/*Industrial Mathematics*).
- Jarrod L. 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 d'Activitats de la web del CRM.

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

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

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

Applications can be formulated by following the guidelines given in the Activities section at the CRM website.

Moreover, the CRM also organises Dissemination Activities and Research Seminars.

3.1. Programes de recerca

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

Els programes de recerca del CRM poden durar normalment entre tres mesos i un curs acadèmic sencer. S'estructuren en dos vessants: els investigadors visitants i les activitats programades. Cada programa té un comitè científic responsable

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 three months to a whole academic year. They are based on two aspects: visiting researchers and activities organised within. Every programme has a scientific committee, which is fully responsible

de planificar les activitats incloses en el programa, elaborar la llista dels investigadors visitants i lliurar un informe final. Típicament, en un programa hi participen investigadors locals a temps complet, investigadors visitants a temps complet (per a estades d'una durada mínima d'un mes), 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.

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 2012. La informació general sobre els programes de recerca es pot trobar a

for the planning of all activities included in the programme, elaboration of the list of participants, and submission of a final report. Typically, participants in a programme include local full-time researchers, visitors on a full-time basis (for stays of at least one month), 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.

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 2012 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 Geometry of Quantization

February to June 2012

Organising Committee	Luis Álvarez-Cónsul	ICMAT-CSIC Madrid
	Steven Bradlow	University of Illinois at Urbana-Champaign
	William Goldman	University of Maryland
	Peter Gothen	Universidade do Porto
	Ignasi Mundet	Universitat de Barcelona, "Chairman"

Coordinators

Peter Gothen	Universidade do Porto
Óscar García-Prada	CSIC
William Goldman	University of Maryland
Ignasi Mundet	Universitat de Barcelona
Luis Álvarez-Cónsul	ICMAT/CSIC Madrid
Steven Bradlow	University of Illinois at Urbana-Champaign
Olivier Biquard	Université Paris 6

Summary

This research programme was centered on the study of the geometry of algebraic moduli spaces, mostly (but not exclusively) associated to compact Riemann surfaces. The scope was intended to be wide, ranging from questions on the topology (cohomology, stable homotopy, etc.) of moduli spaces to problems on their quantization (Verlinde algebra, Hitchin connection, etc.), including also problems on dynamics (e.g. action of the mapping class group of the surface), quantum cohomology (Atiyah-Floer conjecture, Geometric Langlands program) and other areas. Most of the moduli spaces studied in the Research Program were either instances or related to moduli spaces of flat connections and Higgs bundles on Riemann surfaces.

The moduli space of Higgs bundles over Riemann surfaces, introduced by Hitchin in 1987, has a tremendously rich geometric structure and is a remarkable object from the point of view of the theory of completely integrable systems (of which it is an example), hyperkähler geometry, topology (notably through its identification with moduli spaces of local systems), differential geometry (it provides generalizations of Teichmüller spaces for a number of different geometric structures on Riemann surfaces), number theory (it plays a crucial role in the recent proof of Langland's fundamental lemma for automorphic forms by Châu) and mathematical physics (notably through the work of Kapustin and Witten).

The central aims of the programme were to bring together experts in various aspects on the geometry and quantization of moduli spaces and related areas, to advance these topics, and to introduce research students and post-docs to the wealth of ideas and problems in them. As stated above, the interdependence of the identified topics is crucial to the development of the theory. The programme included an advanced course, two workshops, a final conference, as well as a regular seminar.

All program information can be found at:
`http://www.crm.cat/en/Activities/Pages/ActivityDescriptions/Research-Programme-on-Geometry-and-Quantization-of-Moduli-Spaces.aspx`

Visiting Researchers	Luis Álvarez-Cónsul	ICMAT/CSIC Madrid
	Thomas Baier	Universidade do Porto
	Philip Boalch	CNRS
	Steven Bradlow	University of Illinois at Urbana-Champaign
	Leticia Brambila	CIMAT A.C.
	Ugo Bruzzo	International School for Advanced Studies (SISSA)
	Georgios Daskalopoulos	Brown University
	David Fernández	ICMAT/CSIC Madrid
	Carlos Florentino	Instituto Superior Técnico
	Óscar García-Prada	CSIC
	William Goldman	University of Maryland
	Eduardo Gonzalez	University of Massachusetts
	Jochen Heinloth,	University of Amsterdam
	Victoria Hoskins	Oxford University
	Herbert Lange	Emmy-Noether-Zentrum
	Gregor Masbaum	Institut de Mathématiques de Jussieu
	Ignasi Mundet	Universitat de Barcelona
	Madumbai S. Narasimhan	Indian Institute of Science
	Peter Newstead	University of Liverpool
	Hiraku Nozawa	Universidade de Santiago de Compostela
	André Oliveira	Centre of Mathematics of UTAD
	Dragos Oprea	University of California at San Diego
	Andreas Ott	Max Planck Institute for Mathematics
	Sundararaman Ramanan	Chennai Mathematical Institute
	Claudia Reynoso,	Universidad de Guanajuato
	Darío Sánchez	Universidad de Salamanca
	Florent Schaffhauser	Universidad de Los Andes
	Alexander Schmitt	Freie Universität Berlin
	Constantin Teleman	University of California at Berkeley
	Domingo Toledo	University of Utah
	Richard A. Wentworth	University of Maryland
	Peter Zograf	Steklov Mathematical Institute

□ Activities

• Weekly Seminar

Speakers

Leticia Brambila (CIMAT, Guanajuato), George Daskalopoulos (Brown University), Óscar García-Prada (ICMAT, Madrid), William Goldman (University of Maryland), Eduardo González (University of Massachussetts, Boston), Jochen Heinloth (Universität Duisburg-Essen), Herbert Lange (FAU, Erlangen), Vicente Muñoz (Universidad Complutense de Madrid), M. S. Narasimhan (Indian Institute of Science), Peter Newstead (University of Liverpool), Hiraku Nozawa (IHÉS), Dragos Oprea (University of California), Andreas Ott (Max-Planck-Institut für Mathematik), Carlos Simpson (Université de Nice), Constantin Teleman (University of California), Peter Zograf (Steklov Mathematical Institute, Sankt-Petersburg).

• International school on Geometry and Physics, Geometry and Quantization of Moduli Spaces

March 26 to 30, 2012.

Participants: 48

Lecturers

Vladimir Fock, Université de Strasbourg
Quantization of moduli spaces of local systems.

Constantin Teleman (University of California at Berkeley)
Topological Quantum Field Theories.

Richard A. Wentworth (University of Maryland)
Higgs bundles and local systems.

• Master class and Workshop on Topological Quantum Field Theories

April 19 to 27, 2012.

Participants: 46

Lecturers of Master Class

Jørgen Ellegaard Andersen, QGM, Aarhus
Gregor Masbaum, IMJ, Université de Paris 6
Christian Pauly, Université de Nice

Workshop Speakers

Jørgen Ellegaard Andersen (QGM, Aarhus), François Costantino (Strasbourg), Benjamin Himpel (QGM, Aarhus), Rinat Kashaev (Université de Génève), Thang T. Q. Le (Georgia Institute of Technology), Gregor Masbaum (IMJ, Université de Paris 6), Brendan McLellan (QGM, Aarhus), Bertrand Patureau-Mirand (Université Bretagne-Sud, Vannes), Christian Pauly (Université de Nice), Ramanujan Santharoubane (IMJ, Université Paris 6).

• Master class and Workshop on Geometry of Surface Group Representation

May 9 to 17, 2012.

Participants: 34

Lecturers

Philip Boalch (École Normale Supérieure), André Gama Oliveira (Universidade de Trás-os-Montes e Alto Douro), Peter Gothen (Universidade do Porto), Olivier Guichard (Université Paris-Sud), Jacques Hurtubise (McGill University, Montréal), Alessandra Iozzi (ETH Zurich), Vincent Koziarz (Université Bordeaux 1), Sean Lawton (University of Texas), Melissa Liu (Columbia University), Alessia Mandini (Universidade Técnica de Lisboa), Tony Pantev (The Pennsylvania State University), Sundararaman Ramanan (Chennai), Florent Schaffhauser (Universidad de Los Andes), Laura Schaposnik (University of Oxford), Domingo Toledo (University of Utah), Botong Wang (Purdue University), Martin Wijnholt (Universität München), Kang Zuo (Universität Mainz).

• **Conference on Geometry and Quantization of Moduli Spaces (2012 VBAC Conference)**

June 18 to 22, 2012.

Participants: 90

Lecturers

Jorgen Andersen (Aarhus University), Oren Ben-Bassat (University of Haifa), Dan Freed (University of Texas at Austin), João Nunes (Instituto Superior Tecnico Lisboa), Olivier Guichard (Université Paris Sud), Martin Gulbrandsen (KTH Royal Institute of Technology), Nigel Hitchin (Oxford University), Kobi Kremnitzer (Oxford University), Julien Marché (École Polytechnique Palaiseau), Tony Pantev (University of Pennsylvania), Pablo Solis, Jacopo Stoppa (Cambridge University), Szilárd Szábo (Budapest University of Technology and Economics), Gang Tian (Princeton University), Pietro Tortella (SISSA/ISAS, Trieste), Nathalie Wahl (University of Copenhagen), Richard Wentworth (University of Maryland), Alfonso Zamora (ICMAT).

3.1.2. CRM Research Programme on Mathematics of Biodiversity

June to July, 2012

Scientific Committee	Ben Allen	Harvard University
	Silvia Cuadrado	Universitat Autònoma de Barcelona
	Tom Leinster	University of Glasgow
	Richard Reeve	University of Glasgow
	John Woolliams	University of Edimburgh
Organisers	Tom Leinster	University of Glasgow
	Richard Reeve	University of Glasgow

Summary

The five-week research activity on the Mathematics of Biodiversity was an exceptionally interdisciplinary event. Long-stay participants included a population geneticist, a conservationist, a statistical ecologist, an epidemiologist, a mathematical physicist, mathematical modellers, and pure mathematicians. The conference that took place in the middle week attracted an even wider range of scientists, from livestock breeding experts to category theorists.

The central problem that we sought to address was that of quantifying biological diversity. The biodiversity crisis is one of the outstanding scientific issues of our time. But to make accurate, evidence-based decisions on conservation, we need numerical measures of diversity. Otherwise, we cannot meaningfully make statements such as "biodiversity has dropped by 20%", or properly compare the effectiveness of conservation strategies in order to decide which is best.

The global biodiversity crisis is a problem of enormous magnitude and the most pressing concern. There is a vast literature on the subject. However, quantitative methods have not kept up.

To any community – the fish in a river, the trees in a forest, or the bacteria in a human digestive system - one would like to be able to assign a number, measuring the community's diversity. This is not a problem of statistics: even assuming that we have complete information on all the organisms in the community, it is far from clear what the best measure is. The question "what measure of diversity to use?" has been debated in ecology journals for nearly fifty years.

Diversity is closely related to entropy, a concept of profound importance in many branches of science. For example, Shannon or information entropy is commonly used by ecologists as a measure of diversity. The ubiquity of the concept of entropy means that there are close ties to other fields. As an illustration, the information-theoretic quantity known as Rényi entropy made its way into ecology under the name of Hill numbers; it is also used in economics, where diversity in an industry is the opposite of monopoly.

In our research activity, we sought to build on the existing half-century of literature on biological diversity measures, while also taking advantage of methods from other fields and attempting to bring our own new insights.

The middle week was the Exploratory Conference on the Mathematics of Biodiversity. It was attended by about 40 researchers, with 23 talks and three special sessions. Again, we made an effort here to bridge the gaps between different disciplines: the first special session involved each participant introducing themselves and briefly describing their interest in the mathematics of diversity.

More than most conferences, ours saw a lot of participants meeting each other for the first time. We know of several instances where this has led to ongoing collaboration after the activity finished. The participants included a good number of early-career researchers, from a variety of disciplines.

Public dissemination of the programme and some of its results was provided by eight entries in the very popular blog of John Baez (`http://johncarlosbaez.wordpress.com/category/biodiversity`). We also kept a running record of the daily seminars and other events organized during our research activity, which can be found at `http://www.maths.ed.ac.uk/~tl/tmob.html`.

Adding to the CRM's own funding was an International Workshop Award from the UK's Biotechnology and Biological Sciences Research Council. This is the major funding body for biological sciences in the United Kingdom.

We made good progress on the following aims:

1. To develop diversity measures that are sensitive to the varying similarities and differences between species.
2. To deepen our understanding of the partitioning question: given a community divided into several subcommunities, how much of the diversity of the whole should be attributed to diversity within the subcommunities, and how much to diversity between subcommunities?
3. To extend this understanding to similarity-sensitive measures.

All program information can be found at:
`http://www.crm.cat/en/Activities/Pages/ActivityDescriptions/Research-Program-on-Mathematics-of-Biodiversity.aspx`

Visiting Researchers	John Baez	National University of Singapore
	Lou Jost	Independent researcher
	Thomas Leinster	University of Glasgow
	Louise Matthews	University of Glasgow
	Sandrine Pavoine	Muséum National d'Histoire Naturelle
	Richard Reeve	University of Glasgow
	William Sherwin	University of New South Wales
	Simon Willerton	University of Sheffield

□ Activities

• Weekly Seminar

Speakers

Lou Jost (independent researcher)
Tom Leinster (University of Glasgow)
Louise Matthews (University of Glasgow)
William Sherwin (University of New South Wales).

• **Exploratory Conference on the Mathematics of Biodiversity**
March 26 to 30, 2012.
Participants: 39

Lecturers

Ben Allen (Harvard University), John Baez (University of California, Riverside), Andrés Baselga (Universidad de Santiago de Compostela), Neil Brummitt (Natural History Museum, London), Anne Chao (National Tsing Hua University), Christina Cobbold (University of Glasgow), Yoni Gavish (Ben-Gurion University of Negev), Elisabeth Gillet (Universität Göttingen), Hans-Rolf Gregorius (Georg-August-Universität Göttingen), Lou Jost (Independent researcher), Tom Leinster (University of Glasgow), Alison Mather (The Wellcome Trust Sanger Institute), Louise Matthews (University of Glasgow), Hans Metz (Universiteit Leiden), Sandrine Pavoine (Muséum National d'Histoire Naturelle), Richard Reeve (University of Glasgow), Carlo Ricotta (Sapienza Università di Roma), William Sherwin (University of New South Wales), Mike Stear (University of Glasgow), Núria Teixidó (Universitat de Barcelona), Simon Willerton (University of Sheffield), John Woolliams (University of Edinburgh).

3.1.3. CRM Research Programme on Automorphisms of free groups

September to December, 2012

Coordinators	Enric Ventura Capell	Universitat Politècnica de Catalunya
	Martin Lustig	Université d'Aix-Marseille 3
	Juan González-Meneses	Universidad de Sevilla
	Alexandra Pettet	Oxford University
	Ilya Kazachkov	Oxford University

Scientific Committee	Juan González-Meneses	Universidad de Sevilla
	Martin Lustig	Université P. Cézanne - Aix-Marseille III
	Alexandra Ross Pettet	University of Oxford
	Enric Ventura Capell	Universitat Politècnica de Catalunya

Summary

The study of automorphisms of free groups is a classical subject, with more than 100 years of history. The last 25 years have witnessed the development of many interesting new tools, resulting in the subject's diversification into algorithmic, geometric and dynamical aspects. While these aspects continue to be heavily intertwined, they have meanwhile taken root in several other areas of mathematics. The purpose of the proposed program is to assemble experts from these three aspects, with the object of finding innovative approaches to the main open questions from each.

All program information can be found at:
http://www.crm.cat/en/Activities/Pages/ActivityDescriptions/Research-programme-on-Automorphism-and.aspx

Visiting Researchers

Yael Algom-Kfir	Yale University
Yago Antolin Pichel	University of Southampton
Javier Aramayona	University of Ireland at Galway
Lluis Bacardit	Universitat Autònoma de Barcelona
Mladen Bestvina	University of Utah
Martin Bridson	Oxford University
Montserrat Casals-Ruiz	Oxford University
Chris Cashen	Universität Wien
Ruth Charney	Brandeis University
Laura Ciobanu	University of Fribourg
Matt Clay	University of Arkansas
Pedro Ventura Alves da Silva	Universidade do Porto
Marta Aguilera Gómez del Castillo	Universidad de Sevilla
Jordi Delgado	Universitat Politècnica de Catalunya
Volker Diekert	Universität Stuttgart
Stefano Francaviglia	Università di Bologna
François Gautero	Université de Nice Sophia Antipolis
Juan González-Meneses	Universidad de Sevilla
Vincent Guirardel	Université de Rennes
Funda Gultepe	University of Oklahoma
Ursula Hamenstädt	Universität Bonn
Arnaud Hilion	Université P. Cézanne - Aix Mareille III
Camille Horbez	Université de Rennes
Ilya Kapovich	University of Illinois at Urbana-Champaign
Ilya Kazachkov	Oxford University
Eiko Kin	Tokyo Institute of Technology
Chris Leininger	University of Illinois at Urbana-Champaign
Gilbert Levitt	Université de Caen
Eric López Platón	Universitat Politècnica de Catalunya
Jérome Los	Centre de Mathématiques et Informatique
Martin Lustig	Université d'Aix-Marseille
Johanna Mangahas Kutluhan	Brown University
Armando Martino	University of Southampton
Goulnara N. Arzhantseva	Universität Wien
Hossein Namazi	Texas A&M University
Luis Paris	Univeristé de Bourgogne
Alexandra Pettet	Oxford University
Catherine Pfaff	Bard College at Simon's Rock
Doron Puder	Hebrew University
Kasra Rafi Oklahoma	State University
Patrick Reynolds	University of Utah
Saul Schleimer	University of Warwick
Paul Schupp	University of Illinois at Urbana-Champaign

Alessandro Sisto	Oxford University
Juan Souto	The University of British Columbia
Jing Tao	University of Utah
Mark V. Sapir	Vanderbilt University
Dolores María Valladares García	Universidad de Sevilla
Enric Ventura Capell	Universitat Politècnica de Catalunya
Karen Vogtmann	Cornell University
Pascal Weil	Université Bordeaux I
Bert Wiest	Université de Rennes
Conan Wu	Princeton University
Amaia Zugadi Reizabal	Euskal Herriko Unibertsitatea

□ Activities

• Weekly Seminar

Speakers Goulnara Arzhantseva (Universität Wien), Matt Clay (University of Arkansas), Spencer Dowdall (University of Illinois), François Gautero (Université de Nice Sophia Antipolis), Arnaud Hilion (Université P. Cézanne - Aix Marseille III), Jérome Los (Centre de Mathématiques et Informatique, Université d'Aix Marseille), Johanna Mangahas (Brown University), Paul Schupp (University of Illinois, Urbana-Champaign), Enric Ventura (Universitat Politècnica de Catalunya).

• Opening workshop on Automorphisms of Free Groups

September 6 and 7, 2012
Participants: 15

Lecturers Montserrat Casals (Oxford University), Ariadna Fossas (Université de Grenoble), Ilya Kazachkov (Oxford University), Catherine Pfaff (Bard College at Simon's Rock), Mark Sapir (Vanderbilt University), Paul Schupp (University of Illinois, Urbana-Champaign), Juan Souto (University of British Columbia, Vancouver).

• Advanced Course: Summer School on Automorphisms of Free Groups

September 25 to 29, 2012.
Participants: 40

Lecturers

Javier Aramayona	National University of Ireland at Galway
Christopher J. Leininger	University of Illinois at Urbana-Champaign
Ruth Charney	Brandeis University
Volker Diekert	Universität Stuttgart
Saul Schleimer	University of Warwick
Pedro V. Silva	Centro de Matemática da Universidade do Porto

• **Warm-up week for the International Conference**
November 5 to 9, 2012.
Participants: 18

Lecturers

Luis Paris, Université de Bourgogne
The $K(\pi, 1)$ conjecture for Artin groups

Kasra Rafi, Oklahoma State University
Hyperbolicity and $Out(F_n)$

• **Conference on Automorphism of Free Groups: Algorithms, Geometry and Dynamics**
November 12 to 16, 2012.
Participants: 37

Speakers

Yael Algom-Kfir (Yale University), Javier Aramayona (University of Ireland at Galway), Mladen Bestvina (University of Utah), Martin Bridson (Oxford University), Chris Cashen (Universität Wien), Vincent Guirardel (Université de Rennes), Ursula Hamenstädt (Universität Bonn), Arnaud Hilion (Université d'Aix-Marseille), Ilya Kapovich (University of Illinois at Urbana-Champaign), Gilbert Levitt (Université de Caen), Luis Paris (Univeristé de Bourgogne), Doron Puder (Hebrew University), Patrick Reynolds (University of Utah), Saul Schleimer (University of Warwick), Alessandro Sisto (Oxford University), Juan Souto (The University of British Columbia at Vancouver), Jing Tao (University of Utah), Karen Vogtmann (Cornell University), Pascal Weil (Université Bordeaux I), Bert Wiest (Université de Rennes).

• **Cool-down week for the International Conference**
November 19 to 23, 2012.
Participants: 16

Lecturers

Camille Horbez, ENS
The hyperbolicity of the sphere complex via surgery paths

Mathieu Carette, Université Catholique de Louvain
I: Virtually splitting the map from Aut(G) to Out(G)

Mathieu Carette, Université Catholique de Louvain
II: Locally compact convergence groups and n-transitive actions

Christopher Cashen, Universität Wien
Computing JSJ-decompositions for a free group relative to a multiword

Maurice Chiodo, Università degli Studi di Milano
Transversals as generating sets for finitely generated groups

Laura Ciobanu, Université de Fribourg
What are sofic groups?

Stefano Francaviglia, Università di Bologna
The pressure metric on Outer Space

Funda Gultepe, University of Oklahoma
Essential tori, twists and subgroups of Out(F_n)

Martin Lustig, Université d'Aix-Marseille
Tree-irreducible automorphisms of free groups

Catherine Pfaff, Bard College at Simon's Rock
Invariant realization & the construction of ideally decomposed fully irreducibles

• Closing Workshop on Automorphisms of Free Groups
December 13 and 14, 2012.
Participants: 20

Lecturers

Pep Burillo (Universitat Politècnica de Catalunya), Montse Casals (Oxford University), Juan González-Meneses (Universidad de Sevilla), Ilya Kazachkov (Oxford University), Mark Sapir (Vanderbilt University), Enric Ventura (Universitat Politècnica de Catalunya).

3.2. Congressos i Workshops

En aquest apartat es detallen els congressos i *workshops* que va organitzar el CRM durant l'any 2012 al marge dels programes de recerca.

3.2. Conferences and Workshops

This section lists the congresses and workshops organised by CRM during 2012 not included in research programmes.

Operator Theory, Analysis and Mathematical Physics Conference

June 11–14, 2012
Participants: 44

Organisers

Joaquim Puig (Barcelona), Jan Janas (Polish Academy of Sciences, Krakow), David Krejcirik (Academy of Sciences of the Czech Republic), Pavel Kurasov (Stockholm University), Ari Laptev (Imperial College London and Institut Mittag-Leffler), Sergei Naboko (Sankt-Petersburg).

Speakers

Malcolm Brown (Cardiff University), Pavel Exner (Academy of Sciences of the Czech Republic), Anne Boutet de Monvel (Université Paris Diderot Paris 7), Yulia Karpeshina (University of Alabama at Birmingham), Annemarie Luger (Lund University), Luis Silva (Universidad Nacional Autónoma de México), Uzy Smilansky (Weizmann Institute of Science, Rehovot), Andrei Shkalikov (Lomonosov Moscow State University), Gunter Stolz (University of Alabama at Birmingham), Christiane Tretter (Universität Bern), Dmitry Yakubovich (Universidad Autónoma de Madrid).

ESF Perspectives in Discrete Mathematics

June 25–29, 2012

Participants: 94

Organisers	Noga Alon (Chair, Tel Aviv University), Peter Cameron (Queen Mary, University of London), Maria Chudnovsky (Columbia University), Michael Drmota (Technical University of Vienna), Jean-François Le Gall (University Paris 11, Orsay), Jaroslav Nešetřil (Charles University), Marc Noy (Universitat Politècnica de Catalunya), Oriol Serra (Universitat Politècnica de Catalunya), Angelika Steger (ETH Zürich), Benny Sudakov (UCLA), Günter Ziegler (Free University Berlin).
Speakers	Jacob Fox (MIT, US Ben Green (Cambridge University, UK Penny Haxell (University of Waterloo), Michael Krivelevich (Tel Aviv University), László Lovász (Eotvos Lorand University), Jiri Matousek (Charles University), Balázs Szegedy (University of Toronto), Endre Szemerédi (Rutgers University), Carsten Thomassen (Technical University of Denmark), Nicholas Wormald (University of Waterloo).

Workshop on Nanomaths

11–13 juliol, 2012

Participants: 19

Organisers	Wolfgang Bacsa (Université de Toulouse), James Hill (University of Adelaide), Pedro Miana (Universidad de Zaragoza), Tim Myers (CRM).
Speakers	James Hill (University of Adelaide), Tim Myers (Centre de Recerca Matemàtica), Irene Suárez-Martínez (Curtin University), Jon Summers (University of Leeds).

Dynamics of Memory: What is the evidence?

July 12–13, 2012

Participants: 58

Organisers	Albert Compte (IDIBAPS), Alfonso Renart (Champalimaud Neuroscience Programme, Lisboa).
Speakers	Moshe Abeles (Hebrew University), Matthew Chafee (University of Minnesota), Albert Compte (IDIBAPS), Daniel Durstewitz (BCCN Heidelberg-Mannheim), Rainer Friedrich (Friedrich Miescher Institute, Basel), Mark Goldman (UC Davis), Wolfgang Maass (Graz Univ. of Technology), Matthias Munk (MPI Tuebingen), Alessandro Treves (SISSA, Trieste), Misha Tsodyks (Weizmann Institute), Kechen Zhang (Johns Hopkins University School of Medicine).

Applications of Graph Spectra in Computer Science

July 16–20, 2012

Participants: 45

Organisers: Dragan Stevanovic (chair) (University of Primorska Koper and University of Nis), Robert Elsässer (University of Paderborn), Francesc Comellas (Universitat Politècnica de Catalunya), Vladimir Nikiforov (University of Memphis), Nair Maria Maia de Abreu (Federal University of Rio de Janeiro), Fan Chung Graham (University of California at San Diego), Piet F.A. Van Mieghem (Delft University of Technology), Dragos Cvetkovic (Serbian Academy of Science and Arts), Miquel Àngel Fiol (Universitat Politècnica de Catalunya), María José Serna (Universitat Politècnica de Catalunya), Dieter Mitsche (Universitat Politècnica de Catalunya), Steve Kirkland (National University of Ireland, Maynooth).

Speakers: Ben Allen (Harvard University), John Baez (University of California, Riverside), Neil Brummitt (Natural History Museum, London), Anne Chao (National Tsing Hua University), Christina Cobbold (University of Glasgow), Elisabeth Gillet (Universität Göttingen), Hans-Rolf Gregorius (Georg-August-Universität Göttingen), Lou Jost (Independent researcher), Tom Leinster (University of Glasgow), Alison Mather (The Wellcome Trust Sanger Institute), Louise Matthews (University of Glasgow), Hans Metz (Universiteit Leiden), Sandrine Pavoine (Muséum National d'Histoire Naturelle), Richard Reeve (University of Glasgow), Carlo Ricotta (Sapienza Università di Roma), William Sherwin (University of New South Wales), Mike Stear (University of Glasgow), Simon Willerton (University of Sheffield), John Woolliams (University of Edinburgh).

ESF and ERCOM Mathematics Conference on Applied Partial Differential Equations in Physics, Biology and Social Sciences: Classical and Modern Perspectives

September 2–7, 2012

Participants: 85

Organisers: Marco Di Francesco (Universitat Autònoma de Barcelona), José Antonio Carrillo de la Plata, (ICREA & Universitat Autònoma de Barcelona), Peter Markowich (KAUST, Thuwal).

Speakers	Andrea Bertozzi (UCLA), Martin Burger (Universität Münster), Eric Carlen (Rutgers University), Vicent Caselles (Universitat Pompeu Fabra), Peter Constantin (University of Chicago), Camillo De Lellis (Universität Zürich), Laurent Desvillettes (École normale supérieure, Cachan), François Golse (+cole Polytechnique, Palaiseau), Ansgar Juengel (Vienna University of Technology), Jian-Guo Liu (Duke University), Tai-Ping Liu (Stanford University), Pierangelo Marcati (Università degli studi dell'Aquila), Robert McCann (University of Toronto, CA), Masayasu Mimura (Meiji University), Benoit Perthame (École Normale Supérieure), Alfio Quarteroni (EPFL Lausanne, CH and Politecnico di Milano), Panagiotis Souganidis (University of Chicago), Angela Stevens (Universität Münster), Eitan Tadmor (University of Maryland at College Park), Giuseppe Toscani (University of Pavia), Juan Luis Vázquez (Universidad Autonoma de Madrid), Juan J. L. Vélázquez (University Bonn).

3.3. Cursos avançats

En aquest apartat es detallen els cursos avançats que va organitzar el CRM durant l'any 2012 al marge dels programes de recerca.

3.3. Advanced Courses

This section lists the advanced courses organised by CRM during 2012, not included in research programmes.

Intensive Course on Estimates for Dirichlet Polynomials

February 20–23, 2012
Participants: 20

Organiser	European Mathematical Society.
Speaker	Kristian Seip (EMS Lecturer 2012).

Barcelona Summer School on Stochastic Analysis: Functional Itô Calculus and Malliavin Calculus for Lévy Processes

July 23 to 27, 2012
Participants: 39

Coordinators	Josep Vives	Universitat de Barcelona
	Marta Sanz Solé	Universitat de Barcelona
	Frederic Utzet	Universitat Autònoma de Barcelona
	Joan del Castillo	Universitat Autònoma de Barcelona
	Xavier Bardina	Universitat Autònoma de Barcelona
Lecturers	Vlad Bally (Université de Marne-la-Vallée), Rama Cont (CNRS - Université de Paris VI)	

3.4. Jornades temàtiques

El CRM promou també trobades intensives de recerca sota la denominació de "jornades temàtiques". El 2012 es van celebrar les següents:

- *Melnikov's Day*, May 31, 2012

  Coordinators: Xavier Tolsa (UAB).

  Speakers: A. Volberg (Michigan State University), P. Mattila (University of Helsinki) and M. Melnikov (UAB).

- *CRM colloquium on Complex Systems*, June 15, 2012

  Speakers: Álvaro Corral (CRM), Gaspar Orriols (UAB) and Antonio Turiel (Institut de Ciències del Mar, CSIC).

- *Seventh Barcelona Weekend in Group Theory*, December 4 and 5, 2012

  Coordinators: Josep Burillo and Enric Ventura (UPC).

  Speakers: Laura Ciobanu (Université de Fribourg), Aditi Kar (Oxford University), Giovanni Gandini (Hausdorff Center for Mathematics, Bonn), Yago Antolín Pichel (University of Southampton) and Cyril Nicaud (LIGM, Université Paris-Sud).

- *CRM Colloquium: Mathematical Biology and Biophysics*, December 13, 2012

  Speakers: Jordi García-Ojalvo (UPC), Aurora Hernández-Machado (UB) and Philip Maini (University of Oxford).

3.4. Thematic Days

The CRM also promotes intensive research meetings generically named "thematic days". In 2012 the following have been hosted:

3.5. Activitats divulgatives

El CRM promou activitats de divulgació en l'àmbit de la matemàtica, a diferents nivells formatius. Durant el 2012 s'han organitzat xerrades científiques interdisciplinars, s'ha inaugurat una exposició que combina art fotogràfic amb l'esperit de la matemàtica i s'ha difós la recerca entre estudiants preuniversitaris.

- *Exposició "Ments Abstractes"*, Març 2012

  Descripció: Exposició de les fotografies i textos del projecte "Ments Abstractes" a la Facultat de Matemàtiques i Estadística de la UPC.

3.5. Dissemination Activities

The CRM promotes dissemination activities around mathematics, at different specialization levels. During 2012, interdisciplinary scientific lectures have been organised, an exhibition combining photographic art and mathematical spirit has been launched, as well as informative actions for high-school students.

- *Què és el CRM?*, 28 de març de 2012

  Descripció: Activitat de difusió de la recerca al CRM, adreçada a estudiants de ciències. Introducció del Director i breus presentacions dels investigadors principals dels grups de recerca del CRM.

- *Exposició "Ments Abstractes"*, Abril–Juny, 2012

  Descripció: Exposició de les fotografies i textos del projecte "Ments Abstractes" a la Biblioteca de Ciències de la UAB.

- *Modelització en Salut, Biologia i Desastres Naturals*, 21 de novembre de 2012

  Descripció: Activitat dins de la Setmana de la Ciència, adreçada a estudiants de ciències. Introducció del Director i breus presentacions dels investigadors principals dels grups de recerca del CRM.

- *Neurociència computacional*, 22 de novembre de 2012

  Ponent: Albert Compte (IDIBAPS).

  Descripció: Activitat organitzada per la Reial Acadèmia de Ciències i Arts de Barcelona (RACAB) i el CRM.

3.6. 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.

3.6. 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.

Seminar Cycle on Quantitative Finance

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

23/02/2012. Eduard Giménez i Giovanna Villani, l'la Caixa", *Valoració de Productes Derivats en Mercats Heterogenis. Un cas pràctic per FX Forward i Cross Currency Swaps*.

12/04/2012. Luis Ortiz, CRM, *Credit Portfolio Losses and the Wavelet Approximation Method*.

26/04/2012. Archill Gulisashvili, Ohio University, *Asymptotic behavior of implied volatility at extreme strikes in stochastic stock price models*.

10/05/2012. José Fajardo, FGV-EBAPE, *Implied Volatitily Smirk under Asymmetric Dynamics*.

26/06/2012. Albert Ferreiro, University of Bath, *Multilevel Monte Carlo simulation for Lévy processes based on the Wiener-Hopf factorization.*.

20/09/2012. Monique Jeanblanc, Université d'Evry, *Arbitrages opportunities with honest times*.

20/12/2012. Ramon Prat, *Commodities, What's Diferent?*.

Seminar Cycle on Computational and Systems Neuroscience

Coordinator/*Coordinator*: Alex Roxin (IDIBAPS, CRM)

20/01/2012. Francesco Battaglia, Universiteit van Amsterdam, *Neural oscillations and communication between the hippocampus and the neocortex*.

27/04/2012. Henning Sprekeler, Institut für Theoretische Biologie, *Inhibitory plasticity balances excitation and inhibition in sensory pathways and memory networks*.

24/05/2012. Francisco Barceló, Universitat de les Illes Balears, *A bayesian model of human sensorimotor control during task switching*.

20/07/2012. Romain Brette, École Normale Supérieure, *An ecological approach to neural computation*.

The CRM Applied Mathematical and Physics (CAMP) seminar

Coordinators/*Coordinators*: Pilar Guerrero (CRM), M. Teresa Cao (CRM).

24/01/2012. Yury Bakhtin, Georgia Tech, *Noisy heteroclinic networks and sequential decision making*.

25/01/2012. Daniel Gaude-Fugarolas, Independent Research and Consultancy in Physical Metallurgy and Engineering, *Computational Modelling of Steel Transformation Processes*.

18/01/2012. Jordi Zamora, UPC, *Stochastic and deterministic rogue waves: from low dimensional models to chaotic dynamics in semiconductor lasers*.

01/02/2012. Anna Deluca, CRM, *Analysis of the predictability of local rain records from different climates*.

08/02/2012. Simoneta Rubol, UPC, *Mutual interaction between water dynamics & bacteria activity*.

14/03/2012. Francesc Font Clos, CRM, *Von Neumann's model for production economies applied to metabolic networks*.

18/04/2012. Ivón Rodriguez, UB, *Microfluidic device for human blood plasma separation and magnetic cell manipulation*.

25/04/2012. Bernat Corominas Murtra, UPF, *Why is Zipf's law so common?*.

02/05/2012. Joan Serrà, IIIA-CSIC, *Patterns, regularities, and evolution of contemporary popular music*.

20/06/2012. Mark Sinclair, *An overview of applied financial mathematics*.

27/06/2012. Pilar Guerrero, CRM, *Stochastic multi-scale models of cell population with age-structured*.

10/07/2012. Abigail Wacher, BCAM (Bilbao), *Moving finite elements; from shallow water equations to aggregation of microglia in Alzheimer's disease*.

27/09/2012. Luis E. Bergues Cabrales, Universidad de Oriente, Santiago de de Cuba, *Mathematical modeling of tumor growth in mice following low-level direct current*.

31/10/2012. Antoni Ivorra, UPF, *An engineer's perspective on irreversible electroporation for tissue ablation*.

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 participates in its organization through Blanca Ayuso. To see the complete activity, please visit http://www-ma2.upc.es/~edps/.

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*, *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**, format per Carles Casacuberta (editor en cap del CRM), Antoni Guillamon (en representació de l'Equip de Direcció), Javier Gutiérrez (editor adjunt) 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.

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, 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, formed by Carles Casacuberta (Editor-in-Chief of CRM), Antoni Guillamon (representing the Team of Directors), Javier Gutiérrez (Assistant Editor) and Raquel Hernández (edition tasks). The Editorial Board meets every two months.*

We give an overview of the different series and a list of the preprints issued.

4.1. Advanced Courses in Mathematics CRM Barcelona

Els volums d'aquests sèrie, publicada per l'editorial suïssa Birkhäuser, recullen el contingut d'alguns dels cursos avançats impartits al CRM, a partir de les notes prèvies lliurades als participants i reelaborades pels mateixos autors. Es tracta de llibres de text, especialment adreçats a estudiants

The volumes of this series, published by the Swiss publishing company Birkhäuser, cover the content of some of the advanced courses taught by specialists at the CRM. They are based on notes handed out to students and later reworked by the

de doctorat avançats i a joves investigadors postdoctorals.

Des de setembre de 2008, l'editor responsable d'aquesta sèrie és Carles Casacuberta. Va substituir en aquest càrrec a Manuel Castellet, que va iniciar la sèrie l'any 2001.

L'any 2012 han aparegut dos volums d'aquesta sèrie:

authors. These volumes are especially addressed to advanced doctoral and young post-doctoral students.

Since 2008, the responsible editor of this series is Carles Casacuberta. He replaced Manuel Castellet, who started the series in 2001.

The following two volumes of this series were published in 2012:

- L. Berger, G. Böckle, L. Dembélé, M. Dimitrov, T. Dokchitser and J. Voight. *Elliptic Curves, Hilbert Modular Forms and Galois Deformations*, edited by H. Darmon, F. Diamond, L. V. Dieulefait, B. Edixhoven and V. Rotger. Advanced Courses in Mathematics CRM Barcelona, Birkhäuser, Basel, 2012.
- G. Böckle, D. Burns, D. Goss, D. S. Thakur, F. Trihan and D. Ulmer. *Arithmetic Geometry for Function Fields of Positive Characteristic*, edited by F. Bars, I. Longhi and F. Trihan. Advanced Courses in Mathematics CRM Barcelona, Birkhäuser, Basel, 2012.

4.2. CRM Documents

El CRM va iniciar una nova sèrie de volums amb ISBN l'any 2008, anomenada *CRM Documents*. En aquesta sèrie s'hi publiquen monografies, actes de jornades o congressos, informes de projectes de recerca i altres reculls de material de qualitat.

Els volums de la sèrie publicats aquest any 2012 han estat els següents:

The CRM launched a new series of volumes with ISBN in 2008, called CRM Documents. *These include monographs, proceedings of events, reports of research programmes, and other quality material.*

The next two volumes were published in 2012:

- *The Infinity Project: A 2009-2011 Research Programme*, edited by S.-D. Friedman, M. Koerwien and M. Müller, CRM Documents vol. **11**, 2012, ISBN: 978-84-616-3307-4, ISSN: 2014-2323 (edició impresa/*printed edition*), ISSN: 2014-2331 (edició electrònica/*electronic edition*).
- *Extended Conference Abstracts, Fall 2012*, CRM Documents vol. **12**, 2013, ISSN: 2014-2323 (edició impresa/*printed edition*), ISSN: 2014-2331 (edició electrònica/*electronic edition*).

Els dos volums del 2012 d'aquesta sèrie tenen significacions particulars. D'una banda, el volum *The Infinity Project* recull una extensa contribució del programa de recerca que duia el mateix nom i que es va desenvolupar al CRM entre Setembre de 2009 i Agost de 2011. D'altra banda, amb l'altra volum, el Comitè Editorial del CRM inicia una

The two above-mentioned volumes have a particular significance. On one hand, the volume The Infinity Project *contains an extensive contribution of the homonymous research program, which was running at the CRM between September 2009 and August 2011. On the other hand, with the other volume, the Editorial Board of the CRM*

subsèrie dins de la sèrie *Documents* amb l'objectiu d'ajudar a difondre amb celeritat els resultats que es presenten als esdeveniments científics del centre i promoure una actualització efectiva de l'estat de l'art en els corresponents camps de recerca.

initiates a sub-series within the Documents *series with the aim at helping to spread results presented at scientific events led in the center and promote effective update of the state of the art in the corresponding research fields.*

4.3. Preprints

La sèrie de prepublicacions del CRM s'ha incrementat amb els 35 títols següents durant l'any 2012:

The CRM preprint series grew with the following 35 issues in 2012:

- T. G. Myers, S. L. Mitchell. *Mathematical modelling of phase change with a flowing thin film*, preprint No. 01/2012
- L. Costa, N. Hoffmann, R. M. Miró-Roig, A. Schmitt. *Rational families of instanton bundles on* $\mathbb{P}^{2n+1}$, preprint No. 02/2012
- B. R. Draganov. *A sharp Jackson inequality for best trigonometric approximation*, preprint No. 03/2012
- E. D. Nursultanov, A. M. Zhantakbayeva. *The Hardy-Littlewood-Stein inequality for generalized Hardy and Bellman type averages*, preprint No. 04/2012
- J. A. Álvarez, H. Nozawa. *Secondary characteristic classes of transversely homogeneous foliations*, preprint No. 05/2012
- E. Liflyand. *The Fourier transform of a function of bounded variation*, preprint No. 06/2012
- A. Korobeinikov, C. Dempsey. *A continuous strain-space model of viral evolution within a host*, preprint No. 07/2012
- E. Gonzalez, C. Woodward. *Quantum cohomology of toric orbifolds*, preprint No. 08/2012
- P. Chunaev. *Extrapolation of analytic functions by sums of the form* $\sum_k \lambda_k h(\lambda_k z)$, preprint No. 09/2012
- B. Jöricke. *Braids, conformal module and entropy*, preprint No. 10/2012
- *Several authors.* *ESF-EMS-ERCOM conference: Perspectives in discrete mathematics Problem Session*, preprint No. 11/2012
- B. Ayuso de Dios, S. Hajian. *High order and energy preserving discontinuous Galerkin methods for the Vlasov-Poisson system*, preprint No. 12/2012
- B. Ayuso de Dios, A. T. Barker, P. S. Vassilevski. *A combined preconditioning strategy for nonsymmetric systems*, preprint No. 13/2012
- L. Ortiz-Gracia, J. J. Masdemont. *Peaks and jumps reconstruction with B-splines scaling functions*, preprint No. 14/2012
- I. Kapovich. *Algorithmic detectability of iwip automorphisms*, preprint No. 15/2012
- R. Akgün. *Polynomial approximation in rearrangement invariant quasi Banach spaces on the unit circle*, preprint No. 16/2012
- R. Akgün, H. Koç. *Approximation by interpolating polynomials in weighted symmetric Smirnov spaces*, preprint No. 17/2012
- F. Font-Clos. *A weighted message-passing algorithm to estimate volume-related*

properties of random polytopes, preprint No. 18/2012

- Á. Corral, F. Font-Clos. *Criticality and self-organization in branching processes: application to natural hazards*, preprint No. 192/2012
- F. Lledó, D. V. Yakubovich. *Følner sequences and finite operators*, preprint No. 20/2012
- R. Delgado, E. Morozov. *Stability of cascade networks via fluid models*, preprint No. 21/2012
- T. Myers, S. Mitchell, F. Font. *Energy conservation in the one-phase supercooled Stefan problem*, preprint No. 22/2012
- L. Meersseman. *Kuranishi type Moduli spaces for proper CR submersions fibering over the circle*, preprint No. 23/2012
- N. Lev, J. Ortega-Cerdà. *Equidistribution estimates for Fekete points on complex manifolds*, preprint No. 24/2012
- J. Baró, Á. Corral, X. Illa, A. Planes, E. K. H. Salje, W. Schranz, D. E. Soto-Parra, E. Vives. *Statistical similarity between the compression of a porous material and earthquakes*, preprint No. 25/2012
- H. Nozawa, J. I. Royo Prieto. *Tenseness of Riemannian flows*, preprint No. 26/2012
- L. Meersseman. *Feuilletages par variétés complexes et problèmes d'uniformisation*, preprint No. 27/2012
- F. Font, S. L. Mitchell, T. G. Myers. *One-dimensional solidification of supercooled melts*, preprint No. 28/2012
- A. V. Bondarenko, A. Prymak, D. Radchenko. *On concentrators and related approximation constants*, preprint No. 29/2012
- J. Aramayona, J. Souto. *Rigidity phenomena in the mapping class group*, preprint No. 30/2012
- T. Myers, A. Sáez de Tejada, V. Ribas, S. Mitchell, M. J. McGuinness. *Modelling the cardiovascular system for automatic interpretation of the blood pressure curve*, preprint No. 31/2012
- L. Meersseman. *Variétés CR polarisées et G-polarisées, partie I*, preprint No. 32/2012
- J. Aramayona, J. Souto. *Holomorphic maps between moduli spaces*, preprint No. 33/2012
- A. Bounemoura. *Normal forms, stability and splitting of invariant manifolds I. Gevrey Hamiltonians*, preprint No. 34/2012
- A. Bounemoura. *Normal forms, stability and splitting of invariant manifolds II. Finitely differentiable Hamiltonians*, preprint No. 35/2012

4.4. 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/

5

Resum econòmic

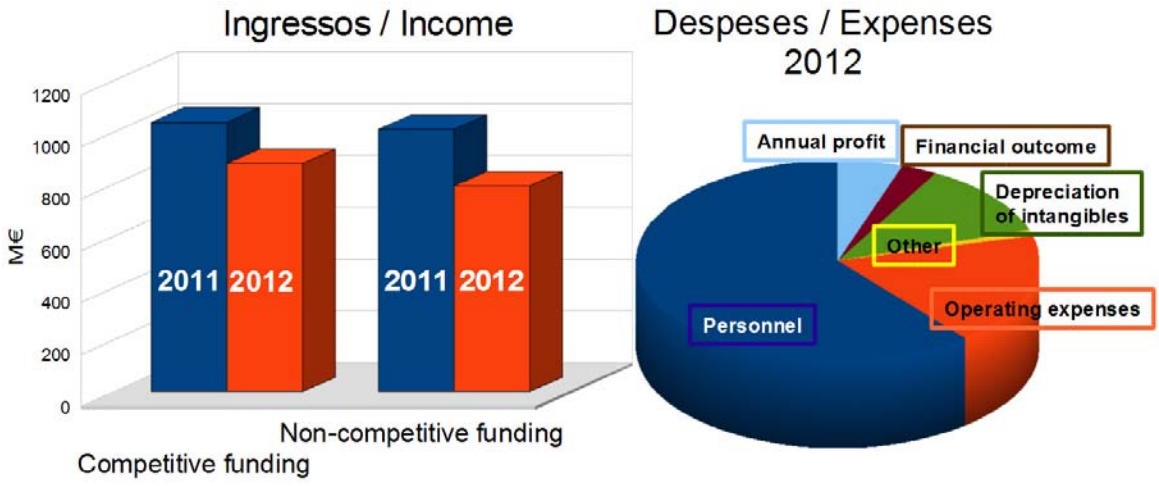
Financial Summary

5.1 Ingressos — 5.1. Income

Ingressos competitius *Competitive funding*	880.819,13 €
Ingressos no competitius *Non-competitive funding*	793.716,85 €
TOTAL	**1.674.535,98 €**

5.2 Despeses — 5.2. Expenses

Despeses de personal *Personnel expenses*	1.136.189,57 €
Despeses d'explotació *Operating expenses*	339.771,44 €
Altres despeses *Other expenses*	17.598,05 €
Amortització immobilitzat *Depreciation of intangibles*	223.835,95 €
Resultat financer (despesa) *Financial outcome (expenditure)*	53.493,30 €
Resultat exercici *Annual profit*	-96.352,33 €
TOTAL	**1.674.535,98 €**



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