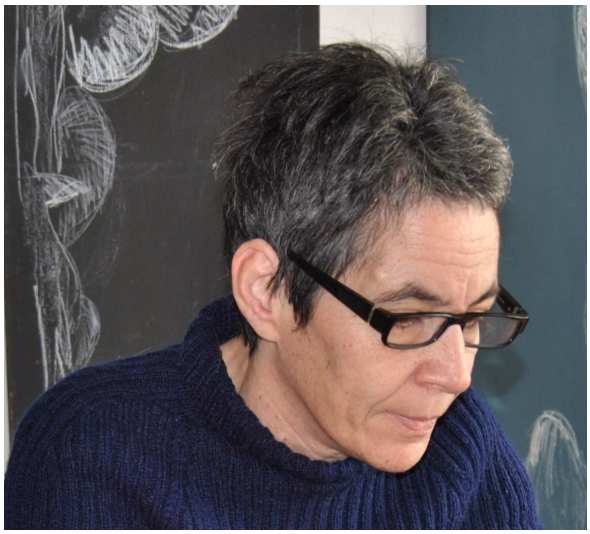
CURRICULUM VITAE



Luisa da Cunha e Costa Consiglieri

Lisbon, June 12, 2020

Contents

Biographical data

Identification

NAME. Luisa da Cunha e Costa Consiglieri
BIRTHPLACE / DATE OF BIRTH. Lisbon / May 17, 1966
MARITAL STATUS. Married
NATIONALITY. Portuguese
E-MAIL. luisa.consiglieri@fulbrightmail.org

URL. https://sites.google.com/site/luisaconsiglieri
http://www.linkedin.com/pub/luisa-cunha-costa-consiglieri/40/3b6/73a

Academic degrees

- Graduate in Mathematics from Faculty of Sciences of University of Lisbon (July 1988).

- Master of Science in *Functional Analysis and Differential Equations*, from Faculty of Sciences of University of Lisbon, adviser: Prof. J.F. Rodrigues (September 1992).

- PhD in *Mathematical Methods of Mechanics*, from Faculty of Sciences of University of Lisbon, adviser: Prof. J.F. Rodrigues (February 2000). Thesis entitled: Mathematical analysis of some problems from non-Newtonian fluid mechanics.

- Post-doctoral fellowship provided by Fulbright (Fulbright Program for Visiting (Non-U.S.) Scholars: Advanced Research and University Lecturing Awards in the United States) in Laboratory of Biomechanics of Biomedical Engineering Department of University of Texas at Austin, under coordination of Dr. M.G. Pandy (February 2003 - August 2003).

- Graduate (Bologna Degree) in Mining and Geological Engineering, from Instituto Superior Técnico, University of Lisbon (July 2019).

Languages:	**conversation**	**reading**	**writing**
English	regular	good	correct
French	regular	good	correct
Spanish	regular	good	regular
Italian	regular	good	regular.

Mother tongue: Portuguese.

Professional activity

Academic teaching positions at the Department of Mathematics of Faculty of Sciences of University of Lisbon from December 1987. Tenure-track position (Assistant Professor) until her retirement (due to speech disorder) in April 2009.

Scientific activity

Open Researcher & Contributor ID (ORCID) 0000-0002-1002-3711
Scopus author ID 55886896400

Research position as a member of the Centro de Matemática e Aplicações Fundamentais of University of Lisbon (CMAFUL) in the area of partial differential equations, 1988–2008. Colaborator member of the Coordenação Interdisciplinar para a Investigação e Inovação (C3i) - Instituto Politécnico de Portalegre, 2011–2015.

She cooperated with several research institutes and universities, and she participated in several projects (national and international) in the scope of

INIC Instituto Nacional de Investigação Científica, 1988-1992.

JNICT Junta Nacional para a Investigação Científica e Tecnológica, 1988-1997.

Fundação Calouste Gulbenkian Plano de Reforço da Capacidade Científica do Departamento de Matemática da FCUL, 1992.

PRAXIS XXI Intervenção Operacional Ciência e Tecnologia do QCA II (Quadro Comunitário de Apoio II), 1994-1999. Project PRAXIS/2/2.1/MAT/125/94: Análise Local e Global das Equações Diferenciais. Fundamentos e Aplicações, from Program PRAXIS XXI - Medida 2, Ação 2.1 (Programas Estruturantes para o Desenvolvimento da Base do Sistema de C& T).

POCTI/POCI Operational Programme for Science, Technology and Innovation, and Operational Programme for Science and Innovation of QCA III (Quadro Comunitário de Apoio III), Ministério da Ciência e Ensino Superior, 2000-2008. Projects POCTI2000 and POCI2010 (Portugal/FEDER-EU).

EIMI The Euler International Mathematical Institute, TETE-A-TETE in RUSSIA program, staying in St.Petersburg in the period from 1.08 till 1.09.2000, coordinated by G. Seregin from PDMI (St. Petersburg Department of V.A. Steklov Institute of Mathematics of the Russian Academy of Sciences).

INTAS EU co-operation with the NIS in science & technology, 2000-2003.

FCT Fundação para a Ciência e a Tecnologia, Ministério da Educação e Ciência, 1997-2008. Projects 3B99, 3B02: Interfaces, Evolution Systems and Nonlinear Problems; FEDER and FCT-Plurianual 2007; Financiamento Base 2008 - ISFL/1/209.

Visiting positions

- in cooperation with: Carmen Muñiz, at University of Santiago de Compostela in September 1-5, 1997, April 13-17, 1998, July 9-22, 2000, June 11-15 and July 9-11, 2001 (under **AI:E-12/00** project: Programa das Acções Universitárias Integradas Luso-Espanholas, from MICINN (Ministerio de Ciencia e Innovación), and Conselho de Reitores das Universidades Portuguesas (CRUP), two years), June 15-24, 2004; and at University of Zurich on 25th June-2nd July 1999.

- in cooperation with: Danielle Hilhorst, at University of Orsay-Paris in September 6-10, 1999.

- in cooperation with: Timofey Shilkin, at Steklov Mathematical Institute of St. Petersburg in August 1 - September 1, 2000.

- in cooperation with: Stanislav Antontsev, several meetings at CMAF/UL under the POCI/MAT/61576/2004 Research and Development Project (36 months), entitled *Variable exponents of nonlinearity in fluid dynamics*, Main Contractor: Universidade da Beira Interior (UBI); Main Research Unit: Centro de Matemática (CM/UBI).

- in cooperation with: Josef Malek and Miroslav Bulicek, grant from Jindřich Nečas Center for Mathematical Modeling, under the project LC06052 financed by Ministry of Education, Youth and Sports (MSMT), at Faculty of Mathematics and Physics (MFF), Charles University, Prague, Czech Republic, from October 2 until November 30, 2006.

- in cooperation with: Cherif Amrouche, at Laboratoire de Mathématiques Appliquées, Université de Pau et des Pays de L'Adour, Pau, France in December 4-22, 2006, November 26-30, 2007, January 29-February 15, 2008 and April 22-30, 2008.

- in cooperation with: Sarka Nečasova and Eduard Feireisl, at Mathematical Institute of The Academy of Sciences of the Czech Republic, and Josef Malek and Miroslav Bulicek, at MFF, Charles University, Prague, Czech Republic in September 3-14, 2007.

- in cooperation with: Francisco Guillén and Maria Ángeles Rodríguez, at Departamento de Ecuaciones Diferenciales y Análisis Numérico of Universidad de Sevilla in November 2-5, 2010.

International co-operation with Icaro dos Santos, CMAFUL, Juin 16-20, 2007. National co-operation with Eduardo Borges Pires, Instituto Superior Técnico, Universidade Técnica de Lisboa, 2008.

Editorial board membership

- *World Applied Sciences Journal* (2006-2009): International Digital Organization for Scientific Information;
- *Advances in Natural and Applied Sciences* (September 2007, –): American-Eurasian Network for Scientific Information;
- *International Journal of Mathematics and Computational Science* (2015-2017): Public Science Framework.

Referee/reviewer participations

She has acted as referee for several international journals, namely

- Annali dell'Università di Ferrara (Springer);
- Computers & Mathematics with Applications (Elsevier);
- Control and Cybernetics (Systems Research Institute of the Polish Academy of Sciences);
- Differential Equations and Nonlinear Mechanics (Hindawi Publishing Corporation);
- European Journal of Applied Mathematics (Cambridge University Press);
- Il Nuovo Cimento B (Società Italiana di Fisica);
- Interfaces and Free Boundaries (EMS Journal);
- International Journal of Computer Mathematics (Taylor & Francis);
- International Journal of Engineering Science (Elsevier);
- International Journal of Physical Sciences (Academic Journals);
- Journal of Mathematical Analysis and Applications (Elsevier);
- Journal of Mathematical Fluid Mechanics (Springer);
- Journal of Nanoparticle Research (Springer);
- Journal of Porous Media (Begell House);
- Mathematical Methods in the Applied Sciences (Wiley InterScience);
- Medical & Biological Engineering & Computing (Springer);

- Nexus Network Journal (Birkhäuser Verlag);
- Nonlinear Analysis Series B: Real World Applications (Elsevier);
- Optimization Methods and Software (Taylor & Francis);
- SIAM Journal on Mathematical Analysis (SIMA, Society for Industrial and Applied Mathematics).

and also collaborated as *referee* for

- NSERC Collaborative Research and Development of **Natural Sciences and Engineering Research Council of Canada**;
- South Africa's National Research Foundation (NRF).
- FP7 Seventh Framework Programme for Research and Technological Development, EU 2007-2013.
- Division of Materials Sciences and Engineering, **US Department of Energy, Office of Basic Energy Sciences** (DOE-BES).

Acting as a reviewer for

2000-2002; July 2019-Present: American Mathematical Society.

2008-Present: Zentralblatt MATH.

Since 2013, she takes part of the Elsevier Researcher Panel.

Membership in professional societies

- APMTAC (Associação Portuguesa de Mecânica Teórica, Aplicada e Computacional), 2004-2010;
- NAAM (Nexus Association for Architecture and Mathematics), 2008-2010 as founding member;
- SPG (Sociedade Portuguesa de Geotecnia), 2019;
- IAEG (International Association for Engineering Geology and the Environment), 2019;
- ISRM (International Society for Rock Mechanics and Rock Engineering), 2019;
- ISSMGE (International Society for Soil Mechanics and Geotechnical Engineering), 2019.

Research interests

Scientific activity has mainly been related to the classical questions in PDE theory, i.e. the existence, uniqueness and regularity of solutions of initial-boundary value problems. Nevertheless, the research interests span a variety of areas in differential equations such as continuum mechanics: in particular fluid mechanics, heat transfer, and electromagnetism. Other interest deals with the relations between the contemporary architecture/aesthetics and mathematics. At the present, the principal aim is the crossdisciplinarity (which includes multi-, inter-, and transdisciplinary) involving chemistry, geophysics, medical biophysics, and biomedical engineering: with emphasis in biomechanics.

Main interests (Mathematics Subject Classification 2020):

00 General and overarching topics; collections:

00Axx General and miscellaneous specific topics: 00A06 Mathematics for non-mathematicians (engineering, social sciences, etc.). 00A67 Mathematics and architecture.

26 Real functions: 26-00 General reference works (handbooks, dictionaries, bibliographies, etc.); 26-01 Instructional exposition (textbooks, tutorial papers, etc.) pertaining to real functions.

31 Potential theory:

31Axx Two-dimensional potential theory: 31A10 Integral representations, integral operators, integral equations methods in two dimensions.

31Bxx Higher-dimensional potential theory: 31B10 Integral representations, integral operators, integral equations methods in higher dimensions.

