



Research Report 1996

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RESEARCH REPORT

1996

Preface

Instituto Superior Técnico (IST) was founded in 1911 with the aim of becoming the leading school of engineering in Portugal. In 1930, together with three other higher education institutes, IST was incorporated into the Universidade Técnica de Lisboa, and presently it is one of the seven schools of this university. Up until 1980 the institute did not have a formal mathematics department, the mathematics courses for engineering students being mostly taught by engineering graduates.

When the Department of Mathematics was created in 1980 it was just a service department for the teaching of mathematics in the engineering programs at IST and counted only five members holding PhD level degrees. In 1983 the department initiated a formal graduate program and adopted the goal of becoming a research department as well. This was the beginning of a period of fast development that is still in progress. Three years later, in 1986, the department began offering its own undergraduate degree in Applied Mathematics and Computer Science, emphasizing mathematical analysis, numerical analysis, statistics and computer science. Since 1992 the geometry and algebra components of this degree have been gradually reinforced.

At present, the department has 50 members holding PhD degrees and relies on the contribution of a large number of teaching assistants. Most of these are also graduate students in mathematics.

For administrative purposes, the department is divided into four sections: *Algebra and Mathematical Analysis, Statistics and Applications, Applied Mathematics and Numerical Analysis, and Computer Science*. The first section accounts for approximately two thirds of the department and includes that part of applied mathematics related to differential and integral equations, linear operator theory, dynamical systems and geometry. In spite of the name of this first section, motivated by historical reasons related to the courses taught at the institute, most of the research activity in this section is on mathematical analysis, geometry and mathematical physics, and it is within this section that areas like topology and algebra are developing.

We regard the annual publication of a research report as an important vehicle, with two complementary purposes. One is internal: to highlight *research publications* by department members and their involvement in *international scientific exchange* as a public statement of the importance we attach to them; the other is external: to provide information to interested people outside the department about our current research work.

In the second half of 1996 most of the research activities of the department were subjected to an external international review, within the overall Research Units Assessment carried out by the Ministry of Science and Technology. The members of the mathematics review board were Hyman Bass (Univ. of Columbia, USA), Eugene Calabi (Univ. of Pennsylvania, USA), Irene Fonseca (Carnegie Mellon Univ., USA), Peter Olver (Univ. of Minnesota, USA), George Papanicolaou (Stanford Univ., USA) and Hugo Beirão da Veiga (Univ. of Pisa, Italy). The research units related to our department received very high ratings from this board acknowledging the international value of the research. These reviews should be taken as an additional stimulus for further development. The department experienced a fast development since it embraced the goal of becoming a research department just 14 years ago. It is now time to accept the challenge of a new phase directed to achieve a significant position among international mathematics research centers.

I would like to thank everyone who was involved in the organization of this issue, especially Professor Gabriel Pires, who coordinated the preparation of the report. I am also grateful to Ema Silva for her work in word processing this issue.

Lisbon, 16 May 1997

The Department Chairman

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Research Areas

The main areas of research pursued in the Department of Mathematics of IST are:

Dynamical Systems and Differential Equations

The dominant research in this area falls within the general field of mathematical analysis with an emphasis on non-linear problems whose interest in applications is well known. The activities cover the following subjects: dynamical systems, ordinary, partial and functional differential equations, calculus of variations and optimization, geometric, topological and algebraic methods in non-linear analysis, control theory and mechanics of continuous media. The research is organized along five lines of work: qualitative theory of dynamical systems, geometric mechanics and hamiltonian systems, methods of non-linear analysis in mechanics of continuous media and methods of non-linear systems analysis in control theory, ergodic theory and discrete dynamical systems.

Geometry and Topology

The work in this area is mostly concerned with problems spanning geometry, topology, algebra and analysis, namely questions related to the connection of some classical topics - differential geometry, mathematical physics, dynamical systems, symplectic geometry - with modern developments, including infinite-dimensional and discrete problems, for which Lie groups, K-theory, von Neumann algebras, noncommutative geometry and combinatorics are essential tools.

Operator Theory and Integral Equations

The work in this area is focused on singular integral operators and other related classes of linear operators like Toeplitz, Carleman-shift and pseudo-differential operators. The motivation for the work comes mainly from problems of diffraction theory and other applications leading to elliptic boundary-value problems. These problems are formulated in appropriate Sobolev spaces and treated by operator theory methods. The emphasis is on linear operator theory and Banach algebras and their connections with complex analysis, in particular Hardy spaces. Current problems under investigation include factorization of (semi)-almost periodic matrix-valued symbols, diffraction problems with approximate boundary conditions of arbitrary order, normalization problems, and finite section methods for singular equations.

Theory of Distributions and Ultradistributions

The work in this area has addressed problems such as algebraic and topological aspects of some concepts of limit and value of a distribution at a point, generalization to distributions on manifolds of certain results of classical analysis like, for instance, Stokes theorem, development of the theory of ultradistributions pursuing the holomorphic representations, the axiomatic and functional analytic approaches, multiplicative product of ultradistributions and limit of an ultradistribution at a point.

Probability, Statistics and Applications

The research in this general area has focused on queueing theory and quality control, multivariate analysis, stochastic optimization, categorical data analysis and statistical inference. In queueing theory and quality control, interest is concentrated on order relations, transient behaviour, threshold problems, and on control charts. In the area of multivariate analysis, topics of interest are factor analysis and related models, multidimensional scaling and discriminant analysis. Particular attention is given to the study of the robustness of these methods. In categorical data analysis and statistical inference, emphasis has been given to incomplete data and statistical theory advanced topics relying on measure and integration.

Numerical Analysis and Mathematical Analysis in Fluid Dynamics

The research on numerical methods for differential and integral equations is mainly directed towards: i) convergence acceleration techniques for ordinary differential equations with singularities and also for integral equations with singular kernels; ii) integral equation methods applied to problems in material science (elasticity and effective properties of composite materials); iii) spline collocation methods for Volterra integral equations with singular kernels; iv) boundary integral equations methods in acoustic and elastic scattering and related inverse scattering problems. The research on fluid dynamics is concerned with the questions of existence, uniqueness and asymptotic behaviour of solutions to the equations modeling the flow of incompressible non-newtonian fluids of differential type. Situations such as flows in bounded and exterior domains and flows in domains with unbounded boundaries (channels, pipes, aperture domains) have been studied. The numerical study of the Stokes and Navier-Stokes equations by boundary and finite element methods as well as by domain decomposition methods has also been addressed.

Computer Science

The work in this area addresses formal system specification with emphasis on the mathematical foundations of object-orientation and concurrency, as well as on verification logics. Most of the work has been carried out within the scope of international cooperation projects, namely the ESPRIT Basic Research Actions ISCORE and COMPASS.

Other Areas

There are also some individual members of the department working in other areas, such as mathematical physics, combinatorics, logic and operations research.

Research seminars

During 1996 the Department of Mathematics at IST ran regular sessions of the following seminars:

- Seminar on Dynamical Systems and Continuous Mechanics, every week.
Organizer: Carlos Rocha.
- Seminar on Mathematical Physics, every week.
Organizers: Rui Loja Fernandes and Esmeralda Dias.
- Seminar on Applied Mathematics and Numerical Analysis, every other week.
Organizer: Adélia Sequeira.
- Seminar on Theory of Computing, every week.
Organizer: Amílcar Sernadas.
- Seminar on Functional Analysis and Applications, one session every two weeks.
Organizer: Frank-Olme Speck.
- Seminar on Geometric and Topological Methods in Low Dimensions and Infinite Dimensions, every other week.
Organizer: J. Sousa Ramos.
- TQFT Club, on Geometry, Topology and Quantum Theory, monthly
Organizer: Roger Picken

1 Publications

1.1 Publications which appeared in 1996

Algebra and Mathematical Analysis

Ashwin, P., Buescu, J. and Stewart I., From attractor to chaotic saddle: a tale of transverse instability, *Nonlinearity*, **9**, (1996), 703-737.

Barreira, L., A non-additive thermodynamic formalism and applications to dimension theory of hyperbolic dynamical systems, *Ergodic Theory and Dynamical Systems*, **16**, (5), (1996), 871-927.

Barreira, L., A non-additive thermodynamic formalism and dimension theory of hyperbolic dynamical systems, *Math. Res. Letters*, **3**, (1996), 499-509.

Barreira, L., Ya. Pesin, J. Schmeling, On the pointwise dimension of hyperbolic measures: a proof of the Eckmann-Ruelle conjecture, *Electron. Res. Announc. Amer. Math. Soc.*, **2**, (1996), 69-72.

Cannas da Silva, A. and Guillemin, V., On the Kostant multiplicity formula for groups actions with non-isolated fixed points, *Advances in Mathematics*, **123**, (1996), 1-15.

Castro, L. P. and Speck, F.-O., On the inversion of higher order Wiener-Hopf operators, *Journal of Integral Equations and Applications*, **8**, (1996), 269-285.

Cordovil, R., Oliveira, A. G. and Les Vergnas, M., A generalized Desargues configuration and the pure braid group, *Discrete Math.*, **160**, (1996), 105-113.

Cordovil, R., Cerdeira, J. O. and Heitor, T. V., On the characterization of axial maps, *Environment and Planning B, Planning and Design*, **23**, (1996), 771-780.

Costa, F. P., On the dynamic scaling behaviour of solutions to the discrete Smoluchowski equations, *Proceedings of the Edinburgh Mathematical Society*, **39**, (1996), 547-559.

Faria, T. and Magalhães, L. T., Restrictions on the possible flows of scalar retarded functional differential equations in neighborhoods of singularities, *Journal of Dynamics and Differential Equations*, **8**, (1996), 35-70.

Fiedler, B. and Rocha, C., Heteroclinic orbits of semilinear parabolic equations, *Journal of Differential Equations*, **125**, (2), (1996), 239-281.

Freitas, P., On some eigenvalue problems related to the wave equation with indefinite damping, *Journal of Differential Equations*, **127**, (1996), 320-335.

Freitas, P. and Zuazua, E., Stability results for the wave equation with indefinite damping, *Journal of Differential Equations*, **132**, (1996), 338-352.

Girão, P. and Kohn, R. V., The crystalline algorithm for computing motion by curvature, in *Progress in Nonlinear Differential Equations and their Applications*, (R. Serapioni and F. Tomarelli Eds.), Birkhäuser, **25**, (1996), 7-18.

Lopes, P. A., dos Santos, A. F., A new approach to the convolution operator on a finite interval, *Integral Equations and Operator Theory*, **26**, (1996), 460-475.

Oliva, W. M., The motion of two-dimensional vortices with mass as a singular perturbation problem, *New Trends for Hamiltonian Systems and Celestial Mechanics*, (E. A. Lacomba and J. Llibre Eds.), *Adv. Series in Non-Linear Dynamics*, World Scientific, **8**, (1997), 301-310.

Oliva, W. M. and Sallum, E. M., Periodic dynamic systems for infected hosts and mosquitoes, *Revista Saúde Pública*, **30** (3), (1996), 218-223.

Paluch, M., Topology on $S^{-1}S$ for Banach algebras, *Topology*, **35**, (1996), 887-900.

Penzel, F. and Teixeira, F. S., A Wiener-Hopf approach for the scattering by a disk, *Integral Equations and Operator Theory*, **24**, (1996), 230-247.

Santos, A. M., Speck, F.-O. and Teixeira, F. S., Compatibility conditions in some diffraction problems, in *Direct and Inverse Electromagnetic Scattering*, (A. H. Serbest and S. R. Cloude Eds.), Pitman Res. Notes in Math., **361**, Addison Wesley Longman (1996), 25-38.

Teixeira, F. S., and Santos, P. A., Sommerfeld type diffraction problems with approximate boundary conditions of arbitrary order, in *Direct and Inverse Electromagnetic Scattering*, (A. H. Serbest and S. R. Cloude Eds.), Pitman Res. Notes in Math, **361**, Addison Wesley Longman (1996), 3-14.

Statistics and Applications

Branco, J. A., Não há fumo sem fogo, *Boletim Informativo da SPE*, **1**, (1996), 21-27.

Branco, J. A., O universo estatístico de Marino Miguel Franzini, *Revista de Estatística*, **1**, (1996), 77-60

Morais, M. and Ramalhoto, M. F., Cartas EWMA unilaterais: uma aplicação ao controlo de um parâmetro de escala, in *Bom Senso e Sensibilidade-Traves Mestras da Estatística*, (Branco, J., Gomes, P. and J. Prata, Eds.), Col. Novas Tecnologias/Estatística, Edições Salamandra, Lisboa, (1996), 291-306.

Morais, M. and Natário, I., Como tornar mais eficaz uma carta c unilateral superior, in Bom Senso e Sensibilidade-Traves Mestras da Estatística, (Branco, J., Gomes, P. and Prata, J. Eds.), Col. Novas Tecnologias/Estatística, Edições Salamandra, Lisboa, (1996), 307-321.

Nunes, C. and Amaral, J., Políticas óptimas e quase-óptimas de inspeção de um sistema sujeito a falhas, in Bom Senso e Sensibilidade-Traves Mestras da Estatística, (J. Branco, P. Gomes and J. Prata, Eds.), Edições Salamandra, Lisboa, (1996), 245-253.

Pacheco, A. and Prabhu, N. U., A Markovian storage model, *The Annals of Applied Probability*, **6**, (1996), 76-91.

Pires, A. M. e Branco, J. A., Generalization of Fisher's linear discriminant, Proceedings of RECPAD'96, APRP, Guimarães, Portugal, (1996), 415-418.

Ramalhoto, M. F., The Weibull distribution in control charts and in some maintenance strategies, Probabilistic Safety Assessment and Management, (P. C., Cacciabue, I. A. Papazoglou, Eds.), Vol. I, (1996), 2659-2691.

Ramalhoto, M. F., Developing synergy between higher education research and industry for improving the transfer of knowledge, Proceedings of the World Congress of Engineering Educators and Industry Leaders, UNESCO Fifty Years Celebration, Vol. III, (1996), 411-416.

Ramalhoto, M. F., Synergy between flexible and distance learning and research and technological development, Proceeding of SEFI Annual Conference, (Francesco Maffioli, Manfred Horvat and Franz Reichl, Eds.), (1996), 327-332.

Ramalhoto, M. F. and Syski, R., Queueing and quality service, *Investigação Operacional*, **15**, (2), (1996), 155-172.

Applied Mathematics and Numerical Analysis

Lima, P. M., Numerical methods and asymptotic expansions for the Emden-Fowler equations, *J. Comp. Appl. Math.*, **70**, (1996), 245-266.

Lima, P. M. and Lemos, A. C., Finite element solution of degenerate boundary-value problems for ordinary differential equations, in Advanced Mathematics Computations and Applications, (A. S. Alekseev and N. S. Bakhvalov Eds.), Ncc Publisher, Novosibirsk, (1996), 503-510.

Computer Science

Andrade, L. and Sernadas, A., Banking and management information system automation, Proc. 13th World Congress of International Federation of Automatic Control, (J. Gertler, J. Cruz e M. Peshkin Eds.), IFAC, (1996), 133-138.

Brown, M. and Carmo, J., Report on the Third International Workshop on Deontic Logic in

Computer Science, *Knowledge Engineering Review*, **11**, (3), (1996), 289-292.

Carmo, J. and Jones, A.J.I., Deontic database constraints, violation and recovery, *Studia Logica*, **57**, (1996), 139-165.

Jungclaus, R., Hartmann, T., Saake, G. and Sernadas, C., TROLL: A language for object-oriented specification of information systems, *ACM Transactions on Information Systems*, **14**, (2), (1996), 175-211.

Menezes, P. B., Costa, J. F. and Sernadas, A., Refinement mapping for (Discrete Event) system theory, *Computer Aided System Technology, EUROCAST'95*, **1030**, (1996), 103-116, Springer-Verlag.

Santos, F. and Carmo, J., A modal action logic based framework for organization specification and analysis, in Proc. of the 5th European Workshop on Logics in AI - JELIA'96, (J.L. Alferes, L.M. Pereira and E. Orłowska Eds.), Springer LNAI Series, (1996), 119-133.

Santos, F. and Carmo, J., Indirect action, influence and responsibility, in *Deontic Logic, Agency and Normative Systems*, (M. Brown and J. Carmo Eds.), Springer-Verlag, Workshops in Computing Series, (1996), 194-215.

Sernadas, A., Sernadas, C. and Ramos, J., A temporal logic approach to object certification, *Journal of Data and Knowledge Engineering*, **19**, (1996), 267-294.

1.2 Articles submitted in 1996

Algebra and Mathematical Analysis

Abreu, M., Topology of symplectomorphism groups of $S^2 \times S^2$, Stanford University, Preprint 96.

Barreira, L., Ya. Pesin, J. Schmeling, On a general concept of multifractality: multifractal spectra for dimensions, entropies, and Lyapunov exponents. Multifractal rigidity, to appear in *Chaos*, **7**, (1), (1997), 27-38.

Barreira, L., Pesin Theory, to appear in Kluwer's Encyclopaedia of Mathematics.

Barreira, L., Ya. Pesin, J. Schmeling, Dimension of hyperbolic measures - A proof of the Eckmann-Ruelle conjecture, Preprint 26/96.

Barreira, L., Ya. Pesin, J. Schmeling, Multifractal spectra and multifractal rigidity for horseshoes, to appear in *Journal of Dynamical and Control Systems*, **3**, (1), (1997), 33-49.

Bastos, M. A., Karlovich, Yu., Spitkovsky, T. M. and Tishin, P. M., On a new algorithm for almost periodic factorization, Proceedings of the IWOTA (1996).

Buescu, J., Transverse instability of attractors in invariant submanifolds, to appear in Proceedings of Equadiff 95 Conference, Lisbon, Portugal.

Câmara, M., C. and dos Santos, A., F., A non-linear approach to generalized factorization of matrix functions, to appear in Operator Theory - Advances and Applications.

Castro, H. M. A. and Oliva, W. M., Poisson structures on the phase space of mechanical systems with constraint, to appear in Resenhas do IME-UPS.

Castro, L. P., Integral equations of convolution type on unions of intervals, to appear in the Proceedings of IMSE 1996.

Castro, L. P. and Speck, F.-O., A Fredholm study for convolution operators with piecewise continuous symbols on a union of a finite and a semi-infinite interval, Preprint 24/96, to appear in *Appl. Anal.*

Fernandes, R. L. and Oliva, W. M., Hamiltonian dynamics of the Lotka-Volterra equations, to appear in Proceedings of the Equadiff 95 Conference, Lisbon, Portugal.

Fiedler, B. and Rocha, C., Orbit equivalence of global attractors of semilinear parabolic differential equations, Preprint 6/96.

Freitas, P., Eigenvalue problems for the wave equation with strong damping, to appear in *Proceedings of the Royal Society*, Edinburgh.

Freitas, P., (In)stability results for the wave equation with indefinite damping, to appear in Proceedings of the Equadiff 95 Conference, Lisbon, Portugal.

Freitas, P. and Vishnevskii, M. P., Stability of stationary solutions of nonlocal reaction - diffusion equations in m -dimensional space, to appear in *Differential and Integral Equations*.

Fusco, G. and Oliva, W., Asymptotic behavior of a system of repelling particles: asymptotic velocities, phases, scattering operator and integrability, to appear in Proceedings of the Equadiff 95 Conference, Lisbon, Portugal.

Fusco, G. and Oliva, W., Integrability of a system of N electrons subjected to coulombian interactions, to appear in *Journal of Differential Equations*.

Giga, Y., Gurtin, M. E. and Matias, J., On the dynamics of crystalline motion, Center for Nonlinear Analysis, Carnegie Mellon University, Preprint.

Gomes, D. L., Chaotic motions in vortices dynamics, Preprint.

Grácio, C. and Sousa Ramos, J., Symbolic dynamics and hyperbolic groups, ECIT 96-European Conference on Iteration Theory, Urbino, Italy, 8.9.96 - 14.9.96.

Lampreia, J. P., Severino, R. and Sousa Ramos, J., Factorizations in dynamics of the interval, Preprint.

Lampreia, J. P., Severino, R. and Sousa Ramos J., *-product for bimodal maps, ECIT 96-European Conference on Iteration Theory, Urbino, Italy, 8.9.96 - 14.9.96, Preprint.

Lebre, A. B., Santos, A. M. and Speck, F.-O., Factorization of a class of matrices generated by Sommerfeld diffraction problems with oblique derivatives, Preprint 20/96, to appear in *Math. Methods Appl. Sci.*

Martins, P. and Sousa Ramos J., Algebraic results on Markov shifts of torus automorphisms, to appear in Proceedings of the Equadiff 95 Conference, Lisbon, Portugal.

Martins, P. and Sousa Ramos J., Topological and geometrical properties of isentropic torus automorphisms, ECIT 96-European Conference on Iteration Theory, Urbino, Italy, 8.9.96 - 14.9.96, Preprint.

Matos, J. P., On gradient Young measures supported on a point and a well, Preprint 5/96.

Oliva, W. M. and Táboas, P. Z., Existence of periodic orbits, set of global solutions and behavior near equilibrium for Volterra equations of retarded type, to appear in *Portugaliae Mathematica*.

Pinto, P., On a computation of the A_5 -graph from the subfactor theory, Preprint.

Pires, G., Ishii, H. and Souganidis, P. E., Approximation schemes by the threshold dynamics for propagating fronts.

Roberts, R.M. and Sousa Dias, E., Bifurcations from relative equilibria of Hamiltonian systems, Warwick Preprints 48/96.

Roch, S., Santos, P. A. and Silbermann, B., Finite section method in some algebras of multiplication and convolution operators and a flip, T. U. - Chemnitz Preprint (1996)

Santos, A. M. and Speck, F.-O., Sommerfeld diffraction problems with oblique derivatives, Preprint 7/96, to appear in *Math. Methods Appl. Sci.*

Santos, A. M., Speck, F.-O. and Teixeira, F. S., Minimal normalization of Wiener-Hopf operators in spaces of Bessel potentials, Preprint 18/96.

Santos, R., and Fernandez, B., Extended symbolic dynamics in bistable CML: Existence and stability of fronts, Preprint 15/96, *Physica D*.

Sarreira, M. and Sousa Ramos, J., Markov Shifts in complex dynamical systems, to appear in Proceedings of the Equadiff 95 Conference, Lisbon, Portugal.

Silva, L. and Sousa Ramos, J., Renormalization of Newton's maps, ECIT 96-European Conference on Iteration Theory, Urbino, Italy, 8.9.96 - 14.9.96, Preprint.

Statistics and Applications

Morais, M. and Ramalhoto, M. F., Cartas EWMA-VSI unilaterais superiores para o parâmetro de escala da população Weibull de mínimos tri-paramétrica: que vantagens?, to appear in Actas do IV Congresso Anual da SPE, Funchal, Portugal, 1996.

Nunes, C., Aproximações de Taylor para o tempo médio de espera numa rede de filas de espera, to appear in Actas do IV Congresso Anual da SPE.

Pacheco, A., A storage equation in continuous time, to appear in Actas do IV Congresso Anual da SPE.

Paulino, C. D. and Silva, G. L., On the maximum likelihood analysis of the general linear model in categorical data, Preprint 21/96.

Pires, A. M. and Branco, J. A., Comparação de duas médias: um velho problema revisitado, to appear in Actas do IV Congresso Anual da SPE, 1996.

Pires, A. M. and Branco, J. A., Comparison of multinomial classification rules, to appear in *Journal of Classification*, 1996.

Applied Mathematics and Numerical Analysis

Alves, C., Ha-Duong, T., On the far field amplitude for elastic waves, Preprint 22/96, to appear in Proceedings of the Sommerfeld'96 Workshop, E. Meister (Ed.) P. L. Verlag.

Alves, C., Ha-Duong, T., On inverse scattering by screens, Preprint 23/96, to appear in *Inverse Problems*.

Galdi, G. P., Sequeira, A. and Videman, J. H., Steady motions of a second-grade fluid in an exterior domain, Preprint 10/96, to appear in *Adv. Appl. Math. Sci.*

Lima, P. M. and Diogo, T., An extrapolation method for a Volterra integral equation with weakly singular kernel, Preprint 16/96, to appear in *Appl. Num. Maths.*

Novotny, A., Sequeira, A. and Videman, J. H., Existence of threedimensional flows of second-grade fluids past an obstacle, Preprint 29/96, to appear in Proceedings of the Second World Congress of Nonlinear Analysts, Athens, Greece, July 1996, Elsevier.

Pileckas, K., Sequeira, A. and Videman, J. H., A note on steady flows of non-newtonian fluids in channels and pipes, Preprint 9/96, to appear in Proceedings of the Equadiff 95 Conference, Lisbon, Portugal.

Computer Science

Caleiro, C., Saake, G. and Sernadas, A., Deriving liveness goals from temporal logic specifications, to appear in *Journal of Symbolic Computation*.

Carmo, J. and Jones, A. J. I., A new approach to contrary-to-duty obligations, in *Defeasible Deontic Logic*, (Donald Nute Ed.), Synthese Library, Kluwer Publ. Co., 1996.

Santos, F., Jones, A. J. I. and Carmo, J., Action concepts for describing organised interaction, HICSS'97: Hawaii International Conference on System Sciences (January, 7-10, 1997, Hawaii), IEEE press, 1996.

Sernadas, A., Sernadas, C. and Caleiro, C., Synchronization of logics, to appear in *Journal Studia Logica*.

Sernadas, A., Sernadas, C. and Caleiro, C., Denotational semantics of object specification.

2 Academic degrees awarded in 1996

2.1 Agregações

Speck, F.-O., Agregação em Matemática, Universidade Técnica de Lisboa, June 1996.

Carmo, J., Agregação em Matemática, Universidade Técnica de Lisboa, June 1996.

2.2 Doutoramentos/PhD's

Abreu, M., Ph.D. in Mathematics, Stanford University, September 1996. Thesis: *Topology of Symplectomorphism Groups of $S^2 \times S^2$* . Supervisor: Yakov Eliashberg.

Barreira, L., Ph.D. in Mathematics, The Pennsylvania State University, University Park, USA, May 1996. Thesis: *A Non-Additive Thermodynamic Formalism and Applications to Dimension Theory of Hyperbolic Dynamical Systems*. Supervisor: Ya. Pesin.

Caetano, A. J. P., Doutoramento em Matemática, Instituto Superior Técnico, Universidade Técnica de Lisboa, 1996. Thesis: *Tópicos de Holonomia em Geometria Diferencial, Teoria do Campo e Relatividade*. Supervisor: Roger Picken.

Cannas da Silva, A., Ph.D. in Mathematics, MIT, June 1996. Thesis: *Multiplicity Formulas for Orbifolds*. Supervisor: Victor Guillemin.

Pires, A. M., Doutoramento em Matemática, Instituto Superior Técnico, Universidade Técnica de Lisboa, March 1996. Thesis: *Análise Discriminante: Novos Métodos Robustos de Estimação*. Supervisor: J. A. Branco.

2.3 Mestrados/MSc's

Bravo, A., Mestrado em Matemática Aplicada, Instituto Superior Técnico, Universidade Técnica de Lisboa, 12.9.96. Thesis: *Operadores de Toeplitz e Factorização em Álgebras de Funções quase Periódicas*. Supervisor: Maria Amélia Bastos.

Carvalho, J., Mestrado em Matemática Aplicada, Instituto Superior Técnico, Universidade Técnica de Lisboa, 28.10.96. Thesis: *Técnicas de Completude em Lógicas Modais e Temporais*. Supervisor: Cristina Sernadas.

Caleiro, C., Mestrado em Matemática Aplicada, Instituto Superior Técnico, Universidade Técnica de Lisboa, 28.3.96. Thesis: *Comunidades Distribuídas de Objectos*. Supervisor: Amílcar Sernadas.

Gomes, D., Mestrado em Matemática Aplicada, Instituto Superior Técnico, Universidade Técnica de Lisboa, 12.7.96. Thesis: *O Modelo Misto dos Vértices*. Supervisor: Waldyr Muniz Oliva.

Gomes, J., Mestrado em Matemática Aplicada, Instituto Superior Técnico, Universidade Técnica de Lisboa, 13.3.96. Thesis: *Lógica Temporal de Objectos com Tempo Explícito*. Supervisor: Cristina Sernadas.

Martins, N., Mestrado em Matemática Aplicada, Instituto Superior Técnico, Universidade Técnica de Lisboa, 30.7.96. Thesis: *Cálculo do Invariante S de CONNES em Alguns Exemplos de Factores do Tipo III*. Supervisor: Shingo Okamoto.

Martins, P., Mestrado em Matemática Aplicada, Instituto Superior Técnico, Universidade Técnica de Lisboa, 22.7.96. Thesis: *Automorfismos Hiperbólicos do Toro*. Supervisor: José Sousa Ramos.

Natário, J., Mestrado em Matemática Aplicada, Instituto Superior Técnico, Universidade Técnica de Lisboa, 27.9.96. Thesis: *Topologia dos Níveis de Energia Regularizados para o Problema Restrito dos Três Corpos*. Supervisor: Waldyr Muniz Oliva.

Oliveira, H., Mestrado em Matemática Aplicada, Instituto Superior Técnico, Universidade Técnica de Lisboa, 13.9.96. Thesis: *Bifurcações de Aplicações do Intervalo*. Supervisor: José Sousa Ramos.

Ravara, A., Mestrado em Matemática Aplicada, Instituto Superior Técnico, Universidade Técnica de Lisboa, 13.3.96. Thesis: *Semântica Operacional para a Linguagem GNOME Baseada em TYCO*. Supervisor: Vasco Vasconcelos and Amílcar Sernadas.

Santos, I., Mestrado em Matemática Aplicada, Instituto Superior Técnico, Universidade Técnica de Lisboa, 29.3.96. Thesis: *Métodos Numéricos para Equações Integrais de Volterra com Núcleo Singular*. Supervisor: Teresa Diogo and Pedro Lima.

Santos, J, Mestrado em Matemática Aplicada, Instituto Superior Técnico, Universidade Técnica de Lisboa, 30.7.96. Thesis: *Linearização dum Sistema de Lotka-Volterra na Jacobiana numa Curva Hiperelíptica*. Supervisor: Rui Loja Fernandes.

Santos, P. M., Mestrado em Matemática Aplicada, Instituto Superior Técnico, Universidade Técnica de Lisboa, 15.11.96. Thesis: *Funções Quasiconvexas*. Supervisor: João Palhoto de Matos.

Silva, L., Master in Applied Mathematics, Instituto Superior Técnico, Universidade Técnica de Lisboa, 1996. Thesis: *Iteradas de Alicações de Newton como Sistemas Dinâmicos*. Supervisor: José Sousa Ramos.

Soares, P., Mestrado em Matemática Aplicada, Instituto Superior Técnico, Universidade Técnica de Lisboa, 19.9.96. Thesis: *Análise Bayesiana de Dados Categorizados Incompletos - Implementação Computacional*. Supervisor: Carlos Daniel Mimoso Paulino.

3. Research Lectures

3.1 Lectures at Conferences, Workshops, Meetings etc.

Algebra and Mathematical Analysis

Abreu, M., Topology of symplectomorphism groups of $S^2 \times S^2$, International Conference on Differential Geometry, IMPA, Rio de Janeiro, Brazil, 8.7.96 - 19.7.96.

Buescu, G., Liapunov stability, adding machines and inverse limits, Workshop in Dynamical Systems, Faculdade de Ciências, Porto, Portugal, 10.7.96 - 11.7.96.

Buescu, G., Sistemas dinâmicos com bacias emaranhadas, Conference in Dynamical Systems CIM, Coimbra, Portugal, September 1996.

Câmara, M. C., Some recent developments in the Wiener-Hopf factorization of 2×2 symbols, Sommerfeld'96 - Workshop on Modern Mathematical Methods in Diffraction Theory and its Applications in Engineering, Freudenstadt, Germany, 30.9.96 - 4.10.96.

Cannas da Silva, A., Presymplectic quantization and circle actions, Géométrie Symplectique, Quantification et Multiplicités, CIRM, Luminy, France, July 1996.

Duarte, P., Persistência de Tangências Homoclínicas em Dinâmica Conservativa, 1º Encontro Projecto Praxis de Física-Matemática, Universidade de Aveiro, Aveiro, Portugal, 10.2.96 - 13.2.96.

Duarte, P., Sistemas de Lotka-Volterra, 1º encontro em Sistemas Dinâmicos organizado pelo Centro Internacional de Matemática, Observatorio Astronómico, Coimbra, Portugal, 16.9.96 - 20.9.96.

Fernandes, R. L., Lax dynamics of Lotka-Volterra equations, XIX Symposium on Mathematical Physics, Torun, Poland, 2.12.96 - 6.12.96.

Martins, P., Topological and geometric results for isentropic torus automorphisms, European Conference on Iteration Theory, Urbino, Italy, 8.9.96 - 14.9.96.

Matos, J. P., On gradient Young measures supported on a point and a well, Nonconvex Analysis and Optimization, Évora, Portugal, June 1996.

Oliva, W., Poisson structures on the phase space of mechanical systems with constraint, Workshop on Non-linear Analysis and Differential Equations, Águas de Lindoia, Brasil, 26.7.96 - 1.8.96.

Picken, R., Spaces of connections via smooth paths and graphs, 1º Encontro Projecto Praxis - Física-Matemática, Aveiro, Portugal, 10.2.96 - 13.2.96.

Picken, R., Reflections on topological quantum field theory, Quantizations, Deformations and Coherent States, (XVth Workshop on Geometric Methods in Physics), Bialowieza, Poland, 1.7.96 - 7.7.96.

Pires, G., Curvature motion generated by local interactions, Regularization Methods in Free Boundary Value Problems, Faro, Portugal, 25.1.96 - 27.1.96

Santos, A. M., Sommerfeld diffraction problems with oblique derivatives, in Sommerfeld'96-Workshop, Modern Mathematical Methods in Diffraction Theory and its Applications in Engineering, Freudenstadt, Germany, 30.9.96 - 4.10.96.

Santos, A. M., Minimal normalization of Wiener-Hopf operators in spaces of Bessel potentials, in Conference on Analysis, Numerics and Applications of Differential and Integral Equations, Stuttgart, Germany, 9.10.96 - 11.10.96.

Santos, P. A., Finite section method in some algebras of multiplication and convolution operators and a flip, Sommerfeld'96 Workshop, Modern Mathematical Methods in Diffraction Theory and its Applications in Engineering, Freudenstadt, Germany, 30.9.96 - 4.10.96.

Santos, R., Extended symbolic dynamics in bistable CML, 2nd School Conference Dynamics, Stochastics and Complexity: Theory and Applications, Marseille, France, 2.9.96 - 20.9.96.

Sousa Dias, E., Abordagem geométrica de sistemas hamiltonianos - elipsóides de Riemann, Encontro de sistemas dinâmicos, CIM, Coimbra. Portugal, Setembro de 1996.

Sousa Ramos, J., Dinâmica simbólica e partições de Markov, Encontro de Sistemas Dinâmicos, CIM, Coimbra, Portugal, 16.9.96 - 20.9.96.

Statistics and Applications

Branco, J. A., Análise de proximidades construídas a partir de variáveis de tipos diferentes, IV Congresso Anual da SPE, Funchal, Portugal, 11.6.96 - 15.6.96.

Branco, J. A., V-Robustness of slope estimators in the errors-in-variable model, 4th World Congress of the Bernoulli Society, Vienna, Austria, 26.8.96 - 31.8.96.

Morais, M., Cartas EWMA-VSI unilaterais superiores para δ : que vantagens?, IV Congresso Anual da SPE, Funchal, Portugal, 9.6.96 - 15.6.96.

Nunes, C., Aproximações de Taylor para o tempo médio de espera numa rede de filas de espera, IV Congresso Anual da SPE, Funchal, Portugal, 11.6.96 - 14.6.96.

Pacheco, A., A storage equation in continuous time, IV Congresso Anual da SPE, Funchal, Portugal, 11.6.96 - 15.6.96.

Paulino, C. D., Análise de dados categorizados via metodologia de mínimos quadrados generalizados, IV Congresso Anual da SPE, Funchal, Portugal, 9.6.96 - 10.6.96.

Pires, A. M., Comparação de duas médias: um velho problema revisitado, IV Congresso Anual da S P E, Funchal, Portugal, 11.6.96 - 15.6.96.

Pires, A. M., Generalization of Fisher's linear discriminant, RECPAD'96, 8th Portuguese Conference on Pattern Recognition, Guimarães, Portugal, 21.3.96 - 22.3.96.

Ramalhoto, M. F., A discussion on the need to link control charts to maintenance schemes, Workshop on Maintenance and Quality Control, INSEAD, Fontainebleau, France, 27.9.96 - 28.9.96.

Applied Mathematics and Numerical Analysis

Alves, C. and Ha-Duong, T., On inverse scattering by screens, Sommerfeld 96 Workshop, Freudenstadt, Germany, October 1996.

Lima, P. M. and Diogo, T., Numerical solution of an integral equation with weakly singular kernel using extrapolation methods, The Second International Conference on the Numerical Solution of Volterra and Delay Equations, Arizona State University, Tempe, U.S.A., 27.5.96 - 30.5.96.

Sequeira, A., On mathematical theory of non-newtonian fluid flows in exterior domains, The Second World Congress of Nonlinear Analysts, Athens, Greece, 10.7.96 - 17.7.96.

Sequeira, A., Mathematical results for the steady motion of a second-grade fluid past an obstacle, International Workshop on Theoretical and Numerical Fluid Mechanics, Vancouver, Canada, 29.7.96 - 2.8.96.

Sequeira, A., Steady flows of non-newtonian fluids in channels and pipes, International Conference on Euler and Navier-Stokes Equations in Unbounded Domains, Nantes, France, 5.9.96 - 7.9.96.

Videman, J. H., On mathematical theory of non-newtonian fluids - flows in domains with noncompact boundaries, The Second World Congress of Nonlinear Analysts, Athens, Greece, 10.7.96 - 17.7.96.

Videman, J. H., Mathematical results on incompressible non-newtonian fluids in unbounded domains, International Workshop on Theoretical and Numerical Fluid Mechanics, Vancouver, Canada, 29.7.96 - 2.8.96.

Videman, J. H., Steady flows of non-newtonian fluids past an obstacle, International Conference on Euler and Navier-Stokes Equations in Unbounded Domains, Nantes, France, 5.9.96 - 7.9.96.

Computer Science

Guerra, S. and Ryan, M., Towards feature-oriented specifications, ModelAge'96, Sesimbra, Portugal, 15.1.96 - 17.6.96.

Ravara, A. and V. Vasconcelos, Operational semantics and type system for Gnome on typed calculus of objects, Workshop on Proof-Theory of Concurrent Object-Oriented Programming (ECOOP'96), Linz, Áustria, 8.7.96.

Resende, P., Quantaes, finite observations and strong bisimilarity, 12th Workshop on the Mathematical Foundations of Programming Semantics, University of Colorado, USA, 3.6.96 - 5.6.96.

Menezes, P. B., Sernadas, A. and Costa, J. F., Refinement in a concurrent, object-based language, I Simpósio Brasileiro de Linguagens de Programação, Sociedade Brasileira de Computação, Belo Horizonte, Brasil, 4.9.96 - 6.9.96.

Sernadas, A., Guerra, S. and Ryan, M., Towards feature-orientation (or how functions strike back), Object-Oriented Portugal 96, 1.10.96 - 3.10.96.

3.2 Invited lectures

Algebra and Mathematical Analysis

Abreu, M., Topology of symplectomorphism groups of $S^2 \times S^2$:

- Members Seminar, Institute for Advanced Study, Princeton, New Jersey, USA, October 1996.
- Symplectic Geometry and Topology Seminar, SUNY at Stony Brook, New York, USA, September 1996.
- Joint Symplectic Geometry Seminar, (Berkeley, Davis, Santa Cruz, Stanford), Berkeley, California, USA, May 1996.

Barreira, L., On the dimension of hyperbolic measures:

- Penn State - Maryland Dynamical Systems Workshop, Penn State, USA, October 1996.
- Conferência de Sistemas Dinâmicos, Faculdade de Ciências, Universidade do Porto, Porto, Portugal, 10 de Julho.

Cannas da Silva, A., Presymplectic quantization and circle actions:

- Special Seminar, University of California, Berkeley, USA, January 1996.
- Geometry Seminar, Stanford University, California, USA, January 1996.
- Global Analysis and Differential Geometry Seminar, University of Texas, Austin, USA, January 1996.
- Lie Group Seminar, Cornell University, Ithaca, New York, USA, February 1996.
- Symplectic Seminar, MIT, Cambridge, Massachusetts, USA, February 1996.

Cannas da Silva, A., Multiplicity formulas for orbifolds:

- Special Seminar, MIT, Cambridge, Massachusetts, USA, May 1996.
- Joint Symplectic Geometry Seminar Berkeley-Stanford-Santa Cruz, University of California, Berkeley, November 1996.

Cannas da Silva, A., Quantization and twisted projective spaces, "Post-Doc" Seminar, MSRI, Berkeley, California, USA, September 1996.

Costa, F. P., Transições de fase em sistemas de partículas em interação, Encontro de Sistemas Dinâmicos, Centro Internacional de Matemática, Coimbra, Portugal, September 96.

Cordovil, R., Braid monodromy groups of arrangements of hyperplanes:

- Universidade de Paris VI, Paris, France, 11.6.96.
- Universidade de Sevilha, Sevilha, Spain, 13.2.96.

Fernandes, R. L., Integrability, Lax equations and algebraic geometry, Encontro de Coimbra em Sistemas Dinâmicos, CIM, Coimbra, Portugal, September 96.

Florentino, C., Symplectic reduction and flat bundles over Riemann surfaces, Symplectic Topology Seminar, Stony Brook, USA, February 96.

Florentino, C., Theta functions and Riemann surfaces, Graduate Student Seminar, Stony Brook, USA, September 96.

Matias, J., On crystalline motions, Nonconvex Optimization, Évora, Portugal, June 1996.

Oliva, W., A dinâmica de d'Alembert e a de tipo variacional para sistemas mecânicos com vínculos não integráveis, Unicamp, Campinas, Brasil, 17.10.96.

Oliva, W., Algebraic integrability of Lotka-Volterra equations, IMPA, Rio de Janeiro, Brasil, 20.11.96.

Paluch, M., Filtrações em K-teoria, Seminário de Geometria, CMAF, Lisboa, Portugal, 16.6.96.

Picken, R., Spaces of connections, graphs and measures, Queen Mary and Westfield College, London, United Kingdom, 9.4.96.

Picken, R., Espaços de conexões generalizadas, Seminário de Geometria, CMAF, Universidade de Lisboa, Portugal, 17.6.96.

Pires, G., Interações locais geram movimento por curvatura média, Seminário de Geometria, CMAF, Lisbon, Portugal, 26.3.96

Rocha, C., Atractores para equações semilineares parabólicas e permutações meândricas, CIM, Coimbra, Portugal, 19.9.96.

Speck, F.-O., Desenvolvimentos recentes nas aplicações dos operadores singulares, Universidade do Algarve, Faro, Portugal. 9.7.96

Sousa Dias, E., Simetrias dos elipsóides de Riemann, Seminário de Geometria, CMAF, Lisboa, Portugal, 6.5.96.

Statistics and Applications

Branco, J. A., Análise multivariada em geral, Instituto Superior de Estatística e Gestão da Informação, Universidade Nova de Lisboa, Lisbon, Portugal, 14.2.96.

Branco, J. A., Análise multivariada, Departamento de Matemática, Universidade de Aveiro, Aveiro, Portugal, 8.3.96.

Branco, J. A., Uma perspectiva geral dos princípios e métodos da análise multivariada, Universidade Católica, Porto, Portugal, 28.11.96.

Pires, A. M., Análise discriminante, Seminário da SPE/Centro de Estatística e Aplicações da Universidade de Lisboa, Lisbon, Portugal, 8.5.96.

Ramalhoto, M. F., A numerical framework to obtain approximations and bound for the most important characteristics of the $M_t / G / r / r + d$ queue, Universidad Complutense de Madrid, Spain, 11.10.96.

Applied Mathematics and Numerical Analysis

Sequeira, A., Steady flows of non-newtonian fluids in unbounded domains, Institute for Mathematics, University of Zürich, Switzerland, 25.1.96.

Sequeira, A., Existence results for some non-newtonian fluid models in channels and pipes, Department of Mathematics, University of Bayreuth, Germany, 4.10.96.

Computer Science

Carmo, J., Deontic logic: the problem of the contrary-to-duties, 4º Encontro de Algebristas Portugueses, Centro de Álgebra da Universidade de Lisboa, Lisbon, Portugal, 19.9.96.

4. Guest Programme

Algebra and Mathematical Analysis

Anderson, L., Indiana University, USA, 23.5.96 - 26.5.96. *Lecture:* Topology of Combinatorial Differential Manifolds, 24.5.96.

Barone, A., IME - Universidade de São Paulo, Brasil, 31.5.96 - 11.6.96.

Castro, L., *Lecture:* A propriedade de Fredholm para operadores de convolução na união de um intervalo limitado com um não-limitado, 28.11.96.

Coelho, Z., Universidade de Aveiro, Portugal, 19.4.96. *Lecture:* Leis assintóticas de Poisson em sistemas dinâmicos hiperbólicos, 19.4.96.

Cruz, I. F. C., Universidade do Porto, Portugal, 16.10.96. *Lecture:* Linearização de estruturas de Poisson.

Diaz, L., PUC - Rio de Janeiro, Brasil, 22.1.96 - 24.1.96. *Lecture:* Frequência de hiperbolicidade em bifurcações sela-nó, 22.1.96.

Ehrhardt, T., Technische Universität Chemnitz, Germany, 4.12.96 - 18.12.96. *Lecture:* Factorization of piecewise constant matrix functions, 12.12.96.

Faria, E., IME - Universidade de São Paulo, Brasil, 13.5.96 - 30.5.96. *Lecture:* Rigidez de homeomorfismos críticos do círculo, 28.5.96.

Fiedler, B., Freie Universität Berlin, Germany, 8.3.96 - 21.3.96. *Lecture:* Do global attractors depend on boundary conditions?, 19.3.96.

Gonçalves, J. B., F. C. da Universidade do Porto, Portugal, 30.10.96. *Lecture:* Caústicas, frentes de onda e perestroikas.

Gonçalves, J. B., F. C. da Universidade do Porto, Portugal, 10.12.96. *Lecture:* Bifurcação em equações de Hamilton implícitas.

Lomeli, H., University of Colorado at Boulder, USA, 17.6.96 - 21.6.96. *Lecture:* Heteroclinic orbits and transport in a perturbed integrable standard map, 18.6.96.

Mark, J., Technische Hochschule Darmstadt, Germany, 2.5.96 - 15.5.96. *Lecture:* Asymptotic expansion of Wiener-Hopf integral equations for a linear visco-elastic screen problem, 6.5.96.

Mascarenhas, L., F. C. da Universidade de Lisboa, Portugal, 26.11.96. *Lecture:* Efeitos de memória em misturas elasto-viscoelásticas.

Montaldi, J., INLS, Université de Nice, France, 11.5.96 - 19.5.96. *Lecture:* Dynamics of symmetric molecules, 15.5.96.

Nunes, A. F. C. da Universidade de Lisboa, Portugal, 17.4.96. *Lecture*: Método de Poincaré-Melnikov.

Nunes, J., Brown University, USA, 19.12.96. *Lecture*: Tópicos em teorias de Seiberg-Witten.

Pinto, A., Universidade do Porto, Portugal, 10.5.96. *Lecture*: Classificação C^{1+} das rotações da circunferência e rigidez C^{1+} Zygmund.

Prössdorf, S., Weierstrass-Institut für Angewandte Analysis und Stochastik, 25.6.96 - 3.7.96. *Lecture*: Wavelet approximation methods for integral and pseudodifferential equations, 1.7.96.

Ramos, M., F. C. da Universidade de Lisboa, Portugal, 21.11.96. *Lecture*: Estimativas L^\bullet para equações elípticas sobrelineares.

Rêgo, E., F. C. da Universidade do Porto, Portugal, 5.2.96. *Lecture*: Esferas de homotopia e o chapéu de burro generalizado.

Roberts, M., University of Warwick, UK, 11.5.96 - 17.5.96. *Lecture*: Bifurcations of reduced phase spaces, 14.5.96.

Sanchez, L., F. C. da Universidade de Lisboa, Portugal, 5.12.96. *Lecture*: Três soluções para um problema elíptico perto da ressonância.

Sweers, G., Technical University of Delft, Holland, 12.7.96 - 20.7.96. *Lecture*: The maximum principle and polyharmonic equations, 16.7.96.

Statistics and Applications

Azen, University of California, USA, 11.5.96 - 13.5.96.

Göb, Würzburg Universität, Germany, 15.12.96 - 20.12.96.

Haas, Insead, France, 2.5.96 - 5.5.96.

Wassenhove, Insead, France, 2.5.96 - 5.5.96.

Applied Mathematics and Numerical Analysis

Clain, S., *Lecture*: A numerical approximation theorem of Rannacher-Scott, 14.10.96.

Frolova, E., *Lecture*: LP- estimates for parabolic equations with time derivative in the boundary, 28.11.96.

Galdi, G. P., University of Ferrara, Italy, 26.4.96 - 2.5.96.

Germain-Bonne, B., Université de Lille, France, 8.6.96 - 15.6.96. *Lecture:* Bref historique des instruments et machines à calculer, 11.6.96.

Guidotti, P., University of Zürich, Switzerland, 21.3.96 - 28.3.96. *Lecture:* Singular parabolic equations, 26.3.96.

Málek, J., Charles University, Prague, Czech Republic, 24.10.96 - 31.10.96. *Lecture:* An existence result for fluids with shear dependent viscosity: steady flows, 29.10.96.

Novotny, A., Université de Toulon et du Var, France, 12.4.96 - 19.4.96. *Lecture:* The analysis of the compressible Navier-Stokes equations via a method of decomposition, 17.4.96.

Rajagopal, K. R., Texas A&M University, USA, 16.6.96 - 21.6.96. *Lecture:* Topics in non-linear fluid mechanics, 18.6.96 - 19.6.96.

Schonbek, M., University of California, Santa Cruz, USA, 11.5.96 - 18.5.96. *Lecture:* Backwards self-similar solutions to the Navier-Stokes equations, 14.5.96.

Shemetov, N., Universidade Independente de Lisboa. *Lecture:* Thermo-mechanical evolution of shape memory alloy, 21.5.96.

Solonnikov, V., Steklov Institute of Mathematics, St. Petersburg, Russia, 12.6.96 - 20.6.96. *Lecture:* Exterior problems for the equations of compressible liquids in Hölder spaces, 18.6.96.

Tang, T., Simon Fraser University, Canada, 8.7.96 - 17.7.96. *Lecture:* Boundary layer resolving spectral methods, 9.7.96.

Thäeter, G., Universität-GH Paderborn, Germany. *Lecture:* Asymptotic conditions for Stokes problems in domains with cylindrical outlets, 28.5.96.

Computer Science

Costa, J. F., Universidade de Lisboa, Portugal. *Lecture:* Biocomputabilidade: Advento de arquiteturas computacionais inspiradas na neurobiologia e na genética molecular, 16.2.96.

Costa, J. F., Universidade de Lisboa, Portugal. *Lecture:* Teorias super-Turing, 21.6.96.

Denker, G., University of Braunschweig, Germany, 16.9.96 - 20.9.96. *Lecture:* Some aspects of refining object specifications, 20.9.96.

Deshpande, Akash, University of California, Berkeley, U. S. A., 8.11.96 - 9.11.96. *Lecture:* Hybrid dynamical systems: Modeling, simulation, verification, control, 8.11.96.

Ehrich, H. D., University of Braunschweig, Germany, 10.12.96 - 14.12.96. *Lecture:* Specifying concurrent information systems without specifying concurrency, 13.12.96.

Filipe, J. K., University of Braunschweig, Germany, 6.12.96 - 14.12.96. *Lecture: Category-based composition of concurrent objects, 6.12.96.*

Monteiro, L. F., Universidade Nova de Lisboa, Portugal. *Lecture: Um sistema de transição universal, 15.3.96.*

Ryan, M., University of Birmingham, United Kingdom, 18.1.96 - 19.1.96. *Lecture: Towards feature-oriented specifications, 19.1.96.*

Ryan, M., University of Birmingham, United Kingdom, 24.7.96 - 27.7.96.

Saake, G., University of Magdeburg, Germany, 18.1.96 - 19.1.96.

Schobbens, P. Y., University of Namur, Belgium, 8.1.96 - 10.1.96.

Sobral, M., Universidade de Coimbra. *Lecture: Equivalência de teorias e técnicas da descida, 18.10.96.*

Valença, J. M., Universidade do Minho, Portugal. *Lecture: Lógica computacional, 1.3.96.*

5. Research Programmes and Sponsorship

5.1 Research Units

Several members of the Department participate in research units that receive grants under the “Programa de Financiamento Plurianual de Unidades de I&D”, JNICT:

- Center for Applied Mathematics, n° 82/96, coordinated by A. Ferreira dos Santos.
- Center for Mathematical Analysis, Dynamical Systems and Applications, n° 89/96, coordinated by L. T. Magalhães.
- Robotics and Systems Institute at Lisbon, n° 101/96 coordinated by J. Sentieiro (Department of Electrical Engineering and Computers)
- Center for Plasma Physics, n° 90 B/96 coordinated by José Tito Mendonça (Complexo Interdisciplinar)
- Research Unit for Naval Engineering and Technology, n° 134/96 coordinated by Guedes Soares (Section of Naval Engineering)

5.2 Research Projects Coordinated by Department Members

Costa, F. P., Coordinated the projects:

- Phase Transitions and Partial Differential Equations, JNICT, PBIC/C/MAT/2139/95.
- Dynamics of Phase Transitions in Systems of Interacting Particles, /423/INIDA.

Ferreira, J. M., Coordinated the research project:

- Algebraic Methods in Discrete Dynamics Geometry, JNICT-STRIDE, STRDA/C/CEN/425/92.

Fernandes, R. L., Coordinated the project:

- Geometric and Topological Methods in Hamiltonian Dynamical Systems and Ergodic Theory, JNICT, PBIC/C/MAT/2140/95.

Magalhães, L. T., Coordinated the projects:

- Non-Linear Analysis and Dynamical Systems, PRAXIS XXI, 2/2.1/MAT/199/94.
- Dynamical Phase Transitions, collaboration with the Universidade de São Paulo, São Paulo, Brasil, CNPQ/JNICT.

Picken, R., Coordinated the Portuguese team in the project:

- Constrained Dynamical Systems Network, Human Capital and Mobility Programme (Contract ERB-CHRX-CT93-0362), 1.1.94 - 31.12.96.

Ramalhoto, M. F., Coordinated the projects:

- HCM Project N° ERBCHCT 930.294-HCM: Decision support for maintenance management.
- TQM Project from EFQM: Master and research program on total quality management.

Santos, A. F., Coordinated the project:

- Operator Factorization and Applications to Mathematical - Physics, 1996-1999, PRAXIS XXI-2/2.1/MAT441/94.

Sequeira, A., Coordinated the projects:

- The Equations of Fluid Dynamics and Related Problems, HCM Project, Contract CHRX/CT93/0407.
- Mathematical Problems in non-Newtonian Fluids, in collaboration with the University of Ferrara, Italy, JNICT/CNR.
- Mathematical Analysis and Numerical Solution of Non-Newtonian Fluids with Applications in Liquid-Crystalline Polymers Technology, PRAXIS XXI-2/2.1/MAT/380/94.
- Numerical Methods in Fluid Mechanics, in collaboration with the École Polytechnique de Tunisie, La Marsa, JNICT/Rep. Tunisienne.

Sernadas, A., Coordinated of the projects:

- **SitCalc: Situation Calculus** - Modularization, reification and distribution
PRAXIS XXI Project 2/2.1/MAT/262/94: 1996-98.

This project aims at establishing the situation calculus (SC) as an alternative to temporal logic for specifying concurrent reactive systems, namely: definition of the logic structure underlying the SC; development of the correspondence theory with respect to first order logic and to temporal logic; extension of SC with modularization, reification and distribution constructs (ESC); semantics of the language GNOME over ESC; ESC theorem prover over ISABELLE and/or MATHEMATICA.

- **COMPASS**

ESPRIT II BRA Working Group COMPASS WG 6112.

This project was aimed at providing a comprehensive algebraic approach to the specification of systems and their components, with emphasis on their correct development. The project was coordinated by the University of Bremen and included seventeen other partners. The contribution of the logic and computation group was to establish institutional frameworks for object behaviour and on theory spaces.

Sousa Ramos, J. coordinated the projects:

- Métodos Geométricos e Topológicos em Baixa Dimensão e em Dimensão Infinita, Programa Praxis XXI - 2/2.1/MAT/132/94,
- Ensino Experimental da Matemática, Programa Ciência Viva, Contrato nº 30/96.

Speck, Frank-Olme coordinated the following projects:

- Singular Operators - New Features and Applications, in collaboration with the Technische Hochschule Darmstadt, JNICT and BMFT (the Federal Minister for Research and Technology in Germany), 1995-98.
- Spline-Galerkin Methods for Integral Equations of Wiener-Hopf Type, in collaboration with the Technische Universität Chemnitz-Zwickau, JNICT and BMFT (the Federal Minister for Research and Technology in Germany), 1995-98.

Teixeira, F., Coordinated the project:

- Operator Methods in Diffraction Theory, JNICT, Programa Base, PBIC/CEN/1040/92.

Viegas, F., Coordinated the project:

- Generalized Functions in Symbolic Calculus, JNICT, Programa Base, PBIC/CEN/1066/92.

5.3 Participation in Other Research Projects

Some members of the Department also received research funding through projects coordinated outside the Department:

- Astrophysics and Gravitational Interaction Physics, ESO, coordinated by A. B. Henriques (Department of Physics, IST) (project number PESO/PRO/1009/93).
- Mathematical Physics, JNICT - Programa Base/PRAXIS XXI, coordinated by A. Cruzeiro (Department of Mathematics, Faculdade de Ciências, Universidade de Lisboa) (project number PBIC/CEN/1631/93).

Carmo, J., Member of:

- ESPRIT-III BRA: "ModelAge: A Common Formal Model of Cooperating Intelligent Agents"
- JNICT - Praxis XXI, national research project "SARA: Society of Animated and Responsible Agents".
- JNICT, national research project "MAGO: Modeling of Agents and Organizations".

6. Organization of Conferences, Meetings, etc.

Branco, J., President of the IV Annual Congress of the Portuguese Statistical Society, Funchal, Portugal, 11.6.96 - 15.6.96.

Carmo, J., Co-chairman of the programme committee of the Third International Workshop on Deontic Logic in Computer Science (Deon'96), Sesimbra, Portugal, 11.1.96 - 13.1.96.

Florentino, C., Organizer of the Graduate Student Seminar, S.U.N.Y. at Stony Brook, USA, January - May 1996.

Picken, R., Member of the Organizing Committee, Vth Porto Meeting on Knot Theory and Physics, Porto, Portugal, 19.4.96 - 22.4.96.

Ramalhoto, M. F., Host of the HCM Project meeting, 28.2.96 - 03.3.96.

Ramalhoto, M. F., Member of the Program Committee, Organizer and Chairperson of Panel 16- Engineering and Management, World Congress of Engineering Educators and Industry Leaders, UNESCO, 2.7.96 - 5.7.96.

Ramalhoto, M. F., Member of the Program Committee, Computer Aided Learning and Instruction in Science and Engineering, 3rd International Conference, CALISCE'96, San Sebastian, Spain, 30.7.96 - 31.7.96.

Sequeira, A., Member of the Scientific Committee of the Fourth International Conference on Navier-Stokes Equations and Related Nonlinear Problems, Kruger Park, South-Africa, 19.5.96 - 24.5.96.

Sequeira, A., Member of the Scientific Committee of the International Conference on Euler and Navier-Stokes Equations in Unbounded Domains, Nantes, France, 5.9.96 - 7.9.96.

7. Personal Notes

Other Notes

Barreira, L., Visitor, The Pennsylvania State University, University Park, USA, May - December 1996.

Branco, J.:

- President of the Portuguese Statistical Society.
- Member of the International Statistical Institute.
- Member of the Grupo de Trabalho sobre Estatísticas da Ciência e Tecnologia da Secção Permanente de Estatísticas Demográficas e Sociais do Conselho Superior de Estatística.
- Coordinator of the Action "Introdução às Probabilidades e Estatística" of the Foco Program.
- Member of the Editorial Council of the "Revista de Estatística" of the Instituto Nacional de Estatística.

Buescu, J., Editor of the Problems Section of the Boletim da Sociedade Portuguesa de Matemática.

Carmo, J.:

- Member of the Program Committee of the Fourth International Workshop on Deontic Logic in Computer Science (DEON-98), to be held in Bologna (Italy), in January 1998.
- Chair of the Session on Modelling Deontic Agents and their Behaviours, Second Workshop of the ModelAge Project, Sesimbra, Portugal, 15.1.96 - 17.1.96.

Cordovil, R.:

- Member of the Editorial Board of European J. of Combinatorics Review, since June 1996.
- Member of the doctoral committee of David Forge, Paris VI University, 13.12.96.

Magalhães, L.:

- Associate Director of the Robotics and Systems Institute in Lisbon. He was the coordinator of the Center for Mathematical Analysis, Dynamical Systems and Applications.
- Coordinator of the Research Units Assessment, under appointment of the Minister of Science and Technology, Portugal, April 1996.

Paulino, D.:

- Referee for Actas do III Congresso da SPE
- Book reviewer for the Brazilian Journal of Probability and Statistics
- JNICT grant for sabbatical leave
- Visiting Professor at the Department of Statistics, University of São Paulo, Brazil,

October - December 1996.

Picken, R., Member of the organizing committee of the VIth Oporto Meeting on Geometry, Topology and Physics (previously known as the Oporto Meetings on Knot Theory and Physics) to be held in Oporto, Portugal, 4.7.97 - 7.7.97.

Ramalhoto, M. F.:

- Inquirer of the Doctoral Committee of the Thesis "Queues with Retrials and Negative Arrivals", Universidad Complutense de Madrid, Madrid, Spain, November 1996.
- Member of the Technical Program Committee, ESREL'97 - International Conference on Safety and Reliability and Organizer of the Session, Reliability and Stochastic Process Control, Lisbon, Portugal, 17.6.97 - 20.6.97.
- Chairperson of the Program and Organizing Committee European Workshop on Maintenance Management, Lisbon, Portugal, 15.6.97 - 17.6.97.

Rocha, C., Member of the Scientific Committee of the IIIème Congrès de Mécanique, Société Marocaine des Sciences Mécaniques, to be held in Tétouan, Morocco, 22.4.97 - 25.4.97.

Sequeira, A.:

- Invited Professor at Université de Toulon et du Var, France, 1.6.96 - 15.6.96.
- Chairman of the Organizing Committee of the International Conference on Applied Analysis, IST, Lisbon, Portugal, 26.2.97 - 1.3.97.

Sousa Dias, E., Received a research grant from Fundação Calouste Gulbenkian for a visit to the University of Warwick.

Videman, J. H., Member of the Organizing Committee of International Conference on Applied Analysis, Lisbon, Portugal, 26.2.97 - 1.3.97.

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