



Scientific Report 2011

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Name of the Research Unit	(MAT-LVT-297) Centro de Matemática e Aplicações – CMA
Coordinator	Maria Luísa Martins Macedo de Faria Mascarenhas
Main Scientific Domain	Mathematics

Leading Host Institution: Faculdade de Ciências e Tecnologia – Universidade Nova de Lisboa.

1. Objectives & Achievements

1.1. Unit Description

CMA/FCT/UNL is located at Faculdade de Ciências e Tecnologia of Universidade Nova de Lisboa (FCT/UNL) at Caparica Campus and occupies two large rooms on the first floor of building VII, where is also located the Department of Mathematics (DM).

CMA/UNL has 49 Ph.D. active researchers and 44 collaborators, including Ph.D. and M.Sc. students, internal collaborators and collaborators integrated in other research units. The scientists at the center are organized into four research groups (see Figure 1):

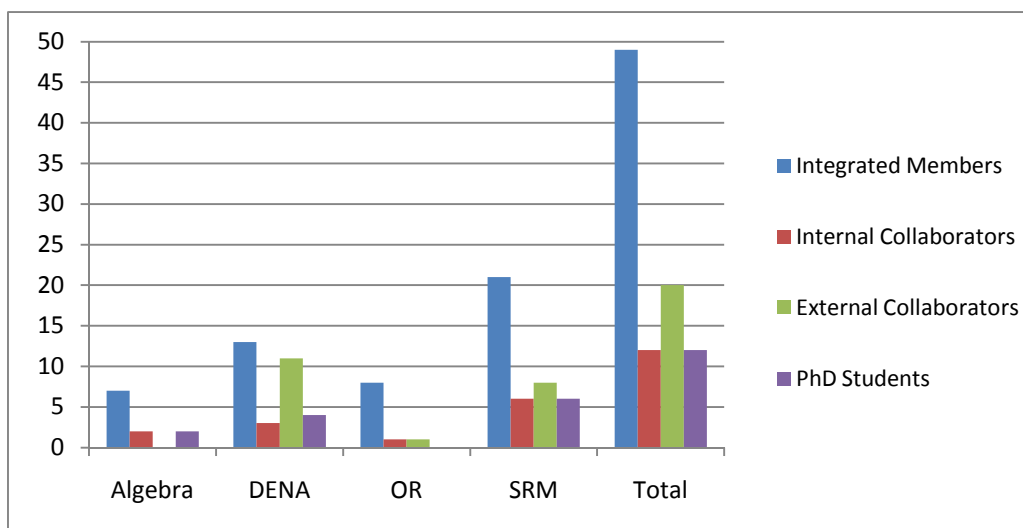


Figure 1 – CMA internal structure.

- Algebra (A)
- Differential Equations and Numerical Analysis (DENA)
- Operations Research (OR) (in the current document also refereed as Operational Research)
- Statistics and Risk Management (SRM)

The Coordinator provides leadership and guidance for the development and implementation of research orientation in accordance with the decisions of the Scientific Committee (composed by all the active Ph.D. members) and is assisted by an Executive Committee composed by four members. An External Permanent Advising Scientific Committee composed by five internationally recognized high-level researchers, follows the scientific activities of the center. The secretariat of the Department of Mathematics supervises accounting and general administrative support is provided by a BGCT grant.

CMA bylaw and membership requirement regulations are available in a written document, reviewed every year in order to contemplate the classification of the researchers according to productivity indicators. Funding is allocated to each team, proportionally to the corresponding number of Ph.D. active researchers.

For more information please visit the CMA/FCT/UNL web site:

<http://www.cma.fct.unl.pt>

1. 2. General Objectives

The objective of CMA/FCT/UNL is to continue to promote high-level scientific research in the areas of pure and applied mathematics and its subsequent national and international projection.

Together with the strong support provided to traditional areas in the unit, like Actuarial Science, Financial Mathematics and Statistics (team Statistics and Risk Management) and Combinatorial and Nonlinear Optimization (team Operations Research), more abstract areas are to be developed within the team Algebra, like Combinatorial Number Theory, Linear Algebra and Matrix Theory, Non-commutative Algebraic Geometry, Ockham Algebras, Semigroups, Combinatorics and Graph Theory, Discrete Geometry and Algebraic and Differential Geometrical Methods for Topological Quantum Field Theories. We also intend to widen the scope of our applications concerning Differential Equations and Numerical Analysis Research has been oriented to Biomathematics, Material Science and Fluid Mechanics.

An effective interaction with high level international research centers and universities, like MIT, CMU, Univ. Texas-Austin, École Polytechnique Fédérale de Lausanne (EPFL), has been successfully promoted, through direct collaboration and/or the approval of several international research projects.

Also the internal interaction among the research teams is steadily increasing, always preserving their own scientific strategy. Collaboration between Operations Research and Differential Equations and Numerical Analysis already exists through optimization problems and numerical methods. Collaboration between the groups Statistics and Risk Management and Differential Equations and Numerical Analysis is leading to some issues in Financial Mathematics. To reinforce this direction and to extend it to other

disciplines inside and outside the FCT/UNL, weekly seminars are organized by the different research teams.

CMA/FCT/UNL collaborates with the Ph.D. and Post Doc Programs in Applied Mathematics, in the scope of CoLab University of Texas at Austin-Portugal and ICTI Carnegie Mellon University-Portugal.

CMA/FCT/UNL supports regular outreach activities promoted by its members such as:

- MatNova 2011, a September Summer School, organized under topics related with Statistics, Games Theory, Number Theory, Operations Research, among others. This event, that we intend to renew every year, is specifically directed to high school students and aims to introduce some topics in these areas, motivating students for their study. The center partially sponsors the event, aiming to increase the number of scholarships for young researchers in future FCT/MEC calls.



- ClubeMath, directed to basic and high school students, which aims to show a different facet of Mathematics, through fun and recreational activities, in order to stimulate skills and interest in this science.

CMA/FCT/UNL also supports several scientific national and international events, organized with the collaboration of its members.

Despite the enormous teaching charge, our researchers generally honor their commitments and develop an interesting scientific work.

In order to encourage good research practices and create adequate working conditions, we mention two goals:

- Promote, whenever it is possible, the reduction of the teaching charge for active researchers with outstanding scientific projects;
- Recover the scientific activity, through work plans, of investigators that have not met the productivity indicators referred in the unit description above.

1. 3. Main Achievements During the Year of 2011

The main achievement of the research unit was the consolidation of its international projection, by the increment in the quality of its scientific production, by the impact of its research in institutions like MIT, CMU or EPFL, where some of its members were invited to lecture.

We list some highlights:

- Carolín Kreisbeck won the "E.ON Kulturpreis Bayern 2011", category: universities, for her Ph.D. thesis entitled "Analytical aspects of relaxation for single-slip models in finite crystal plasticity".

- Carolin Kreisbeck won the "ICIAM Travel Award 2011" for the participation of young scientists to attend ICIAM 2011 (grant from the U.S. National Science Foundation, USA).
- Fabio Chalub and al. edited "The Mathematics of Darwin's Legacy", published by Birkhauser in 2011.
- Fabio Chalub participated in the organization of the "European Mathematical Society/European Society of Mathematical and Theoretical Biology Summer School", hosted for the first time in Portugal.
- Filipe Marques was Elected National Participant to attend to the 17th European Young Statisticians Meeting, 2011, by the International Organising Committee in behalf of the European Regional Committee of the Bernoulli Society.
- Gonçalo Tabuada was on leave during 2011, lecturing in the Department of Mathematics of MIT.
- João Tiago Mexia, Célia Nunes, Dário Ferreira, Sandra S. Ferreira and Elsa Moreira received the Best Paper Award at the International Conference on Applied Mathematics, Simulation, Modelling (ASM'11), held in Corfu Island, Greece, 14-16 July, with the work entitled "Orthogonal Fixed Effects ANOVA with Random Sample Sizes".
- Miguel Brás de Carvalho was awarded by the American Statistical Association, the 2011 Young Researcher Award, Section of Risk Analysis.
- Paulo Canas Rodrigues received the Young Scientists Awards for the Best Communication in MAT TRIAD 2011.
- Rita Ferreira presented her Ph.D. thesis at Carnegie Mellon University (under the scope of ICTI CMU/Portugal program in Applied Mathematics, involving CMU and FCT/UNL).

The unit attracted new members, new collaborators and increased, significantly, its funds.

The following events, organized or co-organized by CMA/FCT/UNL members, were partially funded by CMA/FCT/UNL:

- ClubeMath 2011, FCT/UNL.
- Workshop and School on Higher Gauge Theory, TQFT and Quantum Gravity, Lisbon, 7-13 February 2011.
- Combinatorics Conference in Lisbon, FCT/UNL, 11-15 July 2011.
- MatTriad 2011, Tomar, 12-16 July 2011.

- Optimization 2011, FCT/UNL, 24-27 July 2011.
- Summer School "Dynamical Models in Life Sciences" (Centro Internacional de Matemática, European Mathematical Society, European Society of Mathematical and Theoretical Biology), Évora, 24-30 July 2011.
- 17th European Young Statisticians Meeting, FCT/UNL, 5-9 September 2011.
- Summer School MatNova 2011, FCT/UNL, 6-10 September 2011.

The specific scientific accomplishments during the year 2011 are detailed in the Research Groups report.

The overall scientific production of the teams can be found in Table 1:

Teams	ISI Journals		Other International Publications	PI projects	Ph.D. Completed	M.Sc. Completed
	Published	Accepted				
Algebra	9	3	2	1	0	0
DENA	8	7	3	5	1	0
OR	3	5	6	2	0	1
SRM	17	9	31	1	0	10
Total	37	24	42	9	1	11

Table 1 – Overall scientific production.

This shows an average (where no accepted paper was included) of approximately 1.61 international publications and 0.76 in ISI journals, per researcher per year. Figures 2 and 3 represent a graphical comparison between the number of publications and projects, respectively, in the years 2010 and 2011.

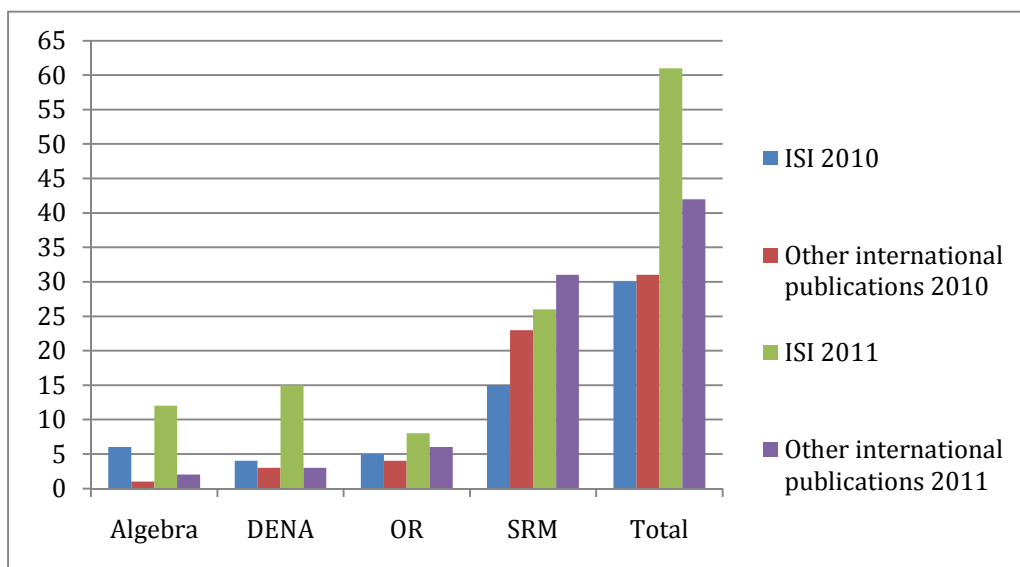


Figure 2 – Comparison between number of journal publications by CMA members, in the years 2010 and 2011.

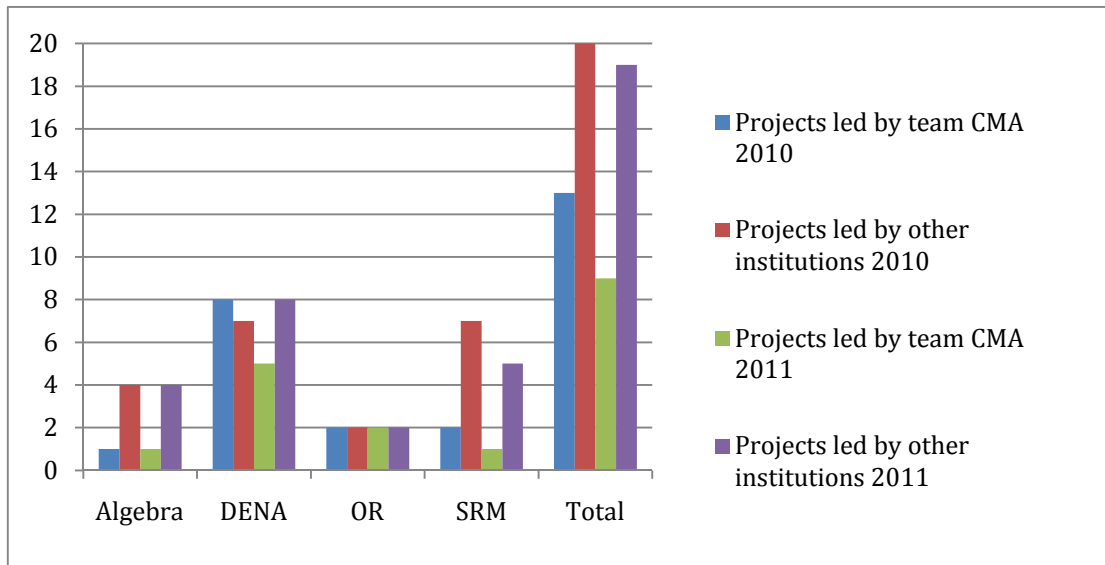


Figure 3 – Number of projects lead by CMA members in the years 2010 and 2011.

2. Activities

2.1. Integrative/Multidisciplinary Activities During the Year of 2011

All research groups organize weekly seminars allowing interaction with other disciplines inside and outside FCT/UNL.

Through the different research projects there were significant interactions with researchers from Mathematical Economy, Medical Schools, Agronomy and Computer Science.

Several members among the researchers, collaborators, Ph.D. and M.Sc. students, especially in team SRM and OR, develop their professional activities in connection with the industry (energy, banking, insurance, networks) allowing very useful interactions.

Some members of the team DENA work in Biomathematics, others in Epidemiology problems, in collaboration with the Gulbenkian Institute of Science. Members of DENA address also problems from Fluid Mechanics, associated to blood flow, mathematical problems in Material Science, Image Reconstruction or Games Theory.

The activities mentioned above are linked with the scientific projects and with the organization/participation in international meetings, described in the items Research Groups.

Our members have scientific collaborations with the main Research Centers in Portugal and with several high level foreign Universities and Research Centers.

We consolidate our participation in the Ph.D. and Post Doc Programs in Applied Mathematics, in the scope of CoLab University of Texas at Austin-Portugal and ICTI Carnegie Mellon University-Portugal.

2. 2. Outreach Activities During the Year of 2011

CMA/FCT/UNL is member of the Associação Portuguesa de Investigação Operacional (APDIO) and of the Comissão Nacional de Matemática (CNM). Collaborates with the Centro Internacional de Matemática (CIM) and with the Sociedade Portuguesa de Matemática (SPM).

Among our members we count:

- The vice-president of the Portuguese Mathematical Society (SPM).
- The director of "Gazeta de Matemática" (a scientific diffusion non-profit publication by the SPM).
- The president of the audit committee of the SPM.
- A member of the Education Committee of the Portuguese Institute of Actuaries.
- A co-founder of the Section of Young Statisticians, of the Portuguese Statistical Society (SPE).

Members of almost all the research groups collaborated in the following projects, all promoted by CMA/FCT/UNL members, exception made for the last two items. Those projects involve scientific divulgation or special training in mathematics, addressed to young students from schools:

- ClubeMath (<http://eventos.fct.unl.pt/clubemath>)
- Conferences “Implica Matemática” (<http://eventos.fct.unl.pt/implica-matematica>)
- DivMAT (<http://sites.google.com/site/divmatfct/o-grupo-divmat>)
- ESCOLA ALEPH (<http://aleph.ptmat.fc.ul.pt/>)
- ExpoFCT (<http://www.unl.pt/eventos/geral/2011/expo-fct-2011>)
- PREPARA-ME (project of the DM/FCT/UNL in Mathematics, directed to students from engineering)
- Summer School MatNova 2011 (<http://ferrari.dmat.fct.unl.pt/matnova2011>)

Several members of the center contributed individually to other outreach activities through:

- Organization of a course “Stochastic Optimization-a brief introduction”, at FCT/UNL.
- Organization of the 1st workshop “A Investigação Operacional e as empresas”, APDIO.
- Participation in a study group, to analyze the level of mathematical knowledge of high school and undergraduate students.
- Participation in several TV programs.
- Scientific diffusion in high schools.
- Several lectures in the scope of “Noite da Matemática”, SPM.

3. Funding

	2008	2009	2010	2011
LA FCT	0,00	0,00	0,00	0,00
Units FCT	68.922,49	187.687,50	131.381,25	202.290,05
Projects FCT	34.200,00	46.337,60	50.773,60	70.786,02
Other (National)	0,00	200,00	0,00	0,00
Other (International)	0,00	0,00	0,00	0,00
National Industry	0,00	0,00	0,00	0,00
International Industry	0,00	0,00	0,00	0,00
Total	103.122,49	234.225,10	182.154,85	273.076,07

4. General Indicators

	2007	2008	2009	2010	2011	Total
No. of Researchers Hired (Ciência Programme)	0	4	2	0	0	6
No. of Researchers integrated with Ph.D.	42	49	48	49	49	---
Training Ph.Ds. (Ph.D. thesis completed)	12	9	7	1	1	30

5. Technical Personnel Hired

Name	Start date	End Date
Vanda Sofia dos Santos Martins	01-04-2011	30-12-2012

6. Research Groups

Reference	Title/Principal Investigator
RG-LVT-297-1846	Algebra (Carlos Manuel Saiago)
RG-LVT-297-1849	Differential Equations and Numerical Analysis (Fabio Augusto da Costa Carvalho Chalub)
RG-LVT-297-1850	Operational Research (Maria Isabel Azevedo Rodrigues Gomes)
RG-LVT-297-3843	Statistics and Risk Management (Manuel Leote Tavares Ingles Esquivel)

6. 1. Algebra Team

Integrated Members

- Carlos Manuel Saiago
- Goncalo Jorge Trigo Nery Tabuada
- Henry Liu
- Herberto Jesus Silva
- João Nuno Gonçalves Faria Martins
- Maria Helena Coutinho Gomes de Almeida Santos
- Teresa Maria Jerónimo Sousa

Collaborators Members

- Björn Gohla (Ph.D. student)
- João Leitão Guerreiro (Ph.D. student)
- Manuel Almeida Silva
- Maria Cecília Perdigão Dias da Silva

6. 1. 1. Funding, Source, Dates

Projects led by team Algebra members:

	Project Title	Principal Investigator	Team Members	Period	Total Funding
1. PTDC/MAT/113207/2009	"H-decompositions of graphs: two new problems"	Teresa Maria Jerónimo Sousa	Manuel Almeida Silva and Henry Liu	2011-2014	18.000 €

Led by other institutions, with participation of team Algebra members, eventually with no budget in our institution:

	Project title	Principal Investigator	Team Members	Period	Total Funding
1. PTDC/MAT/69635/2006	"Mathematical physics"	Jean-Claude Zambrini	João Nuno Gonçalves Faria Martins	2007-2011	93.000 € (FUL/UL)
2. PTDC/MAT/101503/2008	"New geometry and topology"	Roger Francis Picken	João Nuno Gonçalves Faria Martins	2010-2012	120.000 € (IST and Univ. Algarve)
3. PTDC/MAT/098770/2008	"Topological invariants via differential geometry"	Peter Beier Gothen	João Nuno Gonçalves Faria Martins and Björn Gohla	2010-2013	100.000 € (FCUP)
4. PTDC/MAT/098317/2008	"Algebraic topology and applications"	Pedro Ferreira dos Santos	Gonçalo Tabuada	2008-2012	53.740 € (FFCT/UNL)

6. 1. 2. Objectives

The group carried out its research in the following topics: Combinatorial Number Theory, Linear Algebra and Matrix Theory, Non-commutative Algebraic Geometry, Ockham Algebras, Semigroups, Combinatorics and Graph Theory, Discrete Geometry, Algebraic and Differential Geometrical Methods for Topological Quantum Field Theories.

Active Members:

Carlos Saiago: The research in Linear Algebra and Matrix Theory will be focused on the possible multiplicity lists for the eigenvalues of Hermitian matrices whose graph is a given tree. This problem is completely solved for some classes of trees. In general, for a tree T we study the relation between the structure of T and the change in the multiplicity of an eigenvalue, when passing to a principal submatrix. Given a matrix A whose graph is a tree T , having an eigenvalue λ of maximum multiplicity (the path cover number of T), we would like to understand what is the maximum possible multiplicity that can occur for another eigenvalue of A .

Gonçalo Tabuada: In the area of Non-commutative Algebraic Geometry the plan is to establish a precise link between the classical theory of motives, developed by Grothendieck, and the recent theory of noncommutative, developed by Drinfeld and Kontsevich.

Henry Liu: To continue to work on the following research projects, which I am currently involved in.

H-decompositions of a graph (with Teresa Sousa): We study a variant of this problem: Decompose a graph G into edge-disjoint copies of a graph H and single edges, as few as possible.

The rainbow connection number of a graph (with Shinya Fujita and Colton Magnant): We colour a graph with as few colours as possible, so that every two vertices have many “rainbow paths” joining them.

Highly connected coloured subgraphs in graphs with given independence number (with Shinya Fujita): To find highly connected subgraphs in multicoloured graphs with fixed independence number.

Herberto Silva: In the area of Ockham Algebras, we intend to prosecute the ongoing research on the following topics strong endomorphism kernel property in Ockham algebras and the lattice of subalgebras of an Ockham algebra.

João Nuno Faria Martins:

- 1) Understanding of 2-crossed module and crossed squares invariants of knots and knotted surfaces (joint with Roger Picken).
- 2) Finishing previous joint work on three-dimensional holonomy (joint with R Picken and Björn Gohla).
- 3) Finishing previous work on mapping spaces for Gray-Categories (joint with Björn Gohla).
- 4) Study the Lie 2-algebra of 2-chord diagrams, and find examples of infinitesimal 2-R-matrices in the String Lie 2-algebra (joint with Lucio Cirio).
- 5) Define a 4-dimensional spin foam state sum discretizing the path integral for 2-BF theory (joint with Aleksandar Mikovic).

Maria Helena Santos: Prosecute ongoing research in regular semigroups.

Teresa Sousa: A t -edge-coloring of a graph G is a function $c: E(G) \rightarrow \{1, \dots, t\}$. Given a fixed graph H , a graph G of order n and a t -edge-coloring of the edges of G , an edge-monochromatic H -decomposition of G is a partition of the edge set of G such that each part is either a single edge or a monochromatic copy of H . Let $M(G,H,t)$ be the smallest value such that for any t -edge-coloring of G there exists an edge-monochromatic H -decomposition of G with at most $M(G,H,t)$ elements.

The goal is to study the function

$$M(n,H,t) = \max\{M(G,H,t) \mid v(G) = n \text{ and } c: E(G) \rightarrow \{1, \dots, t\}\},$$

which is the smallest number such that for any graph G of order n and any t -edge-coloring of G admits an edge-monochromatic H -decomposition with at most $M(n,H,t)$ elements.

The first interesting open problem is the case when $t=2$ and $H=K_3$. It is known from Ramsey Theory that any 2-edge-coloring of the complete graph of order 6 will have a monochromatic K_3 . However, we can 2-color the edges of the complete graph of order 5 without having any monochromatic K_3 . This leads us to conjecture that $M(n,K_3,2)$ equals number of edges in the 5-partite Turán graph of order n . The r -partite Turán graph of order n is the unique complete r -partite graph on n vertices that has the maximum number of edges and does not contain the complete graph K_{r+1} as a subgraph. During the year 2012 I will study this problem and try to prove that the conjecture holds asymptotically.

Collaborators:

Manuel Silva:

- 1) Consider problems related to the Wilf's conjecture on numerical semigroups.
- 2) Generalize some Euclidean Ramsey Theory results to approximate configurations.
- 3) Study the structure of sets with large sum, in particular the maximal density of Sidon sets.

6. 1. 3. Main Achievements

Carlos Saiago: The main research in Linear Algebra and Matrix Theory was done on the possible multiplicity lists for the eigenvalues among Hermitian matrices whose graph is a given tree. For a general tree T we studied the relation between the structure of T and the change in the multiplicity of an eigenvalue when passing to a principal submatrix. When A is an $n \times n$ matrix, we investigated the relation between perturbing the i th-diagonal entry of A and extracting the principal submatrix $A(i)$ from A with respect to the possible changes in multiplicity of a given eigenvalue. A complete description was given and used to both generalize and improve prior work about Hermitian matrices whose graph is a given tree.

Gonçalo Tabuada: Some advances in the theory of Non-commutative Algebraic Geometry were made. Namely, it was described the tensor triangular geometry of non-commutative motives and constructed a weight structure on it.

Henry Liu: A major result on the project “H-decompositions of a graph” was proved. One paper from the project “The rainbow connection number of a graph” was submitted. A talk based on this project was given at the conference “EuroComb 11” in Budapest, Hungary, and an extended abstract was published in the journal “Electronic

Notes in Discrete Mathematics”. A seminar was also given in Barcelona, Spain. A second project on the same problem was started and steady progress has been made.

Herberto Silva: A description of the minimal Ockham algebras was obtained.

João Nuno Faria Martins:

Topics concerning algebraic and differential-geometrical methods for Topological Quantum Field Theories. Namely:

1) Understanding topological invariants of 4-manifolds and knotted surfaces derived from 2-BF theory.

2) Categorifying the Knizhnik-Zamolodchikov-connection. Namely:

Understanding the Lie 2-algebra of 2-chord diagrams.

Understanding the holonomy of the 2-KZ connection and addressing whether it yields interesting invariants of knotted surfaces.

3) Understanding the three-dimensional holonomy of tri-bundles, and mainly its gauge transformations.

In relation with the listed objectives:

As far as 1) was concerned (joint with Aleksandar Mikovic), we defined a 4-dimensional version of the BF-theory action in the context of 2-connections on 2-bundles. We also addressed the spin foam perturbation theory for 4-dimensional BF-theory.

In relation to 2) (joint with Lucio Cirio), we defined a flat and fake flat 2-connection in the configuration space of n -particles in the complex plane via a differential crossed module of 2-chord diagrams which categorifies the Lie algebra of chord diagrams.

In relation to 3), we made a complete definition of the fundamental 2-crossed complex of a reduced CW-complex, proving its usefulness for the classification of homotopy 3-types (joint with Björn Gohla). We defined the pointed mapping space for Gray-Groupoids (which is a 2-groupoid).

Teresa Sousa: During the period concerning this report I worked on the following problem.

Let G and H be two graphs and c a positive number. Each edge of G has weight 1 and each H -subgraph of G has weight c . An H, c -decomposition of G is a partition of the edge set of G such that each part is either a single edge or forms a graph isomorphic to H and the weight of the decomposition is the sum of the weights of each element in the decomposition. Let $f(G, H, c)$ be the smallest possible weight in an H, c -decomposition of G . We intend to study the problem of finding the smallest value $f(n, H, c)$ such that any

graph of order n admits an H, c -decomposition with weight at most $f(n, H, c)$. Note that the value of this function depends on the structure of the graph H , thus the main goal is to find its asymptotic value. I was able to determine the asymptotical value of the function $f(n, H, c)$ in the case when H is any fixed bipartite graph.

6. 1. 4. Group Productivity

6. 1. 4. 1. Publications in Peer Review Journals

1. Blyth, T. and Santos, M. H. (2011), *On amenable orders and inverse transversals*, Communications in Algebra, 39, 2189-2209 [Impact factor = 0.369].
2. Cisinski, D. and Tabuada G. (2011), *Non-connective K-theory via universal invariants*, Compositio Mathematica, 147 (4), 1281-1320 [Impact factor = 0.941].
3. Dell'Ambrogio, I. and Tabuada, G. (2011), *Tensor triangular geometry of non-commutative motives*, Advances in Mathematics, 229 (2), 1329-1357 [Impact factor = 1.372].
4. Johnson, C. R., Leal-Duarte, A. and Saiago, C. M. (Available online: 27 Sep 2011), *The change in eigenvalue multiplicity associated with perturbation of a diagonal entry*, to appear in Linear and Multilinear Algebra [Impact factor = 0.818].
5. Martins, J. F. and Mikovic, A. (2011), *Four dimensional spin foam perturbation theory*, Symmetry Integrability and Geometry-Methods and Applications, 7, article number: 094, 22 pages [Impact factor = 0.856].
6. Martins, J. F. and Picken, R. (2011), *The fundamental Gray 3-groupoid of a smooth manifold and local 3-dimensional holonomy based on a 2-crossed module*, Differential Geometry and its Applications, 29 (2), 179-206 [Impact factor = 0.521].
7. Martins, J. F. and Picken, R. (2011), *Surface holonomy for non-abelian 2-bundles via double groupoids*, Advances in Mathematics, 226 (4), 3309-3366 [Impact Factor = 1.372].
8. Martins, J. F. (2011), *The fundamental 2-crossed complex of a reduced CW-complex*, Homology Homotopy and Applications, 13 (2), 129-157 [Impact Factor = 0.446].
9. Martins, J. F. and Mikovic, A., *Lie crossed modules and gauge invariant actions for 2-BF theories*, to appear in Advances in Theoretical and Mathematical Physics [Impact Factor = 1.736].
10. Silva, H. J., *On minimal Ockham Algebras*, to appear in Algebra Universalis [Impact Factor = 0.479].

11. **Sousa, T.** (2011), *Decompositions of graphs into a given clique-extension*, ARS Combinatoria 100, 465-472 [Impact factor = 0.441].

12. **Sousa, T.** (2011), *Minimum weight H-decompositions of graphs: the bipartite case*, Electron. J. Combin. 18 (1), Paper 126, 10 pages [Impact factor = 0.626].

6. 1. 4. 2. Other International Publications

1. Fujita, S., **Liu, H.** and Magnant, C. (2011), *Rainbow k-connection in dense graphs* (extended abstract), Proceedings of EuroComb 11, Electronic Notes in Discrete Mathematics, 38, 361-366.

2. **Sousa, T.** (2011), *Greedy friendship decompositions of graphs*, Open J. Discrete Math., 1, 32-34.

6. 1. 4. 3. Organization of Conferences

1. Workshop and School on Higher Gauge Theory, TQFT and Quantum Gravity, Lisbon, 10-13 February 2011 (Workshop), 7-13 February 2011 (School).

Organizing Committee:

Organizers of Workshop

João Faria Martins (Univ. Nova, Lisbon)

Aleksandar Mikovic (Univ. Lusófona, Lisbon)

Jeffrey Morton (IST, Lisbon)

Roger Picken (IST, Lisbon)

Organizers of School

Björn Gohla (Univ. Porto)

Dorota Marciniak (Univ. Barcelona)

Marcin Szamotulski (IST, Lisbon)

2. Combinatorics Conference in Lisbon (CCL 2011), Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 11-15 July 2011.

Co-chair of the organizing committee: **Teresa Sousa**.

Organizing committee: **Henry Liu**, Oleg Pikhurko and **Manuel Silva**.

6. 1. 5. Internationalization

(i) Invited talks at international conferences

Gonçalo Tabuada, Conference Triangulated categories and applications, Noncommutative motives, Banff Institute, Canada, June 2011.

Gonçalo Tabuada, Midwest Topology conference, The fundamental theorem via derived Morita invariance, localization, and A^1 -homotopy invariance, University of Chicago, USA, April 2011.

(ii) Contributed talks at international conferences

João Nuno Faria Martins, Three-Dimensional holonomy, Workshop and School on Higher Gauge Theory, TQFT and Quantum Gravity, IST, Lisbon, Portugal, February 2011.

Henry Liu, Rainbow k -connection in dense graphs, EuroComb 11, Budapest, Hungary, 29 August to 2 September 2011.

(iii) Invited seminars in other research units

João Nuno Faria Martins, Categorifying the Knizhnik-Zamolodchikov Connection, Centre for the Quantisation of Moduli Spaces of Aarhus University, July 2011.

6. 2. Differential Equations and Numerical Analysis Team

Integrated Members

- Ana Margarida Fernandes Ribeiro
- Bento Jose Carrilho Miguens Louro
- Carolin Claudia Kreisbeck
- Fabio Augusto da Costa Carvalho Chalub
- Filipe Serra de Oliveira
- José Maria Nunes de Almeida Gonçalves Gomes
- Maria do Céu Cerqueira Soares
- Maria Fernanda Alves da Veiga de Oliveira
- Maria Luísa Martins Macedo de Faria Mascarenhas
- Paula Cristiana Costa Garcia da Silva Patricio Rodrigues
- Paulo José Fernandes Louro Ribeiro Doutor
- Rita Alexandra Gonçalves Ferreira
- Rogério Ferreira Martins

Collaborators Members

- Alessandro Margheri
- Ana Cristina Melo e Sousa Albuquerque Barroso
- Ana Maria de Sousa Alves de Sá
- Ana Paula Barreira Pimenta (Ph.D. student)
- Filipa Manuela Ventura Caetano
- Gonçalo Nuno Rosado Morais (Ph.D. student)
- João de Deus Mota da Silva Marques
- João Paulo de Carvalho Dias
- Jorge Filipe Drumond Pinto da Silva
- Jorge Manuel dos Santos Pacheco
- José Carlos Pedro Cardoso Matias
- Luis Manuel Trabucho de Campos
- Maria Carlota da Rocha Xavier Rebelo Goncalves
- Maria de Serpa Salema Reis de Orey (Ph.D. student)
- Mario Sequeira Rodrigues Figueira
- Nadir Arada
- Pedro Alves Martins da Silva Girão
- Telma Margarida Cotovio Guerra Santos (Ph.D. student)

6. 2. 1. Funding, Source, Dates

Projects led by team DENA members:

	Project Title	Principal Investigator	Team Members	Period	Total Funding
1. Luso-Spanish integrated actions 2010. Action number E98/10	_____	Rogério Ferreira Martins	_____	2010-2011	4.000 € (FCT/Portugal and MICINN/Spain)
2. Project CMU-PT/0019/2007	"FCT/UNL Activities plan under the mathematics focus area of the CMU-Portugal Program"	Fabio Augusto da Costa Carvalho Chalub	Carolin Kreisbeck, Rita Ferreira, Ana Margarida Ribeiro and Maria Luísa Mascarenhas	2007-2012 (extended)	18.500 € (for the years 2011-2012) (CMU and FCT/Portugal)
3. Bilateral Agreement Portugal-Brazil	"Dispersive equations"	Filipe Serra de Oliveira	_____	2010-2012	10.000 € (FCT/Portugal and Capes/Brazil)
4. PTDC/MAT/109973/2009	"Optimization methods in continuum mechanics"	Maria Luísa Martins Macedo de Faria Mascarenhas	Rita Ferreira, Luís Trabucho de Campos, Bento Louro, Maria do Céu Soares, Nadir Arada, Ana Margarida Ribeiro, Maria de Serpa Orey and Telma Margarida Santos	2011-2013	70.000 € (FFCT/UNL)
5. UTA_CMU/MAT/0005/2009	"Thin structures, homogenization and multi phase problems"	Maria Luísa Martins Macedo de Faria Mascarenhas	Carolin Kreisbeck, Ana Margarida Ribeiro and Rita Ferreira	2011-2013	168.200,00 € (FCT/Portugal and Carnegie Mellon University/USA)

Led by other institutions, with participation of team DENA members, eventually with no budget in our institution:

	Project Title	Principal Investigator	Team Members	Period	Total Funding
1. PTDC/MAT/113383/2009	"Nonlinear dynamics of ordinary differential equations and applications"	Alessandro Margheri	Rogério Ferreira Martins and Gonçalo Nuno Rosado Morais	2011-2014	60.600 € (UL)
2. PTDC/MAT/114397/2009	"Non-linear degenerate elliptic equations and systems"	Diogo Luis de Castro Vasconcelos de Aguiar Gomes	José Maria Nunes de Almeida Gonçalves Gomes	2009- 2014	78.000 € (IST)
3. PTDC/SAU-ESA/71208/2006	"Molecular epidemiology of mycobacterium tuberculosis in Portugal: implementing and analysing a database"	Maria Gabriela Miranda Gomes	Paula Cristiana Costa Garcia da Silva Patrício Rodrigues	2008-2012 (extended)	171.750 € (FCG)
4. PTDC/FIS/101248/2008	"Co-evolution and self-organization of cooperation"	Francisco João Duarte Cordeiro Correia dos Santos	Fabio Augusto da Costa Carvalho Chalub	2010-2012	150.000 € (UNL)
5. PTDC/FIS/70973/2006	"Modeling of complex evolutionary processes"	Jorge Manuel dos Santos Pacheco	Fabio Augusto da Costa Carvalho Chalub	2009-2012 (extended)	65.000 € (UL)
6. UTAustin/MAT/0035/2008	"Analysis of nonlinear partial differential equations"	José Miguel Dordio Martinho de Almeida Urbano	Fabio Augusto da Costa Carvalho Chalub and Filipe Serra de Oliveira	2009-2013	100.000 € (University of Texas at Austin and FCT/Portugal) (UC)
7. Bilateral Agreement Portugal-Brazil	—	Maria Gabriela Miranda Gomes	Paula Cristiana Costa Garcia da Silva Patrício Rodrigues	2009-2011	10.000 € (FCT/Portugal and Capes/Brazil)
8. UTA_CMU/MAT/0007/2009	"Degenerate elliptic and parabolic equations and its applications to front propagation"	Diogo Luis de Castro Vasconcelos de Aguiar Gomes	Fabio Augusto da Costa Carvalho Chalub	2011-2014	209.997 € (IST)

6. 2. 2. Objectives

The principal aim of the group is to increase the number of publications. During the year 2010, the group published 6 papers in journals with peer review, while in 2011 the number increased to 9. For 2012, 7 papers are already accepted for publication. In 2011, one book edited by a group member was published. Currently (2011) the number of publications per member is 0.7; this number is likely to increase due to the progressive enrolment of post-docs in the group and to Ph.D. students in the final phase of their theses.

A second important goal is to increase collaboration within group members, which is still extremely low (1 paper in 2010 with more than one CMA member as author; 2 papers in 2011 in the same conditions). This number is likely to increase due to two factors: the progressive enrolment of post-docs (C. Kreisbeck was the first post-doc in the group) and the creation of new work subgroups (currently, F. Chalub, P. Rodrigues, P. Doutor and M. C. Soares are developing collaborations in math-biology).

It is also important to increase the level of internationalization of the group. The current level of international scientific collaborations is good (most of the group members have international collaborators), but the participation of group members in international meetings abroad is still low (only 2 talks by invitation and 4 contributed talks outside Portugal during 2011). Increasing that number will increase the impact of the research at EDAN/CMA/FCT/UNL.

We plan to continue to organize events (workshops, short-courses, etc), hosted in campus or outside campus. The average of one event per year seems adequated and feasible.

Funding is adequate, although some projects hosted by CMA will end during the year of 2012. Therefore, it is important to apply for new ones during the current year, in order to guarantee steady funding for 2013 and the following years.

The group values scientific diffusion and several of its members are involved in different activities for schools and public at large.

6. 2. 3. Main Achievements

A. M. Ribeiro finished a joint work with A. C. Barroso, and G. Croce on the generalization of existence results for vectorial differential inclusions, leading to an accepted paper in Houston Journal of Mathematics. A. M. Ribeiro and E. Zappale have submitted to publication the work “Relaxation of certain integral functionals motivated by imaging models”.

B. Louro and M. C. Soares made progresses on the well posedness of the Riccati equation that arrives from the invariant embedding method, applied to a Poisson problem in a non-cylindrical domain.

C. Kreisbeck worked with variational principles, subject to linear PDE. Constraints conveyed by a constant-rank operator A allow to treat a wide range of problems in continuum mechanics and electromagnetism in a unified way. In this project, 3d-2d dimension reduction was studied within the A -free framework. Jointly with Sergio Conti and Georg Dolzmann, research was also conducted in the relaxation of models in finite crystal plasticity. We considered a family of models in elastoplasticity describing crystals with one active slip system and linear hardening in two spatial dimensions. In particular, our studies focused on the asymptotic behavior of the system in the limit of diverging elastic coefficients.

F. Chalub submitted two articles, one resulting from an ongoing collaboration with Max Souza in the continuous limit of discrete processes, where a Kimura-type equation was obtained from the Wright-Fisher process. In particular, this proves the limited in time validity of the replicator equation. The second paper was related to experiments in game theory performed at the Azores archipelago.

F. Oliveira studied the local-well posedness of several dispersive systems, such as the quasilinear Benney system or the Schrodinger-Debye system. Regarding this last problem, the surprising result of global existence, in both focusing and defocusing, for initial large data was obtained.

F. Veiga continued the study of questions in general Topology and obtained an example of normality of a product, thus answering a conjecture posed by Mary Ellen Rudin.

J. M. Gomes submitted one article in the study of differential geometry aspects of the Nehari manifold.

L. Mascarenhas: We considered the Laplace operator in a thin three dimensional tube, with a Robin type condition on its boundary, and studied asymptotically the spectrum of such operator as the diameter of the tube's cross section becomes infinitesimal. In contrast with the Dirichlet condition case, we proved different and interesting behaviors, depending on a symmetry criterium for the fundamental mode in the cross section. L. Mascarenhas, in collaboration with L. Trabucho and G. Bouchitté, developed research in waveguides with Robin's conditions.

N. Arada submitted articles studying optimal control problems governed by Navier-Stokes equations with shear-dependent viscosity.

P. Doutor obtained some preliminar results that will hopefully allow to state a variational principle for the nonadditive topological pressure for flows.

P. Rodrigues submitted an alternative explanation for the increased reinfection cases among recurrent cases of tuberculosis. By using a simple model, experimental data was

interpreted as a result from heterogeneity effect and not necessarily from an enhanced susceptibility after recovery. The model was fitted to data resulting from a systematic literature review.

R. Ferreira concluded her Ph.D. in the scope of the CMU | Portugal Ph.D. Program in Applied Mathematics. As a result of her work, she had two papers accepted for publication in peer-reviewed journals. She received a post-doc fellowship due to start during the year 2012.

R. Martins sketched a theory of synchronization for coupled non-identical non-autonomous oscillators, coupled through an environment. On the other hand convergence was proved, i.e. the existence of an orbit that attracts all the other orbits in the future, for a model in liquid crystals in the presence of an alternating shear and magnetic fields.

6. 2. 4. Group Productivity

6. 2. 4. 1. Publications in Peer Review Journals

1. Adán Corcho, **Oliveira F.** and Jorge Silva, *Local and global well-posedness for the critical Schrödinger-Debye system*, to appear in Proceedings of the American Mathematical Society [Impact factor = 0.601].
2. Barroso, A. C., Croce, G. and **Ribeiro, A. M.**, *Sufficient conditions for existence of solutions to vectorial differential inclusions and applications*, to appear in Houston Journal of Mathematics [Impact factor = 0.539].
3. Carita, G., **Ribeiro, A. M.** and Zappale, E. (2011), *An homogenization result in $W^{1,p} * L^q$* , Journal of Convex Analysis, 18 (4) [Impact factor = 0.908].
4. **Chalub, F. A. C. C.** and Souza, M. O. (2011), *The SIR epidemic model from the PDE point of view*, Mathematical and Computer Modelling, 53 (7-8), 1568-1574 [Impact factor = 1.066].
5. Conti, Sergio, Dolzmann, Georg and **Kreisbeck, C.** (2011), *Asymptotic behavior of crystal plasticity with one slip system in the limit of rigid elasticity*, SIAM J. Math. Anal. 43 (5), 2337-2353 [Impact factor = 1.797].
6. Conti, Sergio, Dolzmann, Georg and **Kreisbeck, C.**, *Relaxation and microstructure in a model for finite crystal plasticity with one slip system in three dimensions*, to appear in Discrete Contin. Dyn. Syst. Series B [Impact factor = 0.874].
7. Dias, J-P., Figueira, M. and **Oliveira, F.** (2011), *Non-existence of global solutions for a quasilinear Benney system*, Journal of Mathematical Fluid Mechanics, 13, 81-94 [Impact factor = 0.786].

8. Dias, J-P., Figueira, M. and **Oliveira, F.** (2011), *On the Cauchy problem describing an electron-phonon interaction*, Chinese Annals of Mathematics, 32, 483-496 [Impact factor = 0.452].
9. **Ferreira, R.** and Fonseca, I., *Characterization of the multiscale limit associated with bounded sequences in BV*, to appear in Journal of Convex Analysis [Impact factor = 0.908].
10. **Ferreira, R.** and Fonseca, I., *Reiterated homogenization in BV via multiscale convergence*, to appear in SIAM J. Math. Anal. [Impact factor = 1.797].
11. **Ferreira, R., Mascarenhas, M. L.** and Piatnitski, A. (2011), *Spectral analysis in a thin domain with periodically oscillating characteristics*, ESAIM: Control, Optimisation and Calculus of Variations [Impact factor = 1.221].
12. **Gomes, J. M.** (2011), *Generalized invariant sub-and super-solutions for the energy decreasing flow*, Proceedings of the Royal Society of Edinburgh, 141 A, 521-536 [Impact factor = 0.669].
13. Henry, J., **Louro, B.** and **Soares, M. C.** (2011), *Factorization of linear elliptic boundary value problems in non-cylindrical domains*, C. R. Math. Acad. Sci. Paris, 349 (15-16), 879-882 [Impact factor = 0.399].
14. **Kreisbeck, C.**, *Thin-film limit of the micromagnetic free energy*, to appear in Quart. Appl. Math. [Impact factor = 0.697].
15. **T. Guerra**, *Distributed control for shear-thinning non-Newtonian fluids*, to appear in Journal of Mathematical Fluid Mechanics [Impact factor = 0.786].

6. 2. 4. 2. Other International Publications

Freire, Nuno and **Veiga, M. F.** (2011), *On the box topology on $[0, w+1]^w$ box topology*, Global Journal of Mathematical Sciences: Theory and Practical, 3 (3), 285-288.

6. 2. 4. 2. 1. Edition of Books

"The Mathematics of Darwin's Legacy", edited by **Fabio A. C. C. Chalub** and José Francisco Rodrigues, Birkhauser, Switzerland, 2011, ISBN: 978-3-0348-0121-8.

6. 2. 4. 2. 2. Proceedings

Chalub, F. A. C. C. and Souza, M. O., *Continuous models for genetic evolution in large populations*, Dynamics, Games and Science I (DYNA 2008 in honor of Maurício Peixoto and David Rand, University of Minho), Peixoto, Mauricio Matos; Pinto, Alberto Adrego; Rand, David A (Eds), Springer Proceedings in Mathematics, Vol. 1. 239-242, 2011.

6. 2. 4. 3. Other National Publications

Scientific popularization (in Portuguese)

Chalub, F. "Abelhas viajantes" (Gazeta de Matemática, April 2011).

Chalub, F. "Em ventos turbulentos" (Gazeta de Matemática, July 2011).

Chalub, F. "A Terra é Azulejo" (Gazeta de Matemática, December 2011).

6. 2. 4. 4. Preprint (submitted only, incomplete list)

Kreisbeck, C. and Rindler, Filip., Thin-film limits of functionals on A-free vector fields.

Conti, Sergio, Dolzmann, Georg and **Kreisbeck, C.**, Relaxation of a model in finite plasticity with two slip systems.

Chalub, F. A. C. C. and Souza, M. O., The frequency-dependent Wright-Fisher model: diffusive and non-diffusive approximations.

Almeida, A, Teixeira, R. and **Chalub, F. A. C. C.**, Pay-off relativizers and maximizers: Experiments with non-rational and spiteful behaviour in the Azores.

6. 2. 4. 5. Ph.D. Thesis Completed

Rita Ferreira

"Spectral and Homogenization Problems"

Carnegie Mellon University (under the scope of ICTI CMU/Portugal program in Applied Mathematics, involving CMU and FCT/UNL) 14 July 2011.

6. 2. 4. 6. Organization of Conferences

First Workshop in Game Theory and Evolutionary Dynamics, Niterói, Brazil, 31 January-4 February 2011.

Organizing committee: **Fabio Chalub**, Max Souza, Ralph Teixeira.

Summer School "Dynamical Models in Life Sciences" (Centro Internacional de Matemática, European Mathematical Society, European Society of Mathematical and Theoretical Biology), Évora, 24-30 July 2011.

Organizing committee: **Fabio Chalub**, Fernando Carapau, Francisco Santos, Nico Stollenwerk.

6. 2. 5. Internationalization

A. M. Ribeiro visited Università di Salerno, Italy (11-21 June), for lecturing a short-course and developing scientific collaboration with E. Zappale.

A. M. Ribeiro visited Université du Havre, France (1-9 October) for talk and collaboration with G. Croce.

C. Kreisbeck visited Oxford Centre for Nonlinear PDE (OxPDE) (March 2011, 3 weeks, visiting Filip Rindler).

C. Kreisbeck visited Universität Regensburg, Germany (June 2011, 2 weeks, visiting Georg Dolzmann).

C. Kreisbeck visited Universität zu Köln, Germany (July 2011, 3 days, visiting Stefan Krömer).

F. Chalub visited Universidade Federal Fluminense, Brazil (31 January-4 February), for lecturing a short-course and developing scientific collaboration with Max Souza.

L. Mascarenhas visited IMATH, Université du Sud, Toulon et Var, France (1-14 May), for giving a seminar and developing collaboration with G. Bouchitté.

L. Mascarenhas visited Carnegie Mellon University (8-23 April and 10-15 July) for giving a seminar, integrating a Ph.D. thesis committee and for developing scientific collaboration with Irene Fonseca.

R. Ferreira visited Carnegie Mellon University (20 March-23 April and 9-31 July), for developing scientific collaboration with Irene Fonseca and her Ph.D. defense.

Further ongoing international collaborations

A. M. Ribeiro, with G. Pisante (Seconda Università di Napoli, Italy).

C. Kreisbeck, with Irene Fonseca (Carnegie Mellon University, USA).

F. Oliveira is the principal investigator in a bilateral project with Brazil.

M. C. Soares, B. Louro, with Jacques Henry (INRIA Bordeaux Sud-Ouest, France).

P. Rodrigues participates in a bilateral project with Brazil.

R. Martins is the principal investigator in a bilateral project with Spain.

(i) Invited talks at international conferences

A. M. Ribeiro, Workshop on Nonlinear Analysis and Variational Problems, Sufficient conditions for existence of solutions to vectorial differential inclusions, Universidade de Évora, Portugal,

F. Chalub, First Workshop in Game Theory and Evolutionary Dynamics, Introduction to Population Dynamics, Niterói, February 2011.

F. Chalub, Mathematical Methods and Modeling of Biophysical Phenomena, Discrete and continuous models in evolutionary dynamics, Foz do Iguaçu, Brazil, March 2011.

F. Oliveira, UT-Austin Portugal Workshop in Mathematics, Local and Global well-posedness for the critical Schrodinger-Debye system, Instituto Superior Técnico.

L. Mascarenhas, Workshop on Nonlinear Analysis and Variational Problems, Waveguides with Robin conditions, Universidade de Évora, Portugal, 10-11 February 2011.

M. C. Soares, Recreational Mathematics Colloquium II, ClubeMath Games, Universidade de Évora, Évora, 30 April 2011.

R. Ferreira, Workshop on Nonlinear Analysis and Variational Problems, Multiscale convergence and reiterated homogenization in BV, Universidade de Évora, Portugal, 10-11 February 2011.

(ii) Contributed talks at international conferences

C. Kreisbeck, 7th International Congress on Industrial and Applied Mathematics-ICIAM 2011, Analytical aspects of relaxation for single-slip models in finite crystal plasticity Vancouver, Canada, July 2011.

C. Kreisbeck, 8th International Symposium on Hysteresis Modeling and Micromagnetics-HMM 2011, Thin-film limits in micromagnetics, Levico, Italy, June 2011.

F. Chalub, 8th European Conference in Mathematical and Theoretical Biology, Discrete and continuous models in evolutionary dynamics, Krakow, Poland, June 2011.

R. Martins, Generalized Synchronization of non-autonomous coupled systems, Equadiff 2011, Loughborough, England, August 2011.

6.3. Operational Research Team

Integrated Members

- Ana Luísa da Graça Batista Custódio
- Isabel Cristina Silva Correia
- Manuel Valdemar Cabral Vieira
- Maria do Carmo Proença Caseiro Brás
- Maria Isabel Azevedo Rodrigues Gomes
- Nelson Fernando Chibeles Pereira Martins
- Paula Alexandra da Costa Amaral Jorge
- Susana Maria Marques Henriques Botelho Baptista

Collaborators Members

- Ana Paula Ferreira Dias Barbosa Póvoa
- Rui Alberto Pimenta Rodrigues

6.3.1. Funding, Source, Dates

Projects led by team OR members:

	Project Title	Principal Investigator	Period	Total Funding
1. Luso-German Integrated Actions Action number A-20/11 2011	"New quantitative approaches for logistics network design problems"	Isabel Correia	2011	2.500 € for the year 2011
2. SFRH/BSAB/1091/2010	"Advanced training and qualification of human resources funded by the Fundação para a Ciência e Tecnologia"	Manuel Vieira	2011	2.850 €

Led by other institutions, with participation of team OR members, eventually with no budget in our institution:

	Project Title	Principal Investigator	Team Members	Period	Total Funding
1. PTDC/MAT/098214/2008	"Derivative-free optimization: future challenges and new applications"	Luís Nunes Vicente	Ana Luísa Custódio	2010-2013	158.256 € (UC)
2. PTDC/SEN-ENR/102869/2008	"PEERChain-design and planning of energy efficient and resilient supply chains"	Ana Paula Póvoa	Maria Isabel Gomes and Nelson Martins	2010-2012	199.991 € (IST)

6.3.2. Objectives

For the year 2012, the OR team will continue to develop research in combinatorial and nonlinear optimization.

Regarding nonlinear optimization, the group will strengthen its knowledge in the algorithmic development in global derivative-free optimization and eigenvalue complementary problem, will invest on solvers parallelization in derivative-free optimization (DFO), will continue to study the relation between the satisfiability problem and semi-definite programming and will further develop the application and solution of fractional quadratic problems. In detail, we aim at applying optimization methods to the design of electronic components and to solve fractional quadratic problems arising in electronics. For constrained fractional quadratic problems we aim at developing Branch and Bound methods. Still on algorithmic development, we aim at efficiently design algorithms for finding a solution of the eigenvalue complementarity problem and for computing multiple eigenvalues. In derivative-free optimization, we plan to continue with the parallelization of SID-PSM and DMS codes. Related to the development of a global solver for DFO, we aim to finish its convergence analysis and to develop a numerical implementation, which will be tested against other solvers commonly used in global optimization. We also plan to establish a direct relation between the Farkas' certificate of infeasibility and an unsatisfiable propositional formula. We claim that an exact SDP relaxation contains perfect information of a SAT instance. We question how to extract this information from the SDP model and what kind of information could be extracted.

In combinatorial optimization, the work will proceed on the development of facility location models and algorithms for the design of supply chains networks where aspects such as environmental impacts, uncertainty and resilience will be deepened. Work will carry on the study of hub location problems, on multi-depot, multi-product vehicle routing problems and on the dial-a-ride problem. More specifically, research will be pursued in supply chain design by proposing new formulations and addressing the problem of uncertainty in the design and planning of a multi-period, multi-product closed loop supply chain through stochastic programming. Moreover, a multi-objective context will be introduced in the study of facility location models so as to incorporate environmental concerns and, hopefully, social perspectives into problems that in the past were subject only to economic aspects. Since large exact formulations are expected, we aim at developing evolutive algorithms that demonstrate high levels of efficiency without losing effectiveness. The algorithms' performances will be compared with the exact approaches. Developments related with hub location and new variants of the resource constraint project scheduling problem will also be envisaged. In addition, the concept of resilient supply chains will be deepened. Concerning vehicle routing problems, the work related with the waste collection systems will pursue with the introduction of environmental aspects. Some work is to be developed on the dial-a-ride problem.

6. 3. 3. Main Achievements

The OR Team research focuses on combinatorial (CO) and nonlinear programming (NLP). In CO, studies were made on facility and hub location models, supply chain design models (SCD) and vehicle routing problems (VRP). Some special features were addressed by stochastic formulation. To overcome computational burden, an algorithm and a metaheuristic were developed. In detail, the multi-product capacitated single-allocation hub location problem, some formulations, inequalities and preprocessing tests were developed. In SCD, a two-echelon SC network was studied over a multi-period horizon. Two MILP models were proposed with different performance measures for the design of SC. Further developments were made on closed-loop supply chains (CLSC), with economical and environmental objectives with the application to real case studies. An extension of a CLSC model to stochastic customer demand and return was proposed with a two-stage stochastic formulation. The integer L-shaped algorithm was adopted as solution method, which outperformed the commercial solver CPLEX. An algorithm based on Simulated Annealing with two different functions controlling the acceptance probability was proposed. The algorithm performs an efficiency test on generated solutions and updates the Pareto front, if necessary. In VRP there was the development of a hybrid method with exact formulations. Lastly, first developments were made on the resilience concept of SC.

Regarding NLP, research addressed semidefinite problems (SDP), derivative-free optimization (DFO), fractional quadratic problems, the satisfiability problem and complementary problems. More specifically, the study on copositive exact formulations for the constrained fractional quadratic problem (CFQP) and the standard fractional quadratic problem (StFQP) was performed. For the StFQP we proved that dual attainability holds, while a more specific copositivity condition is needed for this result to hold for a general CFQP. Theoretical results were presented that have important implications in the computation of lower-bounds for the CFQP. Based on the copositive formulations, SDP relaxations were proposed providing good lower bounds. Small relative gaps were obtained, in the computational experience with SDP relaxation of the CFQP, when compared with the initial lower bound given by BARON. The equivalence between the process of resolution in SAT and a linear transformation of feasible sets of SDP relaxations was demonstrated. This connection allows a direct proof of the exactness of Lasserre's SDP relaxation without recourse to Lasserre's general theory. The SDP relaxation exactness proof showed how the relaxation implicitly deduces whether the empty clause can be derived by a finite sequence of resolution steps starting from the SAT formula. A nonlinear programming formulation for the eigenvalue complementarity problem (EiCP) was developed. An hybrid algorithm combining a projection technique and a modified Josephy-Newton method for the asymmetric EiCP was proposed. In multi-objective optimization, good features of a solver are related with the number and spread of points generated in the Pareto front. The numerical performance of DMS solver was improved with the use of a spread metric for reordering the poll set of points before polling, motivating a new code release. A

numerical study comparing several parallel implementations of DFO solvers was conducted in structural optimization problems. A first description of an algorithm for global DFO was proposed.

Overall, 3 papers were published in peer-review journals, 5 were accepted for publication, 5 papers appeared in international proceedings with peer-review, 3 in a national proceeding with peer-review and 1 pre-print was submitted for publication. The conducted research was presented in national/international meetings: 6 invited talks, 12 contributed and 2 posters. An international conference and other scientific meetings were co-organized. The OR Seminar continued.

6.3.4. Group Productivity

6.3.4.1. Publications in Peer Review Journals

1. **Brás, C. P.**, Fukushima, M., Júdice, J. J. and Rosa, S. S., *Variational inequality formulation of the asymmetric eigenvalue complementarity problem and its solution by means of gap functions*, to appear in Pacific Journal of Optimization [Impact factor = 0.392].
2. **Correia, I.**, Nickel S. and Saldanha da Gama F. (2011), *Hub and spoke network design with single-assignment, capacity decisions and balancing requirements*, Applied Mathematical Modelling, 35 (10), 4841-4851 [Impact factor = 1.371].
3. **Custódio, A. L.**, Madeira, J. F. A., Vaz, A. I. F. and Vicente, L. N. (2011), *Direct multisearch for multiobjective optimization*, SIAM Journal on Optimization, 21 (3), 1109-1140 [Impact Factor = 2.091].
4. **Gomes, M. I.**, Barbosa-Povoa, A. P. and Novais, A. Q. (2011), *Modelling a recovery network for WEEE: a case study in Portugal*, Waste Management, 31 (7), 1645-1660 [Impact factor = 2.358].
5. Pais, T. and **Amaral, P.**, *Managing the tabu list length using a fuzzy inference system: an application to examination timetabling*, to appear in Annals of Operations Research [Impact factor = 0.675].
6. Vicente, L. N. and **Custódio, A. L.**, *Analysis of direct searches for non-Lipschitzian functions*, to appear in Mathematical Programming [Impact Factor = 1.970].
7. **Vieira, M. V. C.**, *The accuracy of interior-point methods based on kernel functions*, to appear in Journal of Optimization Theory and Applications (available online) [Impact factor = 1.011].
8. **Vieira, M. V. C.**, *Interior-point methods for symmetric optimization based on a class of non-coercive kernel functions*, to appear in Optimization Methods and Software (available online) [Impact factor = 0.794].

6. 3. 4. 2. Other International Publications

6. 3. 4. 2. 1. Conference Proceedings with Peer-Review

1. Cardoso, J. B., Coelho, P. G. and **Custódio, A. L.** (2011), Parallel direct search in structural optimization, in Proceedings of the Second International Conference on Parallel, Distributed, Grid and Cloud Computing for Engineering, P. Iványi and B. H. V. Topping (editors), Civil-Comp Press, Stirlingshire, UK, Paper 48.
2. **Chibeles-Martins, N.**, Pinto-Varela, T., Barbosa-Povoa, A. P. and Novais, A. Q. (accepted), A simulated annealing for the design and planning of supply chains with economic and environmental objectives, to appear in Computer Aided Chemical Engineering , I. D. Lockhart Bogle and M. Fairweather (editors).
3. **Chibeles-Martins, N.**, Pinto-Varela, T., Barbosa-Povoa, A. P. and Novais, A. Q. (2011), A simulated annealing approach for the bi-objective design and scheduling of multipurpose batch plants, Computer Aided Chemical Engineering, E. N. Pistikopoulos, M. C. Georgiadis, and A. Kokossi (editors), 29, 865-869.
4. Furtado, P., **Gomes, M. I.** and Barbosa-Povoa, A. P. (2011), Design of an electric and electronic equipment recovery network in Portugal-costs vs. sustainability, Computer Aided Chemical Engineering, E. N. Pistikopoulos, M. C. Georgiadis and A. Kokossis (editors), 29, 1200-1204.
5. **Gomes, M. I.**, Zeballos, L. J., Barbosa-Povoa, A. P. and Novais, A. Q. (2011), Optimization of closed-loop supply chains under uncertain quality of returns, Computer Aided Chemical Engineering, E. N. Pistikopoulos, M. C. Georgiadis and A. Kokossis (editors), 29, 945-949.

6. 3. 4. 2. 2. Proceedings with Abstract Review

Ramos, T., **Gomes, M. I.** and Barbosa-Povoa, A. P. (2011), Restructuring service areas and vehicle routes in a recyclable waste collection system, in Proceedings of EUROMA conference, Cambridge, UK.

6. 3. 4. 3. Other National Publications

1. Fradinho, A., **Gomes, M. I.** and Barbosa-Povoa, A. P. (2011), Optimization of batteries sustainable distribution network with reverse flows, Proceedings of conference IO2011, Coimbra, Portugal, 13-24.
2. Ramos, T., **Gomes, M. I.** and Barbosa-Povoa, A. P. (2011), Solving a multi-product, multi-depot vehicle routing problem by a hybrid method, Proceedings of conference IO2011, Coimbra, Portugal, 261-273.

3. Santana, N. M., **Gomes, M. I.** and Barbosa-Povoa, A. P. (2011), Supply chain optimization: application to a real case, Proceedings of conference IO2011, Coimbra, Portugal, 199-211.

6.3.4.4. Preprint

Anjos, M. F. and **Vieira, M. V. C.** (2011), Semidefinite resolution and exactness of semidefinite relaxations for satisfiability, Le Cahiers du GERAD
<http://www.gerad.ca/fichiers/cahiers/G-2011-35.pdf>

6.3.4.5. Patents/Propotypes

Computational Codes

A. L. Custódio, J. F. A. Madeira, A. I. F. Vaz and L. N. Vicente, Direct MultiSearch (DMS): A solver for derivative-free multiobjective optimization (MATLAB), Version 0.2

Web Page: <http://www.mat.uc.pt/dms>

6.3.4.6. Organization of Conferences

Optimization2011, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 24-27 July 2011.

Co-chairs of the organizing committee: **P. Amaral, A. L. Custódio.**

Organizing committee: **S. Baptista, M. C. Brás, I. Correia, N. C. Martins and M. Vieira.**

6.3.5. Internationalization

6.3.5.1. Research

1. Immanuel Bomze, University of Wien-Joint research work with P. Amaral.
2. Luis J. Zeballos, Facultad de Ingeniería Química, Universidad Nacional del Litoral, Santa Fe, Argentina-Joint research work with M. I. Gomes.
3. Maria Teresa Melo, Business School, Saarland University of Applied Sciences, Saarbrücken, Germany-Joint research work with I. Correia.
4. Masao Fukushima-Graduate School of Informatics, Kyoto University, Japan-Collaborative publication with M. C. Brás.

5. Miguel F. Anjos, École Polytechnique de Montréal and member of the research center GERAD (Groupe d'Études et de Recherche en Analyse des Décisions), Canada-Joint research work with M. Vieira.

6. Stefan Nickel, Institute of Operations Research, Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany-Joint research work with I. Correia.

6.3.5.2. Scientific Committees of International Conferences

P. Amaral and A. L. Custódio-Members of the scientific committee of the conference Optimization 2011, 24-27 July 2011, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, Portugal.

(i) Invited talks at international conferences

1. Amaral, P., Bomze, I., Judice, J., Copositivity and constrained fractional quadratic problems, Tenth SIAM Conference on Optimization, Darmstadt, Germany, May 2011.

2. Amaral, P., The analysis and repair of inconsistent linear systems using global optimization, Optimization 2011, Tribute to Joaquim Júdice, Capuchos, Portugal, July 2011.

3. Correia, I., Nickel, S. and Saldanha da Gama F., Multi-product capacitated single allocation hub location problem: formulations and inequalities, EWGLA XIX-19th Meeting of the EURO Working Group On Locational Analysis, Nantes, France, October 2011.

4. Custódio, A. L., Madeira, J. F. A., Vaz, A. I. F. and Vicente, L. N., Direct multisearch: a new DFO approach for multiple objective functions, SC2011 International Conference on Scientific Computing, Cagliari, Italy, October 2011.

5. Custódio, A. L., Madeira, J. F. A., Vaz, A. I. F. and Vicente, L. N., Direct multisearch: A new DFO approach for multiple objective functions, Tenth SIAM Conference on Optimization, Darmstadt, Germany, May 2011.

6. Vieira, M. V. C., Direct representation of the resolution rule via semi-definite programming, Optimization Days, HEC Montréal, Montréal, Canada, May 2011.

(ii) Contributed talks at international conferences

1. Brás, C. P., Fukushima, M., Júdice, J. J. and Rosa, S. S., Variational inequality formulation of the asymmetric eigenvalue complementarity problem and its solution by means of a gap function, Optimization 2011, Caparica, Portugal, July 2011.

2. Correia, I., Lourenço, L. L. and Saldanha da Gama F., Formulation and inequalities for a multi-skill project scheduling problem, Optimization 2011, Caparica, Portugal, July 2011.
3. Correia, I., Melo, M. T. and Saldanha da Gama F., A multi-period two level network design problem with facility sizing decisions, EWGLA XIX-19th Meeting of the EURO Working Group On Locational Analysis, Nantes, France, October 2011.
4. Correia, I., Melo, M. T. and Saldanha da Gama F., Design of multi-period two-echelon logistics networks including facility sizing decisions, International Conference on Operations Research-OR 2011, Zurich, Switzerland, August 2011.
5. Correia, I., Nickel, S. and Saldanha da Gama F., Hub location problems with multiple flow categories, Optimization 2011, Caparica, Portugal, July 2011.
6. Correia, I., Nickel, S. and Saldanha da Gama F., Hub location problems with multiple flow categories, IFORS 2011, Melbourne, Australia, July 2011.
7. Gomes, M. I., Zeballos, L. J., Barbosa-Povoa, A. P. and Novais, A. Q., Optimization of closed-loop supply chains under uncertain quality of returns, 21st European Symposium on Computer Aided Process Engineering ESCAPE 21, Chalkidiki, Greece, June 2011.
8. Ramos, T., Gomes, M. I. and Barbosa-Povoa, A. P., A hybrid method to solve a multi-product, multi-depot vehicle routing problem arising in a recyclable waste collection system, VII ALIO/EURO-Workshop on Applied Combinatorial Optimization, Porto, Portugal, May 2011.
9. Ramos, T., Gomes, M. I. and Barbosa-Povoa, A. P., Restructuring service areas and vehicle routes in a recyclable waste collection system, EUROMA Conference, Cambridge, UK, June 2011.
10. Vieira, M. V. C., Direct representation of the resolution rule via semi-definite programming, Alpen-Adria Workshop on Optimization, Klagenfurt, Austria, May 2011.
11. Vieira, M. V. C., On the accuracy of interior-point methods based on kernel functions, Tenth SIAM Conference on Optimization, Darmstadt, Germany, May 2011.
12. Vieira, M. V. C., Semidefinite resolution and exactness of semidefinite relaxations for satisfiability, Optimization 2011, Caparica, Portugal, July 2011.

(iii) Posters

1. Chibeles-Martins, N., Pinto-Varela, T., Barbosa-Povoa, A. P., and Novais, A. Q., A simulated annealing approach for the bi-objective design and scheduling of multipurpose batch plants, 21st European Symposium on Computer Aided Process Engineering ESCAPE21, Chalkidiki, Greece, June 2011.

2. Furtado, P., Gomes, M. I. and Barbosa-Povoa, A. P., Design of an electric and electronic equipment recovery network in Portugal-costs vs. sustainability, 21st European Symposium on Computer Aided Process Engineering ESCAPE21, Chalkidiki, Greece, June 2011.

(iv) Invited seminars in other research units

1. Custódio, A. L., Direct-search methods for single and multiobjective derivative-free optimization: solving difficult problems in an efficient way, CMUC, Coimbra, Portugal, January 2011.

6.4. Statistics and Risk Management Team

Integrated Members

- Ayana Maria Xavier Furtado Mateus
- Carlos Manuel Agra Coelho
- Carlos Manuel Antunes Veiga
- Célia Maria da Silva Fernandes
- Dora Susana Raposo Prata Gomes
- Elsa Estevão Fachadas Nunes Moreira
- Filipe José Gonçalves Pereira Marques
- Francisco Paulo Vilhena Antunes Bernardino Carvalho
- Frederico Almeida Gião Gonçalves Caeiro
- Gonçalo José Nunes dos Reis
- João Filipe Lita da Silva
- João Tiago Praça Nunes Mexia
- Luís Miguel Lindinho da Cunha Mendes Grilo
- Luís Pedro Carneiro Ramos
- Manuel Leote Tavares Ingles Esquivel
- Maria de Lourdes Belchior Afonso
- Marta Cristina Vieira Faias Mateus
- Miguel Brás de Carvalho
- Miguel dos Santos Fonseca
- Paulo José Raimundo Ramos
- Ricardo Jorge Viegas Covas

Collaborators Members

- Alberto Adrego Pinto
- Célia Maria Pinto Nunes
- Claudia Vanessa Rosa Leitao de Macedo Roçadas
- Dário Jorge da Conceição Ferreira
- Dina Maria Morgado Salvador (Ph.D. student)
- Gracinda Rita Diogo Guerreiro
- Inês Jorge da Silva Sequeira
- Iola Maria Silvério Pinto
- João Beleza Teixeira Seixas e Sousa (Ph.D. student)
- José Moniz Lopes Fernandes (Ph.D. student)
- Paulo Jorge Canas Rodrigues (Ph.D. student)
- Pedro José dos Santos Palhinhas Mota
- Philippe Laurent Didier
- Rui Manuel Pesado Alberto
- Rui Manuel Rodrigues Cardoso
- Rute Alexandra Baião Carrujo (Ph.D. student)
- Sandra Cristina Dias Nunes
- Sandra Inês da Cunha Monteiro (Ph.D. student)
- Sandra Maria Bargão Saraiva Ferreira
- Vera da Conceição Vilelas Montes de Jesus

6. 4. 1. Funding, Source, Dates

Projects led by team SRM members:

	Project Title	Principal Investigator	Team Members	Period	Total Funding
1. Consulting Activity for Banco Atlântico Europa	"Software Platform for V@R portfolio computations"	Manuel Leote Esquível	João Beleza Sousa	2010-2011	50.000 €

Led by other institutions, with participation of team SRM members, eventually with no budget in our institution:

	Project Title	Principal Investigator	Team Members	Period	Total Funding
1. Project number 226544	"Models for adaptive forest management"	José G. Borges	Ayana Furtado	2009-2013	9.071 € (European Commission)
2. PTDC/MAT/101736/2008	"Extrema: statistical extremes in today's world"	Maria Ivette Leal de Carvalho Gomes	Dora Susana Raposo Prata Gomes and Frederico Almeida Caeiro	2010-2013	89.520 € (UL)
3. PTDC/EGE-ECO/108481/2008	"Evaluation of dividend barrier variables in the actuarial dual risk model"	Alfredo Duarte Egídio dos Reis	Rui Manuel Rodrigues Cardoso and Maria de Lourdes Afonso	2010-2013	21.510 € (UTL)
4. CCES Project	"CCES project spatial extremes and environmental sustainability: statistical methods and applications in geophysics and the environment"	Anthony Davison	Miguel Brás de Carvalho	2007-2011	—
5. UTA_CMU/MAT/0006/2009	"Stochastic analysis and numerical approximations in mathematical finance"	Cláudia Rita Ribeiro Coelho Nunes Philippart	Gonçalo dos Reis	—	—

6. 4. 2. Objectives

Ayana Furtado: The principal objective for 2011 was modelling the diameter distribution of *Eucalyptus globulus* in Portugal using a probability density function.

1) In the area of distribution theory (Carlos Agra Coelho, Filipe Marques, Luís Grilo, Rui Pesado Alberto) our research will be centered on the study of the exact distribution of sums and products of several random variables and on the exact, near-exact and asymptotic distributions of likelihood ratio statistics used to perform tests over complex

covariance structures in multivariate statistics. Our aim is the development of very accurate and easy to use near-exact and asymptotic approximations:

a) Development of several near-exact distributions for several likelihood ratio test statistics, namely those used in Multivariate Statistics to (i) circularity of the covariance matrix; (ii) circularity and stationarity.

b) To continue the development of near-exact distributions for statistics used in tests of complex structures in variance-covariance matrices (eg. multisample block-matrix and block-scalar sphericity) through the decomposition of the corresponding null hypotheses into sequences of nested, more elementary and conditionally independent hypotheses.

c) To pursue a general approach for the development of near-exact distributions for the most common l.r.t. statistics used in Multivariate Analysis (namely the ones to test: (i) independence of several blocks of variables, (ii) equality of several mean vectors, (iii) equality of several var-cov. matrices, (iv) sphericity).

d) To obtain the exact distribution of the product of powers of independent Uniform r.v.'s in a form which may enable us to obtain (i) the exact distribution of several l.r.t. statistics used in Multivariate Analysis in much simpler forms and (ii) much simpler finite expressions for several particular cases of the Meijer G function.

e) To develop two new l.r.t.'s and associated test statistics, together with their exact and near-exact distributions:

- a test that embraces both the multisample block-matrix and the multisample block-scalar sphericity tests,

- a second test, which may have interesting applications in the analysis of time series, which tests simultaneously the independence of several blocks of variables and the circularity of their covariance matrices, optionally together with stationarity.

2) In Extreme Value studies (Frederico Caeiro, Dora Prata Gomes):

a) Development of models and parameter estimators for heavy tail distributions in extreme value studies.

b) Use of computationally intensive methods for the estimation of parameters in extreme value studies, in the context of dependence.

c) Development of resampling methods in the estimation of parameters of rare events.

d) Development of estimators for several important parameters related to the extreme value distributions right tail, using probability weighted moments, since such estimators are known to be more efficient than m.l.e. estimators, for small to moderate sample sizes.

e) Modeling and estimation of spatial extremes.

f) Improvement of the estimation of several important model parameters used in Extreme Value Statistics.

Gonçalo dos Reis:

- Work on the topic of high-performance computing for FBSDE and its connection to Plasma Physics and Fluid Dynamics.
- Work on the topic of stability of numerical methods for SDEs and FBSDEs.
- To diversify my research focus, namely follow the direction of control theory and PDE theory.
- Continue to work on the connection of the above with application in finance.

Gracinda Rita Guerreiro, Marta Faias Mateus, João Tiago Mexia: Inference for open populations subject to periodical reclassifications. Evaluation of a Bonus Malus system in an open portfolio approach. Estimation of optimal bonus scales through confidence intervals.

Gracinda Rita Guerreiro, Manuel Leote Esquível, José Moniz Fernandes: Estimation of Default Probability in a Consumption Credit Portfolio of a Cabo Verde Bank considering risk classes for bank clients.

Gracinda Rita Guerreiro, Maria Lourdes Afonso, Rui Rodrigues Cardoso: Estimation of the probability of ruin in the presence of a bonus-malus system.

Miguel Brás Carvalho: My main objectives are currently the following: keep developing research on statistical modeling, estimation, and inference on problems of interest in statistics multivariate extremes; get further acquainted with Bayesian nonparametric inference.

6. 4. 3. Main Achievements

Carlos Agra Coelho, Filipe Marques, Luís Grilo, Rui Pesado Alberto: The objectives in 1.a) were achieved, with the submission of two papers and also the objectives in 1.b), with the submission of two other papers, one of which has already been accepted for publication, and the publication of two extended abstracts in a AIP Proceedings volume, indexed in ISI 1.c), which was partially achieved in 2010 with the publication of a paper and it was completed in 2011, with the publication of a second paper. Objective in 1.d) was achieved with the submission of a paper, already accepted for publication in the invited special volume of the Journal of Multivariate Analysis in memory of Samuel Kotz. 1.e) is being pursued as the Ph.D. Thesis work of two Ph.D. students. The objectives in 2 were achieved through the publication of 2 papers.

Frederico Caeiro, Dora Prata Gomes: Concerning the objectives in 2.:

- Asymptotic comparison at optimal levels of several reduced-bias extreme value index estimators.
- Study of a new bootstrap algorithm for adaptive estimation of parameters of rare events using probability weighted moments (PWM) estimators.
- Models for max-stable processes were considered in an application to the annual maxima of daily precipitation over the North of Portugal.
- A simulation study as well as an application to daily returns of the S&P 500 stock index in the extremal index estimation.
- Classical geostatistical methods were used to analyze separately the spatial variability of variables associated to physicochemical properties of calcareous soils and to model the dependence structure of the data.

Gonçalo dos Reis: In collaboration with C. Frei we considered a problem of interacting agents that take the performance of their peers into account. Using utility maximization tools this lead to a discussion on the existence of game equilibrium. The problem was then connected to an analysis on the existence of solution to multidimensional non-linear equations (in PDE language, multidimensional system with quadratic gradient terms).

We continued the developed of a new class of BSDE, namely "delay BSDE".

Marta Faias: In the context of markets with a high degree of commodity differentiation, we provided examples that confirm that even in an economy with a continuum of agents, thin market attributes could lead to monopolistic competition.

We concluded the public good provision work with a new result; we extended the neutrality result from Bergstrom, Blume and Varian (1985) by allowing for multiple private and public goods. Additionally, we developed the model that we will use to analyze the public good provision in markets with personalized prices

Miguel Fonseca: A methodology to make estimation on non-orthogonal mixed models using stochastic search was developed and established. Progresses were also made in discriminant analysis techniques for mixed linear multivariate models.

A mathematical model for the human spine was developed, as part of the human spine measurement device *Metrica Vertebral*.

Ayana Furtado: Johnson SB distribution was used to model the diameter distribution of *Eucalyptus globulus* in Portugal. We presented a new methodology to estimate the parameters of the distribution, where we develop a system of equations that relates stand characteristics with the non-central moments of the distribution. This way, we assure that the estimates obtained observe some restrictions that will enable them to

keep a sensible biological meaning. We developed also a methodology to simulate the diameter distribution based on a truncated sample from the national forest inventory.

Gracinda Rita Guerreiro, Marta Faias Mateus, João Tiago Mexia: We obtained results on the inference of the relative dimensions of the sub-populations in an open Markov populations model, namely asymptotic distribution and confidence regions. The obtained results were illustrated through the estimation of the evolution of a Pension Fund Beneficiaries.

6. 4. 4. Group Productivity

6. 4. 4. 1. Publications in Peer Review Journals

1. Arnold, B.C., **Coelho, C. A.** and **Marques, F. J.**, *The distribution of the product of powers of independent uniform random variables*, to appear in Journal of Multivariate Analysis [Impact Factor = 1.010].
2. **Caeiro, F.** and Gomes, M.I. (2011), *Asymptotic comparison at optimal levels of reduced-bias extreme value index estimators*, Statistica Neerlandica, 65, 462-488 [Impact Factor = 0.322].
3. **Caeiro, F.** and Gomes, M.I. (2011), *Semi-parametric tail inference through probability-weighted moments*, Journal of Statistical Planning and Inference, 141, 937-950 [Impact Factor = 0.691].
4. **Coelho, C. A.** and **Marques, F. J.**, *Near-exact distributions for the likelihood ratio test statistic to test equality of several variance-covariance matrices in elliptically contoured distributions*, to appear in Computational Statistics [Impact Factor = 0.5].
5. **de Carvalho, M.**, Rodrigues, P., Rua, A. (2011), *Tracking the US business cycle with a singular spectrum analysis*, Economics Letters, 114, 32-35 [Impact Factor = 0.449].
6. **de Carvalho, M.**, Júlio, P. (2011), *Digging out the PPP hypothesis: an integrated empirical coverage*, Empirical Economics [Impact Factor = 0.714].
7. **de Carvalho, M.**, **Fonseca, M.**, Oliveira, M. and **Mexia, J. T.** (2011), *A dimension reduction technique for estimation in linear mixed models*, to appear in Journal of Statistical Computation and Simulation, 1-8 [Impact Factor = 0.469].
8. **dos Reis, G.**, Réveillac, A. and Zhang, J. (2011), *FBSDEs with time delayed generators: L_p -solutions, differentiability, representation formulas and path regularity*, Stochastic Process. Appl., 121 (9), 2114-2150 [Impact Factor = 0.951].

9. **Esquível M. L., Veiga C.** and Wystup U. (2011), *Unifying exotic option closed formulas*, Review of Derivatives Research [Impact Factor = 0.389].
10. **Faias, Marta,** Hérves, Carlos and Moreno, Emma (2011), *Equilibrium price formation in markets with differential informed agents*, Economic Theory, 48, 205-218 [Impact Factor = 0.623].
11. Gauch, H. G., **Rodrigues, P. C.,** Munkvold, J. D., Heffner, E. L. and Sorrells, M. (2011), *Two new strategies for detecting and understanding QTL by environment interactions*, Crop Science, 51, 96-113 [Impact Factor = 2.020].
12. **Grilo, L. M. and Coelho, C. A.,** *A family of near-exact distributions based on truncations of the exact distribution for the generalized Wilks Lambda statistic*, Communications in Statistics-Theory and Methods [Impact Factor = 0.351].
13. **J. Beleza Sousa, M. L. Esquível** and R. M. Gaspar (2011), *Machine learning Vasicek model calibration with Gaussian processes*, Communications in Statistics-Simulation and Computation, 41 (6) [Impact Factor = 0.343].
14. **M. L. Esquível, J. T. Mexia, J. L. da Silva** and **L. P. C. Ramos,** *On the rate of convergence of some asymptotic expansions and distribution approximations via an Esseen type estimate*, to appear in Communications in Statistics-Theory and Methods [Impact Factor = 0.351].
15. **Marques, F. J., Coelho, C. A.** and Arnold, B. C. (2011), *A general near-exact distribution theory for the most common likelihood ratio test statistics used in multivariate statistics*, Test, 20 (1), 180-203 [Impact Factor = 1.036].
16. **Marques, F. J. and Coelho, C. A.,** *The block sphericity test-the exact and near-exact distributions of the likelihood ratio statistic*, to appear in Mathematical Methods in the Applied Sciences [Impact Factor = 0.84].
17. **Mateus, A.** and Tomé M. (2011), *Modelling the diameter distribution of eucalyptus plantations with Johnson's SB probability density function: parameters recovery from a compatible system of equations to predict stand variables*, Annals of Forest Science, 68, 325-335 [Impact Factor = 1.326].
18. **Moreira, E. E., Mexia, J. T.,** Pereira, L. S., *Are droughts occurrence and severity aggravating? A study on SPI drought class transitions using loglinear models and ANOVA-like inference*, to appear in Hydrology and Earth System Sciences [Impact Factor = 2.463].
19. **Moreira, E. E., Mexia J. T.,** Pereira, L. S., *Assessing the homogeneous regions relative to drought class transitions using an ANOVA-like inference*, to appear in Stochastic Environmental Research and Risk Assessment [Impact Factor = 1.777].

20. Nunes, C., Ferreira, D., Ferreira, S. and **Mexia, J. T.** (2011), F tests with a rare pathology, *J. Appl. Stat.* [Impact Factor = 0.306].
21. Nunes, C., Oliveira, M. M. and **Mexia, J. T.** (2011), *Application domains for the Delta method*, *Statistics* [Impact Factor = 0.519].
22. Nunes, C., Ferreira, D., Ferreira, S. and **Mexia, J. T.** (2011), *Control of the truncation errors for generalized F distributions*, *J. Stat. Comput. Simul.* [Impact Factor = 0.469].
23. Paderewski, J., Gauch, H. G., Madry, W., Drzazga and **Rodrigues, P. C.** (2011), *Yield response of winter wheat to agro-ecological conditions using AMMI and cluster analysis*, *Crop Science*, 51, 969-980 [Impact Factor = 2.020].
24. R. Salgado, R. Marques, J. P. Noronha, **Mexia, J. T.**, G. Carvalho, A. Oehmen and A. M. Reis (2011), *Assessing the diurnal variability of pharmaceutical and personal care products in a full-scale activated sludge plant*, *Environmental Pollution* 159 (10), 2359-2367 [Impact Factor = 3.395].
25. **Rodrigues, P. C.**, Pereira, D. and **Mexia, J. T.** (2011), *A comparison between JRA and AMMI: the robustness with increasing amounts of missing data*, *Scientia Agricola*, 68, 679-686 [Impact Factor = 0.816].
26. Roy, A. and **Fonseca, M.** (2011), *Linear models with doubly exchangeable distributed errors*, to appear in *Communications in Statistics: Theory and Methods* [Impact Factor = 0.351].

6. 4. 4. 2. Other International Publications

1. **Caeiro, F.** and Gomes, M. I. (2011), Asymptotic distribution of an extreme value index estimator based on the scaled Log-spacings, *Proceedings of the International Conference on Numerical Analysis and Applied Mathematics 2011, ICNAAM 2011*, 1467-1470.
2. **Caeiro, F.** and Gomes, M. I. (2011), Computational validation of an adaptive choice of optimal sample fractions, *Proceedings of the 58th World Statistics Congress*.
3. **Caeiro, F.** and Gomes, M. I. (2011), Light-Tail estimation: a negative moment EVI-estimator and an application to environmental data, *Book of Abstract of 7th Conference on Extreme Value Analysis, Probabilistic and Statistical Models and their Applications*, 14-15.
4. **Caeiro, F.** and Gomes, M. I. (2011), Probability weighted moments bootstrap estimation: a case study in the field of insurance, *Book of Abstract of Risk & Extreme Values in Insurance and Finance*, 27-30.

5. **Carvalho, F.** and **Mexia, J. T.** and **Covas, R.**, and **Fernandes, C.** (2011), A fundamental partition in models with commutative orthogonal block structure, AIP Conf. Proc., 1389, 1615-1618.
6. **Coelho, C. A.** and **Marques, F. J.** (2011), On the Exact, Asymptotic and near-exact distributions for the likelihood ratio statistics to test equality of several exponential distributions, AIP Conference Proceedings, 1389, 1471-1474.
7. **Covas, R.** and **Mexia, J. T.**, **Fernandes, C.** and **Ramos, P.** (2011), Inference with inducer pivot variables, an Application to the One-Way ANOVA, AIP Conf. Proc. 1389, 1631-1634.
8. **de Carvalho, M.** (2011), Confidence intervals for the minimum of a function using extreme value statistics, International Journal of Mathematical Modelling and Numerical Optimisation, 2, 288-296.
9. **de Carvalho, M.**, Davison, A. C. (2011), Semiparametric Estimation for K-Sample Multivariate Extremes, Proceedings of the 58th World Congress of the International Statistical Institute.
10. **dos Reis, G.** (2011), Some advances on quadratic BSDE: Theory-Numerics-Applications, LAP LAMBERT Academic Publishing.
11. **Fernandes, C.** and **Mexia, J. T.**, **Ramos, P.** and **Carvalho, F.** (2011), Models with Stair Nesting, AIP Conf. Proc. 1389, 1627-1630.
12. Ferreira, S., Ferreira, D., Nunes, C. and **Mexia, J. T.** (2011), Discriminant analysis and decision theory. Far East J. Math. Sci. (FJMS), 51(1), 69-79. Indexed in SCOPUS [SNIP 2010 = 0.552].
13. Ferreira, S., Ferreira, D., Nunes, C. and **Mexia, J. T.**, Estimation and crossing for models with commutative orthogonal block structure, to appear in Advances and Applications in Statistical Sciences.
14. **Fonseca, M.**, Mathew, M., Mexia, J. T. and Zmyslony, R. (2011), Confidence Intervals for Mixed Log-Normal Models. AIP Conf. Proc., 1623-1626.
15. Frei, C. and **dos Reis, G.** (2011), A financial market with interacting investors: does an equilibrium exist? Math. Financ. Econ. 4 (3), 161-182.
16. **Guerreiro, G. R.**, **Mexia, J. T.** and Miguens, M. F., Preliminary Results on Confidence Intervals for Open Bonus Malus Systems, to appear in Selected Papers of XVII Congress of SPE 2009.
17. **Marques, F. J.** and **Coelho, C. A.** (2011), The Multi-sample Block-matrix Sphericity Test, AIP Conference Proceedings, 1389, 1479-1482.

18. **Mateus A.** and Tomé M. (2011), Fitting Johnson's SB distribution to forest tree diameter, to appear in Selected Papers SPE 2009.
19. **Mateus A.** and Tomé M. (2011), Estimating Johnson's SB parameters of eucalyptus plantations diameter distribution from a truncated sample, Boletim Sociedade Portuguesa de Matemática, número especial 2010, 171-176.
20. **Mateus A.** and Tomé M. (2011), Estimating the parameters of the Johnson's SB distribution using an approach of Method of Moments, Numerical Analysis and Applied Mathematics, ICNAAM 2011, AIP Conf. Proc, 389, 1483-1485.
21. **Mexia, J. T.**, Nunes, C. and Oliveira, M. M. (2011), Multivariate application domains for the Delta method, 9th International Conference on Numerical Analysis and Applied Mathematics, AIP Conf. Proc., 1389, 1486-1489.
22. **Mexia, J. T.**, Nunes, C., Ferreira, D., Ferreira, S. S. and **Moreira, E.** (2011), Orthogonal fixed effects ANOVA with random sample sizes, Proceedings of the 5th International Conference on Applied Mathematics, Simulation, Modelling (ASM'11), Corfu, Greece, 84-90. Proceedings ISI.
23. **Mexia, J. T.**, Nunes, C., Ferreira, D., Ferreira S. and **Moreira, E.** (2011), Orthogonal fixed effects ANOVA with random sample sizes. WSEAS proceedings of the 5th International conference on Applied Mathematics, Simulation, Modelling. Included in ISI/SCI Web of Science and Web of Knowledge and Scopus.
24. **Moreira, E. E.** and **Mexia, J. T.** (2011), Multi-treatment regression analysis: the unbalanced case, WSEAS proceedings of the 5th International conference on Applied Mathematics, Simulation, Modelling. Included in ISI/SCI Web of Science and Web of Knowledge and Scopus.
25. Nunes, C., Ferreira, D., Ferreira, S. and **Mexia, J. T.**, Generalized F distributions with random non-centrality parameters: The convolution of Gamma and Beta variables, to appear in Far East J. Math. Sci. (FJMS). Indexed in Scopus [SNIP 2010 = 0.552].
26. Oumow, B., **de Carvalho, M.**, Davison, A.C. (2011), A Bayesian P-Spline Mixture Model for Nonstationary Extremes, Proceedings of the 17th European Young Statisticians Meeting-European Regional Committee of the Bernoulli Society, Ed. P. Rodrigues and M. de Carvalho.
27. **Gomes, D. P.**, **Mexia, J. T.** and Neves, M. (2011), Simulation study of the calibration technique in the extremal index estimation, to appear in Selected Papers SPE 2009.
28. **Gomes, D. P.** and Neves, M. (2011), Geostatistics for spatial extremes, A case study of maximum annual rainfall in Portugal, Procedia Environmental Sciences, Spatial Statistics 2011, Elsevier, 7, 246-251.

29. **Gomes, D. P.** and Neves, M. (2011), Resampling Methodologies and the Estimation of Parameters of Rare Events, Numerical Analysis and Applied Mathematics, ICNAAM 2011, AIP Conf. Proc, 1389, 1475-1478.
30. **Ramos, P., Mexia, J. T., Carvalho F.** and **Covas R.** (2011), Interaction in Balanced Cross Nested Designs, AIP Conf. Proc., 1389, 1619-1622.
31. Torres, M. O., Neves, M. and **Gomes, D. P.** (2011), Spatial Analysis of some soil physicochemical properties in mountainous massif of Sicó, Portugal, Proceedings of SPATIAL 2- Spatial Data Methods for Environmental and Ecological Processes (2nd Edition), Barbara Cafarelli (ed.), 376-379.

6. 4. 4. 3. Other National Publications

1. **Caeiro, F.** and **Gomes, D. P.** (2011), Estimação semi-paramétrica de quantis elevados pelo método dos momentos ponderados de probabilidade. Boletim da Sociedade Portuguesa de Matemática-Actas do Encontro Nacional da SPM, 183-190.
2. **Caeiro, F.** and Gomes, M. I., Asymptotic comparison at optimal levels of minimum-variance reduced-bias tail index estimators. Aceite para publicação em Studies in Theoretical and Applied Statistics-“Selected Papers of the Statistical Societies”.
3. **Caeiro, F.** and Gomes, M. I. (2011), A class of semi-parametric probability weighted moment estimators. Pré-publicações 16/2011, CMA. Submetido.
4. **Caeiro, F.,** Gomes, M. I. and Vandewalle, B. (2011). Semi-Parametric Probability-Weighted Moments Estimation Revisited. Notas e Comunicações no 03/11, CEAUL. Submetido.
5. **Coelho, C. A., Oliveira, S.** and **Marques, F. J.** (2011), Exact and near-exact distributions for the likelihood ratio test statistics used to test for stationarity and circularity in multivariate models, Pré-Publicação, Departamento de Matemática da Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa, 05/2011.
6. **Coelho, C. A.** and **Marques, F. J.** (2011), The multi-sample block-scalar sphericity test-exact and near-exact distributions for its likelihood ratio test statistic, Pré-Publicação, Departamento de Matemática da Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa, 20/2011.
7. **Coelho, C. A., Marques, F. J.,** and Arnold, B. C. (2011), A general approach to the exact and near-exact distributions of the main likelihood ratio test statistics used in the complex multivariate Normal setting, Pré-Publicação, Departamento de Matemática da Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa, 19/2011.
8. **Esquível M. L., Mota P. P.** (2011), On some auto-induced regime switching double threshold glued diffusions. Pré-Publicação, Departamento de Matemática da Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa, 21/2011.

9. **Esquível M. L.**, Dimas L., **Mexia J. T.**, **Didier P.** (2011), Pequenas perturbações com grandes efeitos no Value-at-Risk. Preprint CMA 8-2011.

10. **Marques, F. J.**, **Coelho, C. A.** and Marques, P. (2011), The block-matrix sphericity test-exact and near-exact distributions for the test statistic, Pré-Publicação, Departamento de Matemática da Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa, 10/2011.

11. **Marques, F. J.** and **Coelho, C. A.** (2011), The exact and near-exact distributions of the likelihood ratio statistic for testing circular symmetry, Pré-Publicação, Departamento de Matemática da Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa, 01/2011.

6. 4. 4. 4. Organization of Conferences

Mat-Triad'2011, Tomar, Portugal, 12-16 July 2011.

Scientific committee:

Tomasz Szulc (Poland)-Chair

João T. Mexia (Portugal)

Ljiljana Cvetković (Serbia)

Heike Faßbender (Germany)

Simo Puntanen (Finland)

Organizing committee:

Francisco Carvalho (Portugal)-Chair

Katarzyna Filipiak (Poland)-Vice-Chair

Miguel Fonseca (Portugal)

Paulo C. Rodrigues (Portugal)

UECE Lisbon Meetings 2011: Game Theory and Applications, Lisboa, Portugal, 3-5 November 2011.

Scientific committee: **Marta Faias**.

Annual Meeting of the Association for Public Economic Theory, Indiana University, Bloomington, USA, 1-5 June 2011.

Scientific committee: **Marta Faias**.

17th European Young Statisticians Meeting Universidade Nova de Lisboa 5-9 September 2011.

Co-chair of the organizing committee: **Miguel Brás Carvalho**.

PE&RC day 2011-Innovation for Sustainability, Wageningen, The Netherlands, 20 October 2011.

Member of the organizing committee: **Paulo Canas Rodrigues**.

17th European Young Statisticians Meeting, Caparica, Portugal, 5-9 September 2011. Chair of the local organizing committee and chair of the international organizing committee/scientific program committee: **Paulo Canas Rodrigues**.

11th annual conference of ENBIS (European Network for Business and Industrial Statistics), Coimbra, Portugal, 4-8 September 2011. Member of the international program committee and invited paper session organizer-“ISBIS Session at ENBIS-11: Design of Experiments and Applications”: **Paulo Canas Rodrigues**.

YSI 2011-ISI Young Statisticians Meeting, Dublin, Ireland, 19-21 August 2011. Member of the international scientific program committee: **Paulo Canas Rodrigues**.

Mat Triad 2011 Conference, Tomar, Portugal, 12-16 July 2011. Member of the organizing committee: **Paulo Canas Rodrigues**.

Plant Soil Interaction Discussion Group, Wageningen University, The Netherlands, 15 March 2011. Seminar organizer: **Paulo Canas Rodrigues**.

6. 4. 5. Internationalization

Miguel Brás Carvalho: Currently working as joint editor of a special issue to be published in Communications in Statistics-Theory and Methods, dedicated to the 17th European Young Statisticians Meeting, European Regional Committee of the Bernoulli Society. Currently working as joint editor of the special issue “A Collection of Surveys on Tail Event Modeling” to be published at Revstat-Statistical Journal. Joint editor of the proceedings of the 17th European Young Statisticians Meeting-European Regional Committee of the Bernoulli Society. Main instructor of the course “Modeling Statistics of Extremes” given during the 56th RBRAS-the annual meeting of a regional section of the International Biometric Society; this course is joint work with Stuart Coles and Anthony Davison. Books in Preparation: Coles, S., Davison, A. C., de Carvalho, M. “An Introduction to Statistical Modeling of Extreme Values,” New York: Springer. (Revision to previous edition). Visiting host of Professor Tim Hanson-University of South Carolina, Department of Statistics (November 11-November 22). Reviewing: Journal of the American Statistical Association, Biometrika, Annals of Applied Statistics, Mathematics and Computers in Simulation, Journal of Statistical Computation and Simulation, Journal of Statistical Theory and Practice, Communications in Statistics-Theory and Methods.

Miguel Fonseca: Research stays:

- Universty of Maryland, Baltimore County, USA, April 2011.
- University of Zielona Góra, Poland, September 2011.

Marta Faias: Collaborative research with:

Emma Moreno-Garcia, Universidad de Salamanca, Espanha; Mário Páscoa, Nova School of Business and Economics, Universidade Nova de Lisboa; Carlos Hérves, Universidad de Vigo, Espanha; Myrna Wooders, Vanderbilt University, Nashville, USA; Jaime Luque, Universidad Carlos III de Madrid, Espanha.

Paulo Canas Rodrigues: Joint research with researchers at Cornell University, USA; Wageningen University, The Netherlands; Poznan University of Life Sciences, Poland; Utrecht University, The Netherlands; Évora University, Portugal; Warsaw University of Life Sciences, Poland; University of Waterloo, Canada.

Paulo Canas Rodrigues: Lecturer at Wageningen University, The Netherlands, September of 2011 to March of 2012.

Paulo Canas Rodrigues: Research Assistant at Group of Mathematical and Statistical Methods (Biometris), Wageningen University and Research Centre, The Netherlands, September of 2009 to September of 2011. Host: Professor Fred van Eeuwijk.

(i) Invited talks at international conferences

1. Carlos Agra Coelho, The multi-sample block-scalar sphericity test-exact and near-exact distributions for its likelihood ratio test statistic-17th European Young Statisticians Meeting, Lisbon, Portugal, 5-9 September 2011.

2. Carlos Agra Coelho, Bounds and improved computation for approximate quantiles-5th Workshop on Statistics, Mathematics and Computation: Methods and Applications-Universidade do Algarve, Faro, 11-12 July 2011.

3. Elsa Moreira, Multi-treatment regression analysis: the unbalanced case, WSEAS-ASM'11, 5th International conference on Applied Mathematics, Simulation, Modelling, Corfu, Greece, July 2011.

4. João Tiago Mexia, Estimations in linear mixed models. Invited speaker at 5th Workshop on Statistics, Mathematics and Computation: Methods and Applications, Faculdade de Economia, Universidade do Algarve, Portugal, July 2011.

5. Marta Faias, UECE Lisbon Meetings 2011: Game Theory and Applications, Lisboa, Portugal, 3-5 November 2011.

6. Marta Faias, Annual Meeting of the Association for Public Economic Theory, Indiana University, Bloomington, USA, 1-5 June 2011.

7. Miguel Brás Carvalho, Spectral Density Ratio Models for Multivariate Extremes, Special Topic Session STS040, 58th World Statistics Congress of the International Statistical Institute, Dublin, Ireland, 21-26 August 2011.

8. Miguel Fonseca, Building linear models, Prob&Stat Day@UMBC and USA, Confidence intervals for mixed log-linear models, ICNAAM 2011, Greece, 19-25 September 2011.
9. Paulo Canas Rodrigues, 5th Workshop on Statistics, Mathematics, and Computation: Methods and Applications, A new statistical method to identify the genetic basis of plant responses to stress, Faro, Portugal, July 2011.
10. Paulo Canas Rodrigues, 5th Workshop on Statistics, Mathematics, and Computation: Methods and Applications, Analysing genotype by environment interaction by curvilinear regression (joint work with S. Mejza, I. Mejza, D. Pereira and J.T. Mexia), Faro, Portugal, July 2011.
11. Paulo Canas Rodrigues, Third annual SPICY meeting, INRA, “A sensitivity analysis of physiological genotype to phenotype crop growth modes models”, Avignon, France, April 2011.

(ii) Contributed talks at international conferences

1. Ayana Furtado, Numerical analysis and applied mathematics, 9th International Conference of Numerical Analysis and Applied Mathematics, ICNAAM 2011, Greece, 19-25 September 2011.
2. Carlos Agra Coelho, On the exact, asymptotic and near-exact distributions for the likelihood ratio statistics to test equality of several Exponential distributions, 9th International Conference of Numerical Analysis and Applied Mathematics, ICNAAM 2011, Greece, 19-25 September 2011.
3. Célia Fernandes, Crossing balanced nested and stair nested designs, MAT-TRIAD 2011, Tomar, Portugal, 12-16 July 2011.
4. Célia Fernandes, Models with stair nesting, 9th International Conference of Numerical Analysis and Applied Mathematics, ICNAAM 2011, Greece, 19-25 September 2011.
5. Dário Ferreira with S. S., Nunes, C. and Mexia, J.T., Estimating variance components in models with additivity, oral communication in MAT TRIAD 2011, Tomar, Portugal, 12-16 July 2011.
6. Dora Prata Gomes, Resampling Methodologies and the Estimation of Parameters of Rare Events, Numerical analysis and applied mathematics, 9th International Conference of Numerical Analysis and Applied Mathematics, ICNAAM 2011, Greece, 19-25, September 2011.
7. Dora Prata Gomes, Computer-intensive methods in an adaptive estimation of parameters of rare events, 4th International Conference of the ERCIM Working Group on Computing & Statistics, University of London, UK, 17-19 December 2011.

8. Filipe Marques, On the linear combination of independent Gumbel random variables, 17th European Young Statisticians Meeting, Lisbon, Portugal, 5-9 September 2011.
9. Filipe Marques, The multi-sample block-matrix sphericity test, 9th International Conference of Numerical Analysis and Applied Mathematics, ICNAAM 2011, Greece, 19-25 September 2011.
10. Frederico Caeiro, Asymptotic Distribution of an Extreme Value Index estimator Based on the Scaled Log-spacings, 9th International Conference of Numerical Analysis and Applied Mathematics, ICNAAM 2011, Greece, 19-25 September 2011.
11. Frederico Caeiro, Computational Validation of an Adaptive Choice of Optimal Sample Fractions, ISI 2011, 58th World Statistics Congress of the International Statistical Institute, Dublin, 21-26 August 2011.
12. Frederico Caeiro, Light-Tail Estimation: a Negative Moment EVI-estimator and an Application to Environmental Data-EVA 2011-7th Conference on Extreme Value Analysis, Probabilistic and Statistical Models and their Applications, Lyon, France, 27 June-1 July 2011.
13. João Beleza Sousa, Catastrophic Value at Risk, Mathematica Portugal First User Group Meeting, Coimbra, Portugal, 18 April 2011.
14. João Beleza Sousa, Machine learning Vasicek model calibration with Gaussian processes for portfolios, IME 2011, Trieste, Itália, July 2011.
15. João Tiago Mexia, Boolean algebras of commutative Jordan algebras-application to nesting and interaction, 5th Annual Probability and Statistics Day at UMBC, Department of Mathematics and Statistics, University of Maryland, Baltimore County, USA, 22-23 April 2011.
16. João Tiago Mexia, Multivariate application domains for the Delta method, oral communication, 9th International Conference of Numerical Analysis and Applied Mathematics, ICNAAM 2011, Greece, 19-25 September 2011.
17. João Tiago Mexia, Orthogonal fixed effects ANOVA with random sample sizes, 5th International Conference on Applied Mathematics, Simulation, Modelling (ASM'11), Corfu Island, Greece, July 2011.
18. José Moniz Fernandes, On an Actuarial-Financial Model for a Consumption Credit of Cabo Verde: Preliminary Statistical Analysis, IME 2011, Trieste, Itália, July 2011.
19. Gracinda Rita Guerreiro, A Model for Open Populations subject to periodical reclassifications, IME 2011, Trieste, Itália, July 2011.
20. Manuel Leote Esquível, On a continuous time stock price model with regime switching delay and threshold, IME 2011, Trieste, Itália, July 2011.

21. Manuel Leote Esquível, On the information content of stochastic algorithms for global optimization, Optimization 2011, Caparica, Portugal, July, 2011.
22. Marta Faias, XX European Workshop on General Equilibrium Theory-EWGET 2011, Vigo, Spain, 13-15 June 2011.
23. Marta Faias, 11th Conference of the Society for the Advancement of Economic Theory, Faro, Portugal, 26 June-1 July 2011.
24. Marta Faias, Sorbonne Workshop in Economic Theory, Paris, June 2011.
25. Miguel Brás Carvalho, Spectral Density Ratio Models for Multivariate Extremes, Joint Statistical Meetings, Miami, US, 30 July-4 August 2011.
26. Paulo Canas Rodrigues, XIX conference of the Portuguese Statistical Society, Comparison of statistical methods for the identification of the genetic basis of plant responses to stress (joint work with M. Malosetti, M. Boer, H.G. Gauch and F. Van Eeuwijk), Nazaré, Portugal, September 2011.
27. Paulo Canas Rodrigues, CEN 2011, Analysing genotype by environment interaction by curvilinear regression (joint work with S. Mejza, I. Mejza, D. Pereira and J.T. Mexia), Zurich, Switzerland, September 2011.
28. Paulo Canas Rodrigues, 58th World Statistics Congress of the International Statistical Institute (ISI), Approximating physiological nonlinear genotype-phenotype models by linear-bilinear models (joint work with Fred van Eeuwijk), Dublin, Ireland, August 2011.
29. Paulo Canas Rodrigues, 2011 Joint Statistical Meetings, Simulation of GEI and QEI using a genotype to phenotype model with physiological parameters without GEI, Florida, USA, August 2011.
30. Paulo Canas Rodrigues, Mat Triad 2011, Weighted singular value decomposition and application to the study of QTL by environment interactions, Tomar, Portugal, July 2011.
31. Paulo Ramos, Interaction in balanced cross nested designs, 9th International Conference of Numerical Analysis and Applied Mathematics, ICNAAM 2011, Greece, 19-25, September 2011.
32. Paulo Ramos, Sub-models, oral communication in MAT TRIAD 2011, Tomar, Portugal, 12-16 July 2011.
33. Philippe Laurent Didier, Small perturbations with large effects on the value at risk, IME 2011, Trieste, Itália, July 2011.

34. Ricardo Covas, Inference with inducer pivot variables, an application to the one-way ANOVA, 9th International Conference of Numerical Analysis and Applied Mathematics, ICNAAM 2011, Greece, 19-25, September 2011.

35. Rute Baião Carrujo, On a Continuous Time Markov Chain Model or Long Term Care, IME 2011, Trieste, Itália, July 2011.

36. Sandra Saraiva Ferreira with Ferreira, D., Nunes, C. and Mexia, J.T., Segregation without matching, oral communication in MAT TRIAD 2011, Tomar, Portugal, 12-16 July 2011.

(iii) Posters

1. Dora Prata Gomes, Geostatistics for spatial extremes, A case study of maximum annual rainfall in Portugal, Spatial Statistics 2011, Enschede, Netherlands, 23-25 March 2011.

2. Dora Prata Gomes, Extremal index estimation through an adaptive resampling approach, Risk & Extreme Values in Insurance and Finance, Faculdade de Ciências, Universidade de Lisboa, 6-7 June 2011.

3. Dora Prata Gomes, An empirical study of an adaptive resampling scheme for estimating the extremal index, 7th Conference on Extreme Value Analysis, Probabilistic and Statistical Models and their Applications, Lyon, França, 27 June-1 July 2011.

4. Dora Prata Gomes, Spatial Analysis of some soil physicochemical properties in mountainous massif of Sicó, Portugal, 2011 European Regional Conference of The International Environmetrics Society (SPATIAL 2), Foggia and Gargano (FG), Puglia, Itália, 1-2 September 2011.

5. Elsa Moreira, F tests with random sample size-Applications, YSI 2011 ISI Young Statisticians Meeting, Dublin, Ireland, August 2011.

6. Filipe Marques, On the Linear combination of independent Gumbel r.v.'s, 4th International Conference of the ERCIM (European Research Consortium for Informatics and Mathematics), Working Group on Computing & Statistics (ERCIM 2011), University of London, UK, December 2011.

7. Frederico Caeiro, Probability weighted moments bootstrap estimation: a case study in the field of insurance-Workshop: Risk & Extreme Values in Insurance and Finance, FCUL, 6-7 June 2011.

8. Miguel Fonseca, Inference for the interclass correlation in familial data using small sample asymptotics, DEMA 2011, UK, 30 August-2 September 2011.

9. Paulo Canas Rodrigues, ISI Young Statisticians Meeting (YSI 2011), Simulation and Analysis of Genotype by Environment Interactions and QTL by Environment

Interactions, Dublin, Ireland, August 2011.

10. Paulo Canas Rodrigues, EREM 2011, In-situ electro-osmotic cleanup of tar contaminated soil, Part I-inorganic tracing of water movement (joint work with Lima, A.T. and Loch, J.P.G.), Utrecht, The Netherlands, July 2011.

7. Strategic Project Adjustments

The structure and goals presented in the approved Strategic Project proposal (2011-2012) were kept along 2011.