34 Ordinary differential equations:

34Axx General theory for ordinary differential equations: 34A05 Explicit solutions, first integrals of ordinary differential equations; 34A12 Initial value problems, existence, uniqueness, continuous dependence and continuation of solutions to ordinary differential equations; 34A30 Linear ordinary differential equations and systems, general; 34A34 Nonlinear ordinary differential equations and systems, general.

35 Partial differential equations:

35Axx General topics in partial differential equations: 35A01 Existence problems for PDEs: global existence, local existence, non-existence; 35A02 Uniqueness problems for PDEs: global uniqueness, local uniqueness, non-uniqueness; 35A08 Fundamental solutions to PDEs; 35A09 Classical solutions to PDEs; 35A15 Variational methods applied to PDEs.

35Bxx Qualitative properties of solutions to partial differential equations: 35B30 Dependence of solutions to PDEs on initial and/or boundary data and/or parameters of PDEs; 35B33 Critical exponents in context of PDEs; 35B40 Asymptotic behavior of solutions to PDEs; 35B45 A priori estimates in context of PDEs; 35B50 Maximum principles in context of PDEs; 35B51 Comparison principles in context of PDEs; 35B65 Smoothness and regularity of solutions to PDEs.

35Cxx Representations of solutions to partial differential equations: 35C05 Solutions to PDEs in closed form; 35C15 Integral representations of solutions to PDEs.
35Dxx Generalized solutions to partial differential equations: 35D30 Weak solutions to PDEs; 35D35 Strong solutions to PDEs.
35Exx Partial differential equations and systems of partial differential equations with constant coefficients: 35E05 Fundamental solutions to PDEs and systems of PDEs with constant coefficients; 35E15 Initial value problems for PDEs and systems of PDEs with constant coefficients; 35E20 General theory of PDEs and systems of PDEs with constant coefficients.
35Jxx Elliptic equations and elliptic systems: 35J05 Laplace operator, Helmholtz equation (reduced wave equation), Poisson equation; 35J08 Green functions for elliptic equations; 35J15 Second-order elliptic equations; 35J20 Variational methods for second-order elliptic equations; 35J25 Boundary value problems for second-order elliptic equations; 35J47 Second-order elliptic systems; 35J50 Variational methods for elliptic systems; 35J57 Boundary value problems for second-order elliptic systems; 35J60 Nonlinear elliptic equations; 35J62 Quasilinear elliptic equations; 35J65 Nonlinear boundary value problems for linear elliptic equations; 35J66 Nonlinear boundary value problems for nonlinear elliptic equations; 35J67 Boundary values of solutions to elliptic equations and elliptic systems; 35J86 Unilateral problems for linear elliptic equations and variational inequalities with linear elliptic operators; 35J87 Unilateral problems for nonlinear elliptic equations and variational inequalities with nonlinear elliptic operators; 35J88 Unilateral problems for elliptic systems and systems of variational inequalities with elliptic operators; 35J92 Quasilinear elliptic equations with p-Laplacian.
35Kxx Parabolic equations and parabolic systems: 35K05 Heat equation; 35K08 Heat kernel; 35K10 Second-order parabolic equations; 35K15 Initial value problems for second-order parabolic equations; 35K20 Initial-boundary value problems for second-order parabolic equations; 35K40 Second-order parabolic systems; 35K45 Initial value problems for second-order parabolic systems; 35K51 Initial-boundary value problems for second-order parabolic systems; 35K55 Nonlinear parabolic equations; 35K57 Reaction-diffusion equations; 35K58 Semilinear parabolic equations; 35K59 Quasilinear parabolic equations; 35K60 Nonlinear initial, boundary and initial-boundary value problems for linear parabolic equations; 35K61 Nonlinear initial, boundary and initial-boundary value problems for nonlinear parabolic equations; 35K85 Unilateral problems for linear parabolic equations and variational inequalities with linear parabolic operators; 35K86 Unilateral problems for nonlinear parabolic equations and variational inequalities with nonlinear parabolic operators; 35K87 Unilateral problems for parabolic systems and variational inequalities with parabolic operators; 35K90 Abstract parabolic equations; 35K92 Quasilinear parabolic equations with p-Laplacian.
35Lxx Hyperbolic equations and hyperbolic systems: 35L02 First-order hyperbolic equations; 35L03 Initial value problems for first-order hyperbolic equations; 35L04 Initial-boundary value problems for first-order hyperbolic equations; 35L05

Wave equation; 35L10 Second-order hyperbolic equations; 35L15 Initial value problems for second-order hyperbolic equations; 35L20 Initial-boundary value problems for second-order hyperbolic equations.

35Mxx Partial differential equations of mixed type and mixed-type systems of partial differential equations: 35M10 PDEs of mixed type; 35M11 Initial value problems for PDEs of mixed type; 35M12 Boundary value problems for PDEs of mixed type; 35M13 Initial-boundary value problems for PDEs of mixed type; 35M30 Mixed-type systems of PDEs; 35M31 Initial value problems for mixed-type systems of PDEs; 35M32 Boundary value problems for mixed-type systems of PDEs; 35M33 Initial-boundary value problems for mixed-type systems of PDEs; 35M85 Unilateral problems for linear PDEs of mixed type and variational inequalities with partial differential operators of mixed type; 35M86 Unilateral problems for nonlinear PDEs of mixed type and variational inequalities with partial differential operators of mixed type; 35M87 Unilateral problems for mixed-type systems of PDEs and systems of variational inequalities with partial differential operators of mixed type.

35Qxx Partial differential equations of mathematical physics and other areas of application: 35Q30 Navier-Stokes equations; 35Q35 PDEs in connection with fluid mechanics; 35Q60 PDEs in connection with optics and electromagnetic theory; 35Q61 Maxwell equations; 35Q74 PDEs in connection with mechanics of deformable solids; 35Q79 PDEs in connection with classical thermodynamics and heat transfer; 35Q86 PDEs in connection with geophysics; 35Q92 PDEs in connection with biology, chemistry and other natural sciences; 35Q93 PDEs in connection with control and optimization.

35Rxx Miscellaneous topics in partial differential equations: 35R05 PDEs with low regular coefficients and/or low regular data; 35R06 PDEs with measure; 35R35 Free boundary problems for PDEs; 35R37 Moving boundary problems for PDEs; 35R45 Partial differential inequalities and systems of partial differential inequalities.

40 Sequences, series, summability: 40-00 General reference works (handbooks, dictionaries, bibliographies, etc.) pertaining to sequences, series, summability; 40-01 Instructional exposition (textbooks, tutorial papers, etc.) pertaining to sequences, series, summability.

42 Harmonic analysis on Euclidean spaces:

42Bxx Harmonic analysis in several variables: 42B20 Singular and oscillatory integrals (Calderón-Zygmund, etc.); 42B25 Maximal functions, Littlewood-Paley theory; 42B30 H^p-spaces.

46 Functional analysis:

46Axx Topological linear spaces and related structures: 46A03 General theory of locally convex spaces; 46A20 Duality theory for topological vector spaces.

46Bxx Normed linear spaces and Banach spaces; Banach lattices: 46B25 Classical Banach spaces in the general theory; 46B50 Compactness in Banach (or normed) spaces; 46B70 Interpolation between normed linear spaces.

46Exx Linear function spaces and their duals: 46E15 Banach spaces of continu-

ous, differentiable or analytic functions; 46E20 Hilbert spaces of continuous, differentiable or analytic functions; 46E30 Spaces of measurable functions (L^p-spaces, Orlicz spaces, Köthe function spaces, Lorentz spaces, rearrangement invariant spaces, ideal spaces, etc.); 46E35 Sobolev spaces and other spaces of "smooth" functions, embedding theorems, trace theorems.

47 Operator theory:

47Hxx Nonlinear operators and their properties: 47H04 Set-valued operators; 47H05 Monotone operators and generalizations; 47H06 Nonlinear accretive operators, dissipative operators, etc.; 47H10 Fixed-point theorems.

49 Calculus of variations and optimal control; optimization:

49Jxx Existence theories in calculus of variations and optimal control: 49J15 Existence theories for optimal control problems involving ordinary differential equations; 49J20 Existence theories for optimal control problems involving partial differential equations; 49J30 Existence of optimal solutions belonging to restricted classes (Lipschitz controls, bang-bang controls, etc.); 49J35 Existence of solutions for minimax problems; 49J40 Variational inequalities; 49J45 Methods involving semicontinuity and convergence; relaxation; 49J50 Fréchet and Gateaux differentiability in optimization.

49Kxx Optimality conditions: 49K40 Sensitivity, stability, well-posedness.

49Nxx Miscellaneous topics in calculus of variations and optimal control: 49N05 Linear optimal control problems; 49N15 Duality theory (optimization); 49N60 Regularity of solutions in optimal control.

65 Numerical analysis:

65Mxx Numerical methods for partial differential equations, initial value and time-dependent initial-boundary value problems: 65M60 Finite element, Rayleigh-Ritz and Galerkin methods for initial value and initial-boundary value problems involving PDEs.

65Nxx Numerical methods for partial differential equations, boundary value problems: 65N30 Finite element, Rayleigh-Ritz and Galerkin methods for boundary value problems involving PDEs.

74 Mechanics of deformable solids:

74Axx Generalities, axiomatics, foundations of continuum mechanics of solids: 74A05 Kinematics of deformation; 74A10 Stress; 74A15 Thermodynamics in solid mechanics; 74A20 Theory of constitutive functions in solid mechanics; 74A55 Theories of friction (tribology).

74Fxx Coupling of solid mechanics with other effects: 74F05 Thermal effects in solid mechanics; 74F10 Fluid-solid interactions (including aero- and hydro-elasticity, porosity, etc.); 74F15 Electromagnetic effects in solid mechanics; 74F20 Mixture effects in solid mechanics; 74F25 Chemical and reactive effects in solid mechanics.

74Lxx Special subfields of solid mechanics: 74L05 Geophysical solid mechanics; 74L10 Soil and rock mechanics; 74L15 Biomechanical solid mechanics.

74Mxx Special kinds of problems in solid mechanics: 74M10 Friction in solid mechanics.

74Nxx Phase transformations in solids: 74N20 Dynamics of phase boundaries in solids; 74N25 Transformations involving diffusion in solids.

76 Fluid mechanics:

76Axx Foundations, constitutive equations, rheology, hydrodynamical models of non-fluid phenomena: 76A02 Foundations of fluid mechanics; 76A05 Non-Newtonian fluids; 76A10 Viscoelastic fluids.

76Bxx Incompressible inviscid fluids: 76B03 Existence, uniqueness, and regularity theory for incompressible inviscid fluids.

76Dxx Incompressible viscous fluids: 76D03 Existence, uniqueness, and regularity theory for incompressible viscous fluids; 76D05 Navier-Stokes equations for incompressible viscous fluids; 76D07 Stokes and related (Oseen, etc.) flows; 76D27 Other free-boundary flows; Hele-Shaw flows.

76Exx Hydrodynamic stability: 76E05 Parallel shear flows in hydrodynamic stability; 76E06 Convection in hydrodynamic stability; 76E07 Rotation in hydrodynamic stability; 76E19 Compressibility effects in hydrodynamic stability; 76E30 Nonlinear effects in hydrodynamic stability.

76Fxx Turbulence: 76F10 Shear flows and turbulence; 76F60 k-ε modeling in turbulence.

76Mxx Basic methods in fluid mechanics: 76M30 Variational methods applied to problems in fluid mechanics.

76Nxx Compressible fluids and gas dynamics, general: 76N06 Compressible Navier–Stokes equations; 76N10 Existence, uniqueness, and regularity theory for compressible fluids and gas dynamics.

76Rxx Diffusion and convection: 76R05 Forced convection; 76R10 Free convection; 76R50 Diffusion.

76Sxx Flows in porous media; filtration: 76S05 Flows in porous media; filtration; seepage.

76Uxx Rotating fluids: 76U05 General theory of rotating fluids.

76Vxx Reaction effects in flows: 76V05 Reaction effects in flows.

76Wxx Magnetohydrodynamics and electrohydrodynamics: 76W05 Magnetohydrodynamics and electrohydrodynamics.

76Zxx Biological fluid mechanics: 76Z05 Physiological flows.

78 Optics, electromagnetic theory:

78Axx General: 78A25 Electromagnetic theory, general; 78A30 Electro- and magnetostatics; 78A35 Motion of charged particles; 78A40 Waves and radiation in optics and electromagnetic theory; 78A57 Electrochemistry; 78A70 Biological applications of optics and electromagnetic theory.

78Mxx Basic methods for problems in optics and electromagnetic theory: 78M30 Variational methods applied to problems in optics and electromagnetic theory.

80 Classical thermodynamics, heat transfer:

80Axx Thermodynamics and heat transfer: 80A05 Foundations of thermodynamics and heat transfer; 80A10 Classical and relativistic thermodynamics; 80A17 Thermodynamics of continua; 80A19 Diffusive and convective heat and mass transfer, heat flow; 80A21 Radiative heat transfer; 80A22 Stefan problems, phase changes, etc.; 80A25 Combustion; 80A30 Chemical kinetics in thermodynamics and heat transfer; 80A32 Chemically reacting flows.
80Mxx Basic methods in thermodynamics and heat transfer: 80M30 Variational methods applied to problems in thermodynamics and heat transfer.

86 Geophysics:
86Axx Geophysics: 86A25 Geo-electricity and geomagnetism; 86A40 Glaciology; 86A60 Geological problems.

92 Biology and other natural sciences:
92Cxx Physiological, cellular and medical topics: 92C05 Biophysics; 92C10 Biomechanics; 92C20 Neural biology; 92C30 Physiology (general); 92C35 Physiological flow; 92C37 Cell biology; 92C40 Biochemistry, molecular biology; 92C50 Medical applications (general).
92Exx Chemistry: 92E20 Classical flows, reactions, etc. in chemistry.

97 Mathematics education:
97Gxx Geometry education: 97G30 Area and volume (educational aspects); 97G40 Plane and solid geometry (educational aspects); 97G50 Transformation geometry (educational aspects); 97G60 Plane and spherical trigonometry (educational aspects); 97G70 Analytic geometry, vector algebra (educational aspects); 97G80 Descriptive geometry (educational aspects).
97Hxx Algebra education: 97H20 Elementary algebra (educational aspects); 97H30 Equations and inequalities (educational aspects); 97H60 Linear algebra (educational aspects).
97Ixx Analysis education: 97I20 Mappings and functions (educational aspects); 97I30 Sequences and series (educational aspects); 97I40 Differential calculus (educational aspects); 97I50 Integral calculus (educational aspects); 97I60 Functions of several variables (educational aspects).
97Mxx Education of mathematical modeling and applications of mathematics: 97M10 Modeling and interdisciplinarity (aspects of mathematics education); 97M50 Physics, astronomy, technology, engineering (aspects of mathematics education); 97M60 Biology, chemistry, medicine (aspects of mathematics education); 97M80 Arts, music, language, architecture (aspects of mathematics education).

Computational skills

Ability, with some experience, to use computer software such as

- Latex, Tex, BeamerTex;
- Maple, Mathematica, Matlab, SIMUL8, R;
- AutoCAD, ArcGIS;
- Microsoft Office for Windows and Mac: Word, PowerPoint, Excel, ...

Numerical Analysis, from Undergraduate and Master curricula.

Conferences/Workshops

Conferences/Workshops (with communication)

Participated in the following conferences and workshops, with communication:

1. Summer Course *Mathematical topics in fluid mechanics*, CMAF/Univ. of Lisbon, September 9-13, 1991, with the communication **Stationary solutions for a Bingham flow with nonlocal friction**.

2. *Symposium on trends in applications of mathematics to mechanics*, CMAF/Univ. of Lisbon, July 1994, with the communication **Stationary solutions for a non-Newtonian flow with heat transfer**.

3. Workshop *Regularization methods in free boundary problems*, Univ. of Algarve, Faro, January 1996, with the communication **Stationary weak solutions for a class of non-Newtonian fluids with energy transfer**.

4. Workshop *Nonlinear partial differential equations and applications: Theoretical fluid dynamics and related topics*, CMAF/University of Lisbon, June 16-19, 1999, with the communication **Weak solutions for a class of non-Newtonian fluids with energy transfer**.

5. *III Encontro do Fórum Internacional de Investigadores Portugueses*, University of Algarve, Faro, April 7-10, 2001, with the communication **Regularity of solutions to a thermoconvective flow.**

6. *VII Workshop on Partial Differential Equations: Theory, Computation and Applications*, IMPA (Rio de Janeiro, Brazil), July 16-20, 2001, with the communication (poster format) **Thermal radiation in a steady Navier-Stokes flow**.

7. *2nd International Conference on the Teaching of Mathematics (at the undergraduate level)*, University of Crete, Hersonissos, Crete, Greece, July 1-6, 2002, with the communication **How can architecture be helped by mathematics?**

   http://sites.google.com/site/luisaconsiglieri/Home/architecture

8. *Encontro 1, biomecânica*, Faculdade de Motricidade Humana/Technical Univ. of Lisbon, Martinchel (Abrantes), February 3-4, 2005, with the communication **The squat jumping model revisited.** DOI: 10.5281/zenodo.3572289

9. *2nd International Symposium on Modelling of Physiological Flows*, Instituto Superior Técnico/Technical University of Lisbon, Sezimbra, March 31- April 2, 2005, with the communication **Cooling effect of blood flow on RF ablation technique**.

   http://www.math.ist.utl.pt/∼mpf2005/abstracts/contributed_consiglieri.pdf

10. International Conference *Free Boundary Problems: Theory and Applications*, Univ. of Coimbra, June 7-12, 2005, with the communication **Steady-state Bingham flow with temperature dependent nonlocal parameters**.

    DOI: 10.5281/zenodo.3572593

11. *Third International Conference of Applied Mathematics*, Technical Univ. of Plovdiv, Bulgaria, August 12-18, 2006, with the communication **Steady-state thermal viscous incompressible flows with frictional and radiative effects**.

12. International Conference on *Applied Analysis and Differential Equations*, Univ. "A. I. Cuza" Iasi, Romania, September 4-9, 2006 Abstract (p. 19-20), with the communication **A** $(p-q)$ **coupled system in elliptic nonlinear boundary value problems**.DOI: 10.13140/RG.2.1.1445.0805

13. *ICAM5- Fifth International Conference on Applied Mathematics* in Honour of Professor Ioan A. Rus with the occasion of his 70th birthday, North Univ. of Baia Mare, Baia Mare, Romania, September 21-24, 2006 Abstract (p. 14), with the communication **Friction boundary conditions for stationary thermal viscous incompressible flows**. DOI: 10.13140/RG.2.1.4909.1608

14. *International Conference on Mathematical Fluid Mechanics a Tribute to Giovanni Paolo Galdi* on the Occasion of Professor Galdi's 60th Birthday, Estoril, IST/UTL, May 21-25, 2007, with the communication **Convective-radiation effects on thermal viscous incompressible flows**.

    DOI: 10.6084/m9.figshare.11369532.v1

15. *CMNE- Congresso de Métodos Numéricos em Engenharia, XXVIII CILAMCE-Congresso Ibero Latino-Americano sobre Métodos Computacionais em Engenharia*, Univ. do Porto, June 13-15, 2007, with the communication **Um modelo analítico para a determinação de momentos internos utilizando dinâmica inversa de multi-corpos**. DOI: 10.5281/zenodo.3572418

16. International Conference *Nexus 2008: Relationships between Architecture and Mathematics*, Point Loma Nazarene University, San Diego, California, USA, June 23-26, 2008, with the communication **Continuity versus Discretization**. DOI: 10.5281/zenodo.3571028

Participated with co-authored works presented at the following scientific meetings:

- (co-authored with M.G. Pandy and A. Seth) **Induced Kinematics: A new computational approach for assessing muscle function during movement** communication presented by A. Seth at *CMBBE*, Madrid (Spain), February 25-28, 2004.

- (co-authored with N. Kim and J.F. Rodrigues) **Generalized Newtonian flows with phase transitions** communication presented by J.F. Rodrigues at *INdAM workshop: Dissipative models in phase transitions*, Cortona (Italy), September 5-11, 2004. Abstract (p. 25)

- (co-authored with T. Shilkin) **Existence and regularity of solutions to the Navier-Stokes system with temperature-dependent viscosity** communication presented by T. Shilkin at *P.D.E. in Mathematical Physics* in memory of Olga A. Ladyzhenskaya, Levico T., Trento (Italy), October 24-30, 2004.

- (co-authored with S. Nečasova and J. Sokolowski) **Shape sensitivity analysis of incompressible Maxwell-Boussinesq problem** comunication presented by S. Nečasova at *IFIP WG 7.2 Workshop: Boundary Control and Optimization*, Mathematical Institute (Czech. Acad. Sci.), Prague (Czech Republic), April 7-8, 2008; **and** The Banach Center Conference on *50 Years of Optimal Control*, Bedlewo (Poland), September 15-20, 2008 (included into the celebration of 60-th anniversary of Institute of Mathematics of the Polish Academy of Science).

- (co-authored with R. Albuquerque) **Invariant connections on Euclidean space** presented as poster on Riemannian Geometry at *VIII International Colloquium on Differential Geometry*, Santiago de Compostela (Spain), July 7-11, 2008.

Workshop (as Organizing Committee)

Workshop *Topics of Regularity on Partial Differential Equations*, held in CMAFUL, November 8-10, 2001. Invited speakers: Cherif Amrouche (Université de Pau et des Pays de L'Adour, France). Stanislav Antontsev (Universidade da Beira Interior, Portugal). João Pedro Boto (Universidade de Lisboa, Portugal). Michel Chipot (Universität Zürich, Switzerland). Martin Fuchs (Universität des Saarlandes, Germany). Olga A.Ladyzhenskaya (Steklov Mathematical Institute, St. Petersburg, Russia). Josef Málek (Charles University, Prague, Czech Republic). Sylvie Mas-Gallic (Université d'Évry-val-d'Essonne, France). Peregrina Quintela (Universidade de Santiago de Compostela, Spain). Lisa Santos (Universidade do Minho, Portugal). Vsevolod Solonnikov (Steklov Mathematical Institute, St. Petersburg, Russia). Hugo Beirão da Veiga (Università di Pisa, Italia).

Conferences/Workshops (without communication)

Participated in the following conferences and workshops, without communication:

- *1º. Congresso Português de Urosexopatia Neurogénia*, Hospital Curry Cabral and CMFRA, Torre do Tombo, Lisboan, Portugal, May 6-8, 1993.

- *International Conference: Asymptotic Methods for Elastic Structures*, Lisbon, Portugal, October 4-8, 1993. Proceedings
- *IV Encontro Nacional de Mecânica Computacional*, LNEC, Lisbon, Portugal, April 10-12, 1995.
- *International School of Mathematics: Free Boundary Problems in Mathematics and Industry*, Universidad Internacional Menéndez Pelayo, Santander, Spain, August 21-25, 1995.
- *Encontro História das Ciências Matemáticas: Portugal e o Oriente*, Convento da Arrábida, Portugal, November 2-4, 1995.
- *Para uma Sociedade Plural - Eliminação de barreiras socio-psicológicas*, Commission of the European Communities, Helios Team of Experts and Liga Portuguesa dos Deficientes Motores, November 10-11, 1995, **Session Chair:** Participação das Pessoas com Deficiência para o Processo de Vida Autónoma.
- *International Conference on Applied Analysis*, Instituto Superior Técnico, Lisbon, Portugal, 26 February/1 March 1997.
- *Mathematical Treatment of Free Boundary Problems*, Universidade da Madeira, Funchal, Portugal, January 23-26, 1998.
- *Nonlinear partial differential equations and applications: Interfaces in continuous media*, Universidade de Lisboa, March 1-4, 1999; *Nonlinear parabolic problems*, Universidade de Lisboa, May 13-16, 1999.
- *4th Annual Conference of the International Functional Electrical Stimulation Society*, Sendai, Japan, August 23-27, 1999.
- *VI Curso de actualização em doenças neuromusculares*, Faculty of Medicine of Lisbon - Hospital Sta. Maria, Portugal, December 3, 2001.
- Advanced school and workshop on *Mathematical and Computational Modeling of Biological Systems*, Instituto Superior Técnico, Lisbon, Portugal, June 17-21, 2002.
- *8th Annual UT Symposium on Neuroscience*, The University of Texas at Austin, USA, March 22, 2003.
- *2nd European Medical and Biological Engineering Conference*, Vienna, Austria, December 4-8, 2002.
- *Congresso de métodos computacionais em engenharia*, LNEC, Lisbon, Portugal, May 31 - June 2, 2004.

- *II Int. Conf. on Comp. Bioeng.*, IST/UTL, Lisbon, Portugal, September 14-16, 2005, **Session Chair:** Mechanobiology and modelling of biological processes.
- *Industrial Workshop*, CMUC, Coimbra, Portugal, October 14-15, 2005.
- Workshop *Prague-Heidelberg on nonlinear analysis*, MFF UK (Charles University), Prague, November 24-25, 2006.
- *III Seminário de Bioengenharia*, Escola Superior de Tecnologia e Gestão, Instituto Politécnico de Portalegre, December 13-14, 2011.
- Meeting *Molecular Biology in Portugal and EMBL (and EMBL Alumni)*, FCUL, Lisbon, July 18, 2013.
- *MATLAB Virtual Conference 2014* by MathWorks, March 26, 2014.
- *MATLAB Virtual Conference 2015* by MathWorks, March 25, 2015.
- *7th Workshop on Biomedical Engineering*, University of Lisbon, April 18, 2015.
- *Simulation World, 16th LS-DYNA International Conference and 16th LS-DYNA Users Meeting* by Ansys, Live Virtual Event, June 10-11, 2020.

Courses

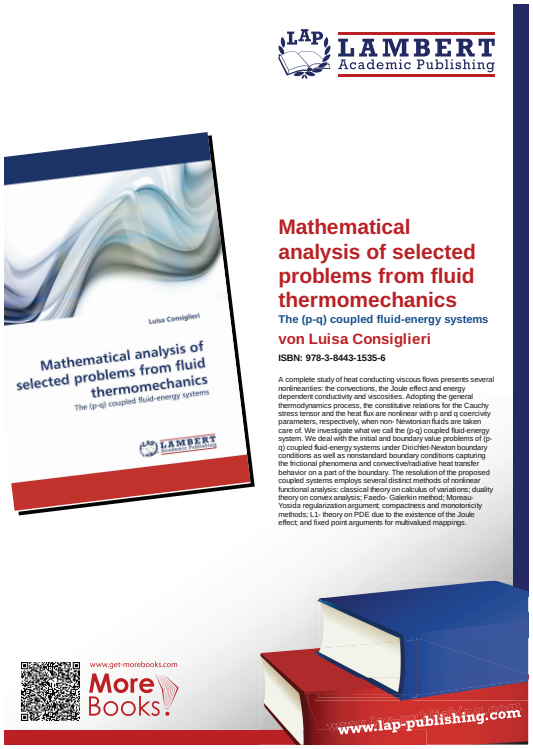
- Open Lectures & Short Course *Some Problems on Geodynamics* by Giorgio Ranalli (Dept of Earth Sciences, Carleton University, Ottawa, Canada), Departamento de Geologia FCUL, November 7-13, 2013.
- MOOC Esri (esri.com/training): *Cartography*, by Ken Field, Edie Punt, John Nelson, Wesley Jones and Nathan Shephard. 6 weeks, started on April 10, completed on May 15, 2019.
- MOOC Técnico (http://mooc.tecnico.ulisboa.pt): *Energy Services*, by Carlos Santos Silva. Self-paced learning, started on March 18, completed on May 22, 2019.
- MOOC Técnico (http://mooc.tecnico.ulisboa.pt): *Recognizing Frailty*, by Marco Arkesteijn, on behalf of the whole FACET team (Aberystwyth University's rfX). Self-paced learning, started on February 20, completed on July 3, 2019.
- RDMLA Course (https://learn.canvas.net/courses/2719/modules) by Research Data Management Librarian Academy. Badge
  Self-paced, completed on January 14, 2020.
- MOOC Técnico (http://mooc.tecnico.ulisboa.pt): *Metal Air Batteries*. Self-paced learning, started on March 17, completed on April 30, 2020.

Publications

Books

1. *Mathematical analysis of selected problems from fluid thermomechanics. The $(p-q)$ coupled fluid-energy systems.* Lambert Academic Publishing, Saarbrücken 2011. (*e.g.* Amazon, Google, LAP)

2. *Quantitative estimates on boundary value problems: Smallness conditions to thermoelectric and thermoelectrochemical problems.* Lambert Academic Publishing, Saarbrücken 2017. (*e.g.* Amazon, LAP)



Articles

1. Stationary solutions for a Bingham flow with nonlocal friction, **in** "Mathematical topics in fluid mechanics", Eds. J.F.Rodrigues & A. Sequeira, *Pitman Res. Notes in Math. Ser.* **274**, Longman (1992), 237-243.

   Description: Serrin suggest to introduce a local friction law on a part of the boundary of a flow. However a local law gives not enough regularity to the normal stress tensor. Nonlocal friction laws arise in elasticity and have been considered by various authors. Roughly speaking, a nonlocal friction law proposes that impending motion at a point of contact between two deformable continuous media will occur when the shear stress at that point reaches a value proportional to a weighted measure of the normal stresses in a neighborhood of the point. The character of the effective local neighborhood and the manner in which neighborhood stresses contribute to the sliding condition depends upon features of the microstructure of the materials in contact. Different methods were used to avoid the difficulty of lack of regularity of the normal stress tensor. In the remaining part of the boundary we assume a regularization to the stress tensor. The existence of a solution is proved by means of a fixed point technique.

2. A steady-state non-Newtonian unidirectional flow with energy dissipation, **in** "Trends in applications of mathematics to mechanics", Eds. M.M. Marques & J.F. Rodrigues, *Pitman Monog. Surv. Pure Appl. Math.* **77**, Longman (1995), 177-184.

   Description: In this work we prove the existence of at least a solution to the coupled system of momentum-energy equations. This problem has been considered by various authors, but the viscous dissipation term was omitted in energy equation as is usual for Newtonian fluids. However in many thermo-convection problems, like for instance, the high-speed lubrication problems or boundary-layer heating during space-vehicle reentry the energy dissipation term can not be neglected. In the non-Newtonian heat-transfer field, this term has a large effect on the rheological parameters, the flow patterns, and the thermal degradation of the fluids. The nonuniqueness of Lagrange multipliers leads us to use a fixed point theorem to multivalued functions.

3. Stationary weak solutions for a class of non-Newtonian fluids with energy transfer, *Int. J. Non-Linear Mechanics* **32** (1997), 961-972.

   DOI: 10.1016/s0020-7462(96)00087-x

   Abstract. We prove the existence of weak solutions to the coupled system of stationary equations for a class of general non-Newtonian fluids with energy transfer. In particular, we may include Bingham flows that lead to classical free boundary problems of fluid dynamics. Using convex analysis and L^1-theory for

elliptic mixed boundary value problems, we consider separately two auxiliary problems, obtained by prescribing the essential nonlinearities in the equations for the velocity and for the energy. We use then a general fixed point theorem, due to Glicksberg, for the multivalued mapping in a product of Banach spaces endowed with the weak topologies.

4. Weak solutions for a class of non-Newtonian fluids with energy transfer, *J. Math. Fluid Mechanics* **2** :3 (2000), 267-293. DOI: 10.1007/PL00000952

   Abstract. In the present paper, we shall consider a nonlinear thermoconvection problem consisting of a coupled system of nonlinear partial differential equations due to temperature dependent coefficients. We prove that weak solutions exist in appropriate Sobolev spaces under mild hypothesis on the regularity of the data. This result is established through a fixed point theorem for multivalued functions, which requires a detailed analysis of the continuous dependence of auxiliary problems, including the associated Lagrange multipliers of the generalized Navier-Stokes system.

5. (joint work with T.Shilkin) Regularity to stationary weak solutions for generalized Newtonian fluids with energy transfer, *Zapiski Nauchnyh Seminarov POMI* **271** (2000), 122-150. DOI: 10.1023/A:1023369819312

   Abstract. In this work, we prove a regularity result to stationary weak solutions for generalized Newtonian fluids with energy transfer. Namely, it consists in the proof of strong solution. In the two-dimensional case, we get a little more regularity to the solution but even not the classical notion.

6. Thermal radiation in a steady Navier-Stokes flow, *Matemática Contemporânea* **22** (2002), 55-66. http://www.mat.unb.br/ matcont/22_4.pdf

   Abstract. In this work, we prove an existence result for a coupled system of partial differential equations, valid for dimensions two and three. To prove this mathematical result, we use a fixed point argument for multivalued mappings. The main part of this work is to obtain estimates in the presence of L^1-data and to prove continuous dependence with respect to given parameters. For a two-dimensional case, it can be recognized as thermoconvective flow for a Navier-Stokes fluid with heat transfer by radiation on a part of the boundary of the domain.

7. (joint work with M.C. Mũniz) Existence of a solution for a free boundary problem in the thermoelectrical modelling of an aluminium electrolytic cell, *European Journal of Applied Mathematics* **14** (2003), 201-216.

   DOI: 10.1017/s0956792502005028

ABSTRACT. We present a coupled system of elliptic equations describing the steady state of the thermoelectrical behaviour of an aluminium electrolytic cell. The thermal model is a free boundary problem which consists of the heat equation with Joule's heating as a source. We neglect the Joule heating in the ledge and allow for temperature-dependent electrical conductivity. We also formulate a numerical approximation using a finite element method. An iterative algorithm and numerical results are present. The existence of a weak solution is also proved.

8. A nonlocal friction problem for a class of non-Newtonian flows, *Portugaliae Mathematica* **60** : 2 (2003), 237-252.

   http://www.emis.de/journals/PM/60f2/6.html

   ABSTRACT. In this work we study the flow for a class of non-Newtonian fluids with a nonlocal friction condition obtained by the mollification of the normal stresses on part of the boundary. Considering a reformulated problem using an abstract boundary operator, we prove an existence result for the steady case. The mathematical framework of the paper is mainly constituted by the duality theory of convex analysis and an application of a fixed point theorem to multivalued mappings.

9. (joint work with V. Consiglieri) A proposed two-semester program for mathematics in the Architecture Curriculum, *Nexus Network Journal* **5** :1 (Spring 2003), 127-134. DOI: 10.1007/s00004-002-0007-3

   ABSTRACT. We propose a one-year mathematics course for architecture students. The aim of this work is to examine the relevance of mathematics in contemporary architecture, namely its most representative forms of cultural or sport buildings. Because today the architectural object is characterized by a great exuberance, as in the Gothic age with its ogival forms, or the Baroque with its vaults and spherical calottes, some notions of topology are required; classical linear algebra and analytical geometry are becoming inadequate for the purpose. For the education of an architect, with a modern vision of the utility of technology, the academic staff must understand what students lack, and promote quality in their professional work. Indeed, it is important that mathematics do not fall into neglect, and students might profit from mathematics and topological geometry as previous requisites for their imagination and poetic ability. Nevertheless, harmony, expression or quality of the actual worth of architectonic messages are not explained rationally by mathematics, but by appealing to sentiment or sensibility.

10. (joint work with J.F. Rodrigues) On stationary flows with energy dependent nonlocal viscosities, *Zapiski Nauchnyh Seminarov POMI* **295** (2003), 99-117.

    DOI: 10.1007/s10958-005-0148-5

Dedicated to O.A. Ladyzenskaya on the occasion of her 80th birthday

ABSTRACT. A nonlocal constitutive law for an incompressible viscous flow in which the viscosity depends on the total dissipation energy of the fluid is obtained as a limit case of very large thermal conductivity when the viscosity varies with the temperature. A rigorous analysis is illustrated in an Hilbertian framework for unidirectional stationary flows of Newtonian and Bingham fluids with heating by viscous dissipation. The extension to quasi-Newtonian fluids of power law type and with temperature dependent viscosities is obtained in the framework of the heat equation with a L^1-term. The nonlocal model proposed by Ladyzenskaya in 1966 as a modification of Navier-Stokes equations, in particular, may be obtained with this procedure.

11. (joint work with I. dos Santos and D. Haemmerich) Theoretical analysis of the heat convection coefficient in large vessels and the significance for thermal ablative therapies, *Phys. Med. Biol.* **48** (2003), 4125-4134.

DOI: 10.1088/0031-9155/48/24/010

ABSTRACT. Ablative therapies such as radiofrequency (RF) ablation are increasingly used for treatment of tumors in liver, and other organs. Often large vessels limit the extent of the thermal lesion, and cancer cells close to the vessel survive resulting in local recurrence. Accurate estimates of the heat convection coefficient h for large vessels will help to improve ablation techniques, and are required for estimation of thermal lesion dimensions in simulations. Previous estimates of h did not consider that only part of the vessel is heated, and assumed uniform temperature distribution at the vessel wall. An analytical relationship between the heat convection coefficient, blood velocity and temperature is formulated in order to improve hepatic radio-frequency ablation technique. The heat convection coefficient evaluated will assist both simulations and design of proper protocols for *in vivo* measurements. The mathematical model developed in this work describes the exchange of heat between a solid surface and a moving fluid and it is based on energy and motion equations for Navier-Stokes fluids. A particular case of a laminar blood flow in the portal vein is studied when a portion of its surface is heated. Our results show that heating a larger portion of the vessels reduces convective heat loss, which may result in more effective ablation strategies.

12. (joint work with J.F. Rodrigues and T. Shilkin) On the Navier-Stokes equations with the energy-dependent nonlocal viscosities, *Zapiski Nauchnyh Seminarov POMI* **306** (2003), 71-91. DOI: 10.1007/s10958-005-0378-6

ABSTRACT. We discuss the mathematical derivation of incompressible viscous flows where the viscosity depends on the total dissipation energy. In the two-dimensional periodic case, we consider first the case of temperature dependent

viscosities with very large thermal conductivity in the heat convective equation, in which we obtain as an asymptotic limit the Navier-Stokes system coupled with and ordinary differential equation involving the dissipation energy. Letting further the latent heat vanish, we derive the Navier-Stokes equations with a nonlocal viscosity depending on the total dissipation of energy.

13. (joint work with J.F. Rodrigues and T. Shilkin) A limit model for unidirectional non-Newtonian flows with nonlocal viscosity, **in** "Trends in Partial Differential Equations of Mathematical Physics." Eds. J.F. Rodrigues, G. Seregin & J.M. Urbano, *Progress in Nonlinear Differential Equations and their Applications* **61**, Birkhäuser Basel (2005), 37-44.

    Dedicated to V.A. Solonnikov in its 70th birthday

    ABSTRACT. A p-Laplacian flow ($1 < p < \infty$) with nonlocal diffusivity is obtained as an asymptotic limit case of a high thermal conductivity flow described by a coupled system involving the dissipation energy.

14. Existence for a class of non-Newtonian fluids with a nonlocal friction boundary condition, *Acta Mathematica Sinica* **22** :2 (2006), 523-534.

    DOI: 10.1007/s10114-005-0621-6

    ABSTRACT. We deal with a variational inequality describing the motion of incompressible fluids, whose viscous stress tensors belong to the subdifferential of a functional at the point given by the symmetric part of the velocity gradient, with a nonlocal friction condition on a part of the boundary obtained by a generalized mollification of the stresses. We establish an existence result of a solution to the nonlocal friction problem for this class of non-Newtonian flows. The result is based on Faedo-Galerkin and Moreau-Yosida methods, duality theory of convex analysis and Tychonov-Kakutani-Glicksberg fixed point theorem to multivalued mappings in appropriate functional space framework.

15. (joint work with Namkwon Kim and J.F. Rodrigues) On non-Newtonian incompressible fluids with phase transitions, *Math. Meth. Appl. Sci.* **29** :13 (2006), 1523-1541. DOI: 10.1002/mma.739

    ABSTRACT. A modified model for a binary fluid is analyzed mathematically. The governing equations of the motion consists of a Cahn-Hilliard equation coupled with a system describing a class of non-Newtonian incompressible fluid with p-structure. The existence of weak solutions for the evolution problems is shown for the space dimension $d = 2$ with $p \geq 2$ and for $d = 3$ with $p \geq 11/5$. The existence of measure-valued solutions is obtained for $d = 3$ in the case $2 \leq p < 11/5$. Similar existence results are obtained for the case of nondifferentiable free energy, corresponding to the density constraint $|\psi| \leq 1$. We also give regularity and uniqueness results for the solutions and characterize stable stationary solutions.

16. (joint work with V. Consiglieri) Structure of phenomenological forms: morphologic rhythm, *Nexus Network Journal* **8** : 2 (October, 2006), 101–110.

    DOI: 10.1007/s00004-006-0022-x

    Abstract. The images in architecture are handed down through mathematical forms. The meaning of the plastic value of the forms and the conflict between their visual boundaries are a result of the geometrical composition of the object. Since Stonehenge in Britain, the Egyptian pyramids, the Greek Parthenon or the Roman Pantheon, the architecture has been a reflex of simple boundaries without accidental confrontations. Nowadays materials are organised through movement/change in order to represent the required profile. This developed structure emerges in the artistic manifestations according to the theory of continuity. As an expression of the formal quality in opposition to the ancient characteristics of quantity, a new conception of rhythm appears. The concept of a cell as an architectural element that can have any biological form and can be grouped itself according to different ways and functions (such as repetition of floors) is introduced. This concept of cell permits eurhythmy (harmony in the proportion of a building) through the notion of rhythm once all the elements of a building are situated among themselves.

17. Steady-state thermal viscous incompressible flows with convective-radiative effects and a nonlocal Coulomb friction law, *Comm. Appl. Analysis* **10** :4 (2006), 491–502.

    Abstract. We deal with a coupled system of elliptic motion and energy equations motivated by the thermal flow of a class of non-Newtonian fluids. A nonlocal Coulomb friction condition on a part of the liquid-solid boundary is taken into account. On this part of the boundary it is also considered a convective-radiative heat transfer related to the frictional work. The existence of a weak solution constitutes the main result of the present work which proof is based on a fixed point argument for multivalued mappings. The nonlinear boundary conditions as well as the energy dependent viscosities and the thermal conductivity are the crucial contribution on the interdependence on the fluid velocity vector, the stress tensor and the internal energy. The mathematical framework of the paper includes the classical monotone theory on elliptic equations, the duality theory of convex analysis in order to describe the Lagrange multipliers; and the L^1-theory on partial differential equations due to the existence of the Joule effect.

18. Steady-state flows of thermal viscous incompressible fluids with convective-radiation effects, *Math. Mod. Meth. Appl. Sci.* **16** :12 (2006), 2013-2027.

    DOI: 10.1142/s0218202506001790

Abstract. The work deals with the coupled system constituted by the equations of motion and energy with nonlinear and nonlocal boundary conditions in order to describe the thermal flow motion of a class of non-Newtonian fluids and the convective-radiation balance, respectively. For the constitutive laws in a n-dimensional space ($n = 2, 3$), the stress tensor and the heat flux are considered related with the (p, q) coercivity parameters for $p > 2n/(n + 1)$ and $q > np/(p(n + 1) - n)$, respectively. The radiation character on the boundary condition presents an additional difficulty to the problem which already includes energy-dependent viscosity and conductivity behaviours. In the framework of non-standard Sobolev spaces we prove the existence of steady-state solutions applying a fixed point argument. We also study the existence of a solution to a coupled system motivated by the buoyancy driven flows from geophysical and astrophysical models.

19. (joint work with E.B. Pires) Analytical approach for the evaluation of the torques using inverse multibody dynamics, *Multibody System Dynamics* **18** :3 (2007), 471-483. DOI: 10.1007/s11044-007-9046-6

Abstract. A mathematical model for the analysis of human motion is presented in this paper. This model is based on linkage dynamics in order to understand trajectory and internal moment of force coordination. Mobility at the base of the supporting limb is a critical factor in the freedom to fall forward. The approach used to state a coupled system of differential equations of motion consists in introducing the displacement of the center of mass together with the displacement of each segment of the body and to evaluate the final system as a whole. The resultant methodology is task independent. The main goal of this study is to assist the work of health care professionals in the determination of the torques at the joints generated to maintain the movement. The evaluation of a weighted average of all the forces has served as a basis for other authors to obtain the center of pressure. In this work the resultant ground reaction force passes through the center of mass of the body system enabling the calculation of the location of this force.

20. (joint work with J.F. Rodrigues) Steady-state Bingham flow with temperature dependent nonlocal parameters and friction, **in** Free Boundary Problems: Theory and Applications. Eds. I.N. Figueiredo, J.F. Rodrigues & L. Santos, *Intern. Series Numerical Math.* **154**, Birkhäuser Verlag Basel, Switzerland (2007), 149-157.

Abstract. We consider Bingham incompressible flows with temperature dependent viscosity and plasticity threshold and with mixed boundary conditions, including a friction type boundary condition. The coupled system of motion and energy steady-state equations may be formulated through a variational inequality for the velocity and variational methods provide a weak solution to the model. In the asymptotic limit case of a high thermal conductivity, the temperature becomes a constant solving an implicit total energy equation involving the viscosity function, the plasticity threshold and the friction yield coefficient. The limit model corresponds to a steady-state Bingham flow with nonlocal parameters, which has therefore at least one solution.

21. A $(p-q)$ coupled system in elliptic nonlinear problems with nonstandard boundary conditions, *J. Math. Anal. Appl.* **340** :1 (2008), 183-196.

    DOI: 10.1016/j.jmaa.2007.07.080

    Abstract. We state an abstract variational formulation to a coupled system constituted by an inequality and an equality motivated by the motion and energy equations, and the constitutive laws for the stress tensor and the heat flux, respectively, when non-Newtonian fluids are taken care of. Here the existence of a weak solution is proven via a fixed point argument to multivalued mappings. The nonstandard boundary conditions correspond to friction wall laws and energy transfer condition considered on a part of the boundary, whereas there exists the presence of the frictional work due to the friction of the fluid motion. We conclude by formulating the corresponding stationary heat conducting viscous incompressible flow problem and we establish an existence result.

22. (joint work with A.R. Domingos) An analytical solution for the ionic flux in an axonial membrane model, **in** *Progress in Mathematical Biology Research*. Ed. J.T. Kelly, Nova Science Publishers, New York 2008, 321–334.

    Abstract. The knowledge of the nerve impulse in medicine is of particular relevance to the improvement of medical diagnostic and therapeutic methods. The electrochemical behaviour of the axon membrane plays an important and key role in the resulting nerve impulse, which can be related to the movement of ions between the extra and intracellular regions due to the active and the passive transports. We present a new contribution for the understanding of the diffusion process in a biological membrane of an axon. The problem is formulated for the sodium current from the electromagnetic theory. Indeed from the Maxwell equations we state a mathematical model considering the Fick-Ohm law for the total electrical current density. An analytical solution is proposed under different physiological parameters.

23. Friction boundary conditions on thermal incompressible viscous flows, *Annali di Matematica Pura ed Applicata* **187** :4 (2008), 647–665.

DOI: 10.1007/s10231-007-0060-3

Abstract. This work addresses an unsteady heat flow problem involving friction and convective heat transfer behaviors on a part of the boundary. The problem is constituted by a variational motion inequality with energy dependent coefficients, and the energy equation in the framework of L^1-theory for the dissipative term. Using the duality theory of convex analysis, it also involves the existence of Lagrange multipliers. Weak solutions of an approximate coupled system are proven by a fixed point argument for multivalued mappings and compactness methods. Then the existence result for the initial coupled system is proven by the passage to the limit.

24. The Joule-Thomson effect on the thermoelectric conductors, *Z. Angew. Math. Mech.* **89** :3 (2009), 218–236. DOI: 10.1002/zamm.200800108

Abstract. The transmission of an electric current in a conductor is a process in which some electrical energy is converted into heat (thermal energy). We deal with a nonlinear boundary value elliptic problem which describes the electrical heating of a solid conductor and the Joule-Thomson effect is taken into account. The existence of a weak solution is proved under both space and temperature dependence of the electrical and thermal conductivities. When the coefficients are only dependent on their temperature argument, some regularity results are stated.

25. (joint work with S. Antontsev) Elliptic boundary value problems with nonstandard growth conditions, *Nonlinear Analysis: Theory, Methods & Applications* **71** :3-4 (2009), 891–902. DOI: 10.1016/j.na.2008.10.109

Abstract. We study different boundary value problems to the $p(x)$-Laplacean equation, namely of Robin and Signorini types. We prove existence and uniqueness of weak solutions to the problems under study and also their continuous dependence on the exponent data.

26. (joint work with V. Consiglieri) Continuity versus Discretization, *Nexus Network Journal* **11** :2 (2009), 151–162. DOI: 10.1007/s00004-008-0086-x

Abstract. The threefold interest in architecture, biology and mathematics motivated us to examine and justify new architectural forms. We discuss some notions of rhythm: Euclidean, morphogenetic and morphologic. Contemporary relationships between structure and form are based on the generation of shape by technological processes, thus the resulting objects are restricted to their material expression. Here a phenomenological organisation of form and its continuity with the landscape arise out of the mathematical and architectural creativity. The use of the computer is applied from outside to inside instead from inside to outside; this means that we are dealing with the organisational processes via continuous

methods instead of evolutionary processes given by computer simulations, known as *genetic algorithms*, where the resulting configurations are reduced to a matter of routine. The role of design as an aesthetic component innovates the theoretical framework of structural engineering to establish the architectural environments.

27. (joint work with E.B. Pires) An analytical model for the ergometer rowing: inverse multibody dynamics analysis, *Computer Methods in Biomechanics and Biomedical Engineering* **12** :4 (2009), 469–479.

    DOI: 10.1080/10255840802687400

    Abstract. A model for the ergometer rowing exercise is presented in this paper. From quantitative observations of a particular trajectory (motion), the model is used to determine the moment of the forces produced by the muscles about each joint. These forces are evaluated according to the continuous system of equations of motion. An inverse dynamics analysis is performed in order to predict the joint torques developed by the muscles during the execution of the task. An elementary multi-body mechanical system is used as an example to discuss the assumptions and procedures adopted.

28. Regularity for the Navier-Stokes-Fourier system, *Differential Equations & Applications* **1** :4 (2009), 583–604. http://dea.ele-math.com/volume/1/issue/4

    Abstract. We prove the existence of strong 2-dimensional solutions for two Cauchy-Dirichlet problems to the Navier-Stokes-Fourier system which characterizes the Newtonian fluids under heat-conducting effects. The nonstationary Navier-Stokes system for an incompressible homogeneous fluid with temperature dependent viscosity is completed by the equation of balance of energy which includes the term of dissipative heating. The regularity of solutions to the problems under study is proved through compactness methods and fixed point arguments, instead assuming the existence of weak solutions to the problems.

29. (joint work with R. Albuquerque) Invariant connections on Euclidean space, *Bol. Soc. Paranaense de Mat.* (3s) **27** :1 (2009): 65–83.

    http://www.spm.uem.br/bspm/pdf/vol27-1/Art2.pdf

    Abstract. We recall and solve the equivalence problem for a flat C^1 connection ∇ in Euclidean space, with methods from the theory of differential equations. The problem consists in finding an affine transformation of $\mathbb{R}^n$ taking ∇ to the so called trivial connection. Generalized solutions are found in dimension 1 and some example problems are solved in dimension 2, mainly dealing with flat connections. A description of invariant connections in the plane is attempted, in view the study of real orbifolds. Complex meromorphic connections are shown in the cone $cL(p, q)$ of a lens-space.

30. (joint work with Šárka Nečasová and Jan Sokolowski) Incompressible Maxwell-Boussinesq approximation: Existence, uniqueness and shape sensitivity, *Control and Cybernetics* **38** :4A (2009), 1193–1215.

ABSTRACT. We prove the existence and uniqueness of weak solutions to the variational formulation of the Maxwell-Boussinesq approximation problem. Some further regularity in $W^{1,2+\delta}$, $\delta > 0$, is obtained for the weak solutions. The shape sensitivity analysis by the boundary variations technique is performed for the weak solutions. As a result, the existence of the strong material derivatives for the weak solutions of the problem is shown. The result can be used to establish the shape differentiability for a broad class of shape functionals for the models of Fourier-Navier-Stokes flows under the electromagnetic field.

31. The $(p-q)$ coupled fluid-energy systems, **in** *Advances in mathematical fluid mechanics. Dedicated to Giovanni Paolo Galdi on the Occasion of his 60th Birthday.* Eds. R. Rannacher & A. Sequeira, Springer-Verlag, Berlin Heidelberg 2010, 177–190. DOI: 10.1007/978-3-642-04068-9_11

ABSTRACT. We investigate the nonlinear coupled system of elliptic partial differential equations which describes the fluid motion and the energy transfer what we call *the* $(p-q)$ *coupled fluid-energy system* due to p and q coercivity parameters correlated to the motion and heat fluxes, respectively. Due to the simultaneous action of the convective-radiation effects on a part of the boundary, such system leads to a boundary value problem. We present existence results of weak solutions under different constitutive laws for the Cauchy stress tensor with $p > 3n/(n+2)$, in a n-dimensional space. If the Joule effect is neglected in the energy equation, the existence result is stated for a broader class of fluids such that $p > 2n/(n+1)$, and related q-coercivity parameter to the heat flux.

32. (joint work with V. Consiglieri) Morphocontinuity in the work of Eero Saarinen, *Nexus Network Journal* **12** :2 (Summer 2010), 239–247.

DOI: 10.1007/s00004-010-0026-4

ABSTRACT. Continuity as the mathematical tool in the creation of architectural forms is known as morphocontinuity. In the present work, we explain how morphocontinuity appears on the work of Eero Saarinen and discuss its correspondence with its environmental (physical, social and cultural) contexts.

33. The non-incompressibility on Navier-Stokes-Fourier fluids. The stationary case, *J. Math. Fluid Mechanics* **12** :3 (2010), 379–396.

DOI: 10.1007/s00021-009-0294-5

ABSTRACT. This work deals with generalized viscous flows that can only undergo isochoric motions in isothermal processes, but can sustain motions that

are not necessarily isochoric in processes that are not isothermal. The heat conducting Stokes and Bingham fluids appear as a direct application. The method used here is a combination of the fixed point argument, the Uzawa-type algorithm and the optimization theory. Indeed, the pressure is found as a limit of a sequence such that satisfies a constraint condition.

34. (joint work with Šárka Nečasová and Jan Sokolowski) New approach to the incompressible Maxwell-Boussinesq approximation: Existence, uniqueness and shape sensitivity, *J. Differ. Equations* **249** (2010), 3052–3080.

    DOI: 10.1016/j.jde.2010.09.029

    Abstract. The Boussinesq approximation to the Fourier-Navier-Stokes (F-N-S) flows under the electromagnetic field is considered. Such a model is the so-called *Maxwell-Boussinesq approximation*. We propose a new approach to the problem. We prove the existence and uniqueness of weak solutions to the variational formulation of the model. Some further regularity in $W^{1,2+\delta}$, $\delta > 0$, is obtained for the weak solutions. The shape sensitivity analysis by the boundary variations technique is performed for the weak solutions. As a result, the existence of the strong material derivatives for the weak solutions of the problem is shown. The result can be used to establish the shape differentiability for a broad class of shape functionals for the models of Fourier-Navier-Stokes flows under the electromagnetic field.

35. (joint work with Chérif Amrouche) On the Stationary Oseen Equations in $\mathbb{R}^3$, *Commun. Math. Anal.* **10** :1 (2011), 5–29.

    Special Issue in Honor of Professor Stephen Smale

    http://projecteuclid.org/euclid.cma/1305810733

    Abstract. The stationary Oseen equations are studied in $\mathbb{R}^3$ in its general form, that is, with a non-constant divergenceless function on the convective term. We prove existence, uniqueness and regularity results in weighted Sobolev spaces. From this new approach, we also state existence, uniqueness and regularity results for the generalized Oseen model which describes the rotating flows. The proofs are based on Laplace, Stokes and Oseen theories.

36. (joint work with M. Bulíček and J. Málek) On solvability of a non-linear heat equation with a non-integrable convective term and data involving measures, *Nonlinear Analysis: Real World Applications* **12** :1 (2011), 571–591.

    DOI: 10.1016/j.nonrwa.2010.07.001

    Abstract. Considering a mixed boundary-value problem for a non-linear heat equation with the nonhomogeneous Neumann condition, the right-hand side and the initial condition in space of sign-measures, we establish large-data existence

results even if the convective term is not integrable. In order to develop a theory under minimal assumptions on given data, we deal with two concepts of solution: weak solution (for data in measures) and entropy solution (for L^1-data). Regarding the entropy solution we identify conditions ensuring its uniqueness. Improved properties of the Lipschitz approximations of Bochner functions represent an important tool in establishing the existence of large-data solutions.

37. (joint work with A.R. Domingos) On the sodium concentration diffusion with three-dimensional extracellular stimulation, *International Journal of Mathematics and Mathematical Sciences* **2011** (2011), Article ID 862813, 19 pages.

    http://www.hindawi.com/journals/ijmms/2011/862813

    Abstract. We deal with the transmembrane sodium diffusion in a nerve. We study a mathematical model of a nerve fibre in response to an imposed extracellular stimulus. The presented model is constituted by a diffusion-drift vectorial equation in a bidomain, that is, two parabolic equations defined in each of the intra- and extra- regions. This system of partial differential equations can be understood as a reduced three-dimensional Poisson-Nernst-Planck model of the sodium concentration. The representation of the membrane includes a jump boundary condition describing the mechanisms involved in the excitation-contraction couple. Our first novelty comes from this general dynamical boundary condition. The second one is the three-dimensional behaviour of the extracellular stimulus. An analytical solution to the mathematical model is proposed depending on the morphology of the excitation.

38. Partial regularity for the Navier-Stokes-Fourier system, *Acta Mathematica Scientia* **31B** :5 (2011), 1653–1670. DOI: 10.1016/S0252-9602(11)60351-2

    Abstract. This paper addresses a nonstationary flow of heat-conductive incompressible Newtonian fluid with temperature-dependent viscosity coupled with linear heat transfer with advection and a viscous heat source term, under Navier/Dirichlet boundary conditions. The partial regularity for the velocity of the fluid is proved to each proper weak solution, that is, for such weak solutions which satisfy some local energy estimates in a similar way to the suitable weak solutions of the Navier-Stokes system. Finally, we study the nature of the set of points in space and time upon which proper weak solutions could be singular.

39. A limit model for thermoelectric equations, *Annali dell'Università di Ferrara Sez. VII Sci. Mat.* **57** :2 (2011), 229–244. DOI: 10.1007/s11565-011-0129-1

    Abstract. We analyze the asymptotic behavior corresponding to the arbitrary high conductivity of the heat in the thermoelectric devices. This work deals with a steady-state multidimensional thermistor problem, considering the Joule effect and both spatial and temperature dependent transport coefficients under

some real boundary conditions in accordance with the Seebeck–Peltier–Thomson cross-effects. Our first purpose is that the existence of a weak solution holds true under minimal assumptions on the data, as in particular nonsmooth domains. Two existence results are studied under different assumptions on the electrical conductivity. Their proofs are based on a fixed point argument, compactness methods, and existence and regularity theory for elliptic scalar equations. The second purpose is to show the existence of a limit model illustrating the asymptotic situation.

40. Heat-conducting viscous fluids over porous media, *Communications in Mathematical Sciences* **10** :3 (2012), 835–857. DOI: 10.4310/CMS.2012.v10.n3.a6

    Abstract. A new model is introduced for describing the heat-conducting viscous fluids over porous media. The innovative features of the presented model are the nonlinear character given by temperature dependence of the physical parameters such as the viscosities, the permeability and complementary the thermal conductivity and thermal expansion. The flow velocities are small (for steady processes) and mainly driven by the pressure gradient in porous medium such that the Stokes–Darcy system is completed by the energy equation with the heat flux given by the Fourier law. The existence of solutions is established for the Stokes–Darcy–Fourier system either with the Beavers–Joseph–Saffman or Beaver–Joseph interface boundary conditions. Both problems are solved by means a fixed point procedure and Lagrange multiplier approach.

41. Continuum models for the cooling effect of blood flow on thermal ablation techniques, *International Journal of Thermophysics* **33** :5 (2012), 864–884.

    DOI: 10.1007/s10765-012-1194-0

    Abstract. We examine the important role played by perfusion-mediated tissue cooling due to large vessels during the radio-frequency ablation procedures performed in biomedical sciences. The existence of blood flow near heated tissue carries away the heat from the ablation zone. This undesired thermal dissipation, known as the cooling effect, affects the final volume of the necrosis zone, and it is responsible for a large number of local recurrences. In this work, different continuum models are considered to describe the heat transfer and the blood circulation behavior dependence on several physiological parameters: the velocity of the blood, its viscosity, temperatures of the blood and the contact tissue, the diameter of the cross-sectional area, and the area of the heated region. The correspondent closed-form expressions are provided and discussed.

42. Thermal expansion on Stokes–Fourier systems, *SIAM J. Math. Anal.* **44** :3 (2012), 1831–1860. DOI: 10.1137/110832665

    Abstract. We prove the global solvability of an initial boundary value problem for the Stokes–Fourier system when the thermal expansion makes a non-

incompressibility behavior. The natural convection including Oberbeck–Boussinesq effects appears as its primordial application. The solutions are obtained as limit of the so called Faedo–Galerkin approximations, since the problem is constituted by a nonlinear coupled system with discontinuous coefficients. In this process, we prove some regularity of weak solutions for the Dirichlet problem to a second order parabolic equation in nonvariational form with discontinuous coefficient. The presented regularity results, which contribute in the approximate process for the finding of solutions to the Stokes–Fourier system, deserve consideration by themselves because of their many applications. Restricting to the two-dimensional space, the problem under study is solved under smallness on the data when the advective term is considered into the energy equation.

43. Existence of proper weak solutions to the Navier–Stokes–Fourier system, *Funkcialaj Ekvacioj* **55** :3 (2012), 347–365. http://www.math.kobe-u.ac.jp/ fe

    Abstract. The existence of proper weak solutions of the Cauchy problem constituted by the Navier-Stokes-Fourier system which characterizes the incompressible homogeneous Newtonian fluids under thermal effects is studied. We call *proper* weak solutions such weak solutions that verify some local energy inequalities in analogy with the suitable weak solutions for the Navier-Stokes equations.

44. On the generalized Forchheimer–Stokes–Fourier systems under the Beavers–Joseph–Saffman boundary condition, *Proceedings of the Royal Society of Edinburgh: Section A Mathematics* **143** :1 (2013), 101–120.

    DOI: 10.1017/S0308210511001661

    Abstract. A Stokesian fluid in motion sitting across an interface above a porous medium saturated by the same fluid is modelled by the Beavers–Joseph–Saffman boundary value problem to generalised Forchheimer–Stokes–Fourier systems what we call by Beavers–Joseph–Saffman (shortly BJS) problem. The model has nonlinear character given by temperature dependence of the physical parameters such as the viscosity, the permeability, the thermal conductivity and thermal expansion. The present work is concerned with the study of the steady-state and the time-dependent regimes via the Galerkin and the Faedo-Galerkin techniques, respectively.

45. Dynamic bilateral boundary conditions on interfaces, *Rivista di Matematica della Università di Parma* **4** :1 (2013), 81–111.

    http://rivista.math.unipr.it/vols/2013-4-1/07.html

    Abstract. Two boundary value problems for an elliptic equation in divergence form with bounded discontinuous coefficient are studied in a bidomain. On the interface, generalized dynamic boundary conditions such as of the Wentzell-type

and Signorini-type transmission are considered in a subdifferential form. Several nonconstant coefficients and nonlinearities are the main objective of the present work. Generalized solutions are built via time discretization.

46. On the posedness of thermoelectrochemical coupled systems, *Eur. Phys. J. Plus* **128** : 5 (2013), Article 47. DOI: 10.1140/epjp/i2013-13047-7

    Abstract. We examine the complete coupled thermoelectrochemical system that describes reaction problems. The cross effects, namely the thermoelectric (Peltier–Seebeck), the thermodiffusion (Dufour–Soret), and the electrochemical diffusion, occur as the reciprocal phenomena of irreversible processes. We deal with convective/radiative heat-transfer boundary conditions on a part of the boundary. The objective is their application to the electrolysis, the Li-batteries, and the fuel cells. The existence of stationary solutions for the theoretical model is found, under different smallness conditions on the data, via a fixed point argument.

47. An analytical solution for a bio-heat transfer problem, *International Journal of Bio-Science and Bio-Technology* **5** :5 (2013), 267–278.

    DOI: 10.14257/ijbsbt.2013.5.5.26

    Abstract. Catheter ablation along the posterior aspect of the left atrium has a small but real risk of esophageal perforation. This left atrioesophageal fistula formation is associated with multiple gaseous and/or septic embolic events causing cerebral and myocardial damage. The main objective is to mathematically model the ablation associated with delivery of radiofrequency (RF) energy to treat atrial fibrillation in order to control the temperature rise in the esophageal lumen. We model the heat exchange problem in a time-dependent multi-region for the catheter ablation therapy, with particular application to RF thermal ablation on the atrial tissue. From the selected set of geometric and operational parameters, benchmark calculations result in graphical representations. The proposed solutions enable whether quantitative or qualitative the study of temperature behavior whenever in space or in time. These enhance the physical understanding of what factors can affect the esophageal temperature and how to most accurately measure it. The model is sufficiently explicit to be, in turn, applied to different performances of one ablation procedure, or even to other thermal techniques.

48. Modeling in rowing, in *Routledge Handbook of Ergonomics in Sport and Exercise*. Ed. Youlian Hong, Series: Routledge International Handbooks, Taylor & Francis Group, New York, 2014, 479–493.

    http://www.routledge.com/books/details/9780415518635

49. Explicit estimates for solutions of mixed elliptic problems, *International Journal of Partial Differential Equations* **2014** (2014), Article ID 845760, 17 pages.

DOI: 10.1155/2014/845760

ABSTRACT. We deal with the existence of quantitative estimates for solutions of mixed problems to an elliptic second-order equation in divergence form with discontinuous coefficients. Our concern is to estimate the solutions with explicit constants, for domains in $\mathbb{R}^n$ ($n \geq 2$) of class $C^{0,1}$. The existence of L^∞ and $W^{1,q}$ estimates is assured for $q = 2$ and any $q < n/(n-1)$ (depending on the data), whenever the coefficient is only measurable and bounded. The proof method of the quantitative L^∞ estimates is based on the De Giorgi technique developed by Stampacchia. By using the potential theory, we derive $W^{1,p}$ estimates for different ranges of the exponent p depending on the fact that the coefficient is either Dini-continuous or only measurable and bounded. In this process, we establish new existences of Green functions on such domains. The last but not least concern is to unify (whenever possible) the proofs of the estimates to the extreme Dirichlet and Neumann cases of the mixed problem.

50. (joint work with V. Consiglieri) Architectural form as space-time cell, *Architecture Research* **4** :1B (2014), 21–26.

http://article.sapub.org/10.5923.s.arch.201402.03.html

ABSTRACT. The architecture has its basis in a dialectic search of new choices of representation. We deal with form on the contemporary architecture under two approaches: expression and content. We examine how mathematical principles based on natural growth can be applied in architectural design in order to create a dynamic, rather than static, structure. The dynamic process of cell *and its growth* provides the basic structure. We exemplify the impact of the new forms on the new society that already began.

51. Explicit estimates for solutions of nonlinear radiation-type problems, *Acta Mathematica Sinica, English Series* **31** :7 (2015), 1123–1140.

DOI: 10.1007/s10114-015-4419-x

ABSTRACT. We establish the existence of weak solutions of a nonlinear radiation-type boundary value problem for elliptic equation on divergence form with discontinuous leading coefficient. Quantitative estimates play a crucial role on the real applications. Our objective is the derivation of explicit expressions of the involved constants in the quantitative estimates, the so-called absolute or universal bounds. The dependence on the leading coefficient and on the size of the spatial domain is precise. This work shows that the expressions of those constants are not so elegant as we might expect.

52. Sufficient conditions to the existence for solutions of a thermoelectrochemical problem, *Journal of Fixed Point Theory and Applications* **17** :4 (2015), 669–692.

DOI: 10.1007/s11784-015-0255-y

Abstract. A mathematical model is introduced for thermoelectrochemical phenomena in an electrolysis cell, and its qualitative analysis is focused on existence of solutions. The model consists of a system of nonlinear parabolic PDEs in conservation form expressing conservation of energy, mass and charge. On the other hand, an integral form of Newton's law is used to describe heat exchange at the electrolyte/electrode interface, a nonlinear radiation condition is enforced on the heat flux at the wall and a nonlinear boundary condition is considered for the electrochemical flux in order to account for Butler-Volmer kinetics. The main objective is the nonconstant character of each parameter, that is, the coefficients are assumed to be dependent on the spatial variable and the temperature. Making recourse of known estimates of solutions for some auxiliary elliptic and parabolic problems, which are explicitly determined by the Gehring-Giaquinta-Modica theory, we find sufficient smallness conditions on the data to guarantee the existence of the original solutions via the Schauder fixed point argument. These conditions may provide useful informations for numerical as well as real applications. We conclude with an example of application, namely the electrolysis of molten sodium chloride.

53. Explicit higher regularity on a Cauchy problem with mixed Neumann-power type boundary conditions, *Le Matematiche* **70** f.2 (2015), 79–108.

DOI: 10.4418/2015.70.2.6

Abstract. We investigate the regularity in L^p $(p > 2)$ of the gradient of any weak solution of a Cauchy problem with mixed Neumann-power type boundary conditions. Under suitable assumptions we prove the existence of weak solutions that satisfy explicit estimates. Some considerations on the steady-state regularity are discussed.

54. Analytical solutions in the modeling of the local RF ablation. *Journal of Mechanics in Medicine and Biology* **16** :2 (2016), 1650071 (14 pages).

DOI: 10.1142/S0219519416500718

Abstract. Coupled mathematical models for the radiofrequency (RF) ablation performed in biomedical sciences have been developed based on the bioheat transfer theory. The heat exchange problem is important to be analytically studied in order to control the size of the necrosis zone caused by RF ablation. This lesion size in the tissue may be predicted by the knowledge of the internal tissue temperature. We propose an analytical solution for the Pennes

heat transfer equation in bi- and tri-region domains, applicable to the RF ablation of cancerigeneous tissue – a clinical relevant problem. The model consists of two partial differential equations describing the spatio-temporal interactions between the electric and thermic effects. The aim is to find simple algebraic expressions of analytical solutions that may allow to generate quantitative results which in turn may be interpreted (including uncertainties). The dependence of the temperature as function of the electrothermal parameters in both diseased and surrounding healthy tissues is pointed out. Two cases, namely the tumor–tissue and tumor–tissue–skin systems, are graphically computed, and important findings include the fact that the presence of tissue with smaller value parameters protects somehow healthy cells. Moreover, the graphical representations are conducted to highlight the link of the profile of current density distribution in the physiological problem with the (neither oval nor circular) shape of the temperature isoclinic lines.

55. Radiative effects for some bidimensional thermoelectric problems, *Adv. Nonlinear Anal.* **5** :4 (2016), 347–366. DOI: 10.1515/anona-2015-0128

ABSTRACT. There are two main directions in this paper. One is to find sufficient conditions to ensure the existence of weak solutions for some bidimensional thermoelectric problems. At the steady-state, these problems consist of a coupled system of elliptic equations of the divergence form, commonly accomplished with nonlinear radiation-type conditions on at least a nonempty part of the boundary of a C^1 domain. The model under study takes the thermoelectric Peltier and Seebeck effects into account, which describe the Joule-Thomson effect. The proof method makes recourse of a fixed point argument. To this end, well-determined estimates are our main concern. The paper is in the second direction for the derivation of explicit $W^{1,p}$-estimates ($p > 2$) for solutions of nonlinear radiation-type problems in the general n-dimensional space situation, where the leading coefficient is assumed to be a discontinuous function on the space variable. In particular, the behavior of the leading coefficient is conveniently explicit on the estimate of any solution.

56. Explicit estimates on a mixed Neumann-Robin-Cauchy problem, *Turkish Journal of Mathematics* **40** (2016), 1356–1373. DOI: 10.3906/mat-1505-62

ABSTRACT. We deal with the existence of weak solutions for a mixed Neumann-Robin-Cauchy problem. The existence results are based on global-in-time estimates of approximating solutions, and the passage to the limit exploits compactness techniques. We investigate explicit estimates for solutions of the parabolic equations with nonhomogeneous boundary conditions and distributional right hand sides. The parabolic equation is of divergence form with discontinuous coefficients. We consider a nonlinear condition on a part of the boundary that the power laws (and the Robin boundary condition) appear as particular cases.

57. Weak solutions for a thermoelectric problem with power-type boundary effects. *Bollettino dellÚnione Matematica Italiana* **11** :4 (2018), 595–619.

DOI: 10.1007/s40574-018-0159-z

Abstract. This paper deals with thermoelectric problems including the Peltier and Seebeck effects. The coupled elliptic and doubly quasilinear parabolic equations for the electric and heat currents are stated, respectively, under power-type boundary conditions that describe the thermal radiative effects. To verify the existence of weak solutions to this coupled problem (Theorem 1), analytical investigations for abstract multi-quasilinear elliptic-parabolic systems with nonsmooth data are presented (Theorem 2 and 3). They are essentially approximated solutions based on the Rothe method. It consists on introducing time discretized problems, establishing their existence, and then passing to the limit as the time step goes to zero. The proof of the existence of time discretized solutions relies on fixed point and compactness arguments. In this study, we establish quantitative estimates to clarify the smallness conditions.

58. Weak solutions for multiquasilinear elliptic-parabolic systems: application to thermoelectrochemical problems, *Boletín de la Sociedad Matemática Mexicana* **26** :2 (2020), 535–562. DOI: 10.1007/s40590-019-00253-3

Abstract. This paper investigates the existence of weak solutions of biquasilinear boundary value problem for a coupled elliptic-parabolic system of divergence form with discontinuous leading coefficients. The mathematical framework addressed in the article considers the presence of an additional nonlinearity in the model which reflects the radiative thermal boundary effects in some applications of interest. The results are obtained via the Rothe-Galerkin method. Only weak assumptions are made on the data and the boundary conditions are allowed to be on a general form. The major contribution of the current paper is the explicit expressions for the constants appeared in the quantitative estimates that are derived. These detailed and explicit estimates may be useful for the study on nonlinear problems that appear in the real world applications. In particular, they clarify the smallness conditions. In conclusion, we illustrate how the above results may be applied to the thermoelectrochemical phenomena in an electrolysis cell. This problem has several applications as, for instance, to optimize the cell design and operating conditions.

Papers presented at Conferences

1. The squat jump model revisited. **In** Proceedings "Encontro, 1, Biomecânica", Martinchel (Abrantes), February 3-4, 2005. Eds. J.A. Simões, H.C. Rodrigues, M.A. Vaz & A.P. Veloso, 231–234.

   https://www.researchgate.net/publication/282851304

   Abstract. The ground reaction force and the center of pressure are very important measurements in clinical and rehabilitation settings to predict internal moments generated at the hip, knee and ankle during the process of patient assessment. Explicit equations for a jumping model are stated, and the present mathematical model can be extended for gait models. The analysis of the accurate position of the center of pressure and the correlate relation with the ground reaction force can significantly contribute to the understanding of the mechanics of gait. The importance of ground interaction during contact from heel-strike to stance to toe-off in jumping and walking is in the fact that the ground reaction force accelerates the center of mass. The action of the center of pressure varying with time is the most relevant object of study. When a "hard constraint" (i.e. pinned) is applied it is imperative that the pin point be coincident to the center of pressure (and thus change with the center of pressure) in order to get the best approximation of the ground reaction force from a hard constraint approximation. This is necessary for performing induced acceleration calculations on models that have compliant contact. In this work, the base of the feet is modeled by a finite number of springs and compared to the model when there exists a pin point.

2. (joint work with E.B. Pires) Um modelo analítico para a determinação de momentos internos utilizando dinâmica inversa de multi-corpos. **In** Proceedings "CMNE- Congresso de Métodos Numéricos em Engenharia, XXVIII CILAMCE-Congresso Ibero Latino-Americano sobre Métodos Computacionais em Engenharia", Univ. do Porto, 13-15 Junho 2007, **and in:** *Métodos Numéricos e Computacionais em Engenharia CMNE CILAMCE 2007* Eds. J. César de Sá, R. Delgado, A.D. Santos, A. Rodríguez-Ferran, J. Oliver, P.R.M. Lyra & J.L.D. Alves, APMTAC/FEUP, Porto, 2007. Indice (a1174)

   https://www.researchgate.net/publication/283016723

3. Frictional work on stationary thermal viscous incompressible flows. **In** *Theoretical and Experimental Aspects on Fluid Mechanics* "Proceedings of the 5th WSEAS International Conference on Fluid Mechanics", January 25-27, 2008,

Acapulco, Mexico, Eds. S.H. Sohrab, H.J. Catrakis & F.K. Benra, *Mathematics and Computers in Science and Engineering*, WSEAS Press (2008), 36–40.

Abstract. The frictional phenomena appears on thermal viscous incompressible flows as a natural behaviour and the frictional heat generation enters as a boundary condition for the temperature. In the present work, different friction laws are considered on a part of the boundary. We deal with a $(p-q)$ coupled fluid-energy system which weak formulation consists by an inequality and an equality corresponding to the motion and energy equations, respectively. It presents the following nonlinearities: the convections, the viscous heating, the conductivity and viscosities dependence on the internal energy, and the constitutive laws for the stress tensor and the heat flux when non-Newtonian fluids are taken care of. The existence result of a weak solution is based on a fixed point argument to multivalued mappings. We discuss some open problems.

Other publications

- Pensamento e raciocínio. *Magazine E-ciência* **37** July 22 (2004), 12.

Some of the abstracts published in the proceedings at the conferences/workshops.

- How can architecture be helped by mathematics?, in *2nd International Conference on the Teaching of Mathematics (at the undergraduate level)*, Crete, Greece, July 1-6, 2002.

- (joint work with M.G. Pandy and A. Seth) Induced Kinematics: A new computational approach for assessing muscle function during movement, in *Proceedings of CMBBE (Computer Methods in Biomechanics & Biomedical Engineering)*, Madrid 25-28 February 2004.

  Abstract. Models of human movement can determine the net muscle torques and/or forces necessary to reproduce experimental observations of motion. In complex models, the number of muscles can exceed 50, and interpreting muscle force curves and relating them to function is difficult. A computational method called Muscle Induced Accelerations can provide significant insight into how a muscle accelerates all the joints in a multi-joint system, not just those that it spans. By calculating the joint accelerations induced by a particular muscle, the contribution of individual muscles forces (or torques) to task performance can be directly quantified. To calculate muscle induced accelerations, most biomechanical models of locomotion hinge the feet to the ground, because then the ground reaction force can be eliminated from the system equations of motion. In this case, muscle system induced accelerations can be determined independent of the ground reaction force, and further analyses can be carried out to specify the action of each muscle at each body joint. In general, however, contact with the ground is non-ideal and contact forces can appear in the EOMs equations of

motion as functions of the system state. Thus in this paper, we present a new computational approach for quantifying muscle induced accelerations, which we refer to as Induced Kinematics. The method quantifies not only how each muscle accelerates each body joint, but also how each muscle contributes to the velocity and displacement of the joint in question. Thus, the method can be applied to evaluate the partial influence of each muscle-force contributor to a state-dependent ground reaction (or joint contact) force. We have applied the Induced Kinematics method to a simplified jumping modelplanar model of vertical jumping, in which the interaction of the feet with the ground are modeled using non-linear spring contact points at the base of the foot. The results predicted by this method are also compared with those obtained by pinning the model feet to the ground applied to the same jumping model. Our findings reveal that the Induced Kinematics method can be very accurate, especially as the foot leaves the ground, where the pinning assumption breaks down. This is a significant result, because in tasks such as walking the foot must make and break contact with the ground, and at these instances the Induced Kinematics method continues to yield accurate estimates of muscle-induced accelerations.

- (joint work with I. dos Santos) Cooling effect of blood flow on RF ablation technique, in *2nd International Symposium on Modelling of Physiological Flows*, IST/Technical University of Lisbon, Sezimbra, March 31- April 2, 2005. Abstract

- Steady-state thermal viscous incompressible flows with frictional and radiative effects, in *Third International Conference of Applied Mathematics*, Technical Univ. of Plovdiv, Bulgaria, August 12-18, 2006.

- A $(p-q)$ coupled system in elliptic nonlinear boundary value problems, in International Conference on *Applied Analysis and Differential Equations*, Univ. "A. I. Cuza" Iasi, Romenia, September 4-9, 2006.

- Friction boundary conditions for stationary thermal viscous incompressible flows, in *ICAM5- Fifth International Conference on Applied Mathematics* in Honour of Professor Ioan A. Rus with the occasion of his 70th birthday, Baia Mare, Romenia, September 21-24, 2006. Abstract (p. 14)

- Convective-radiation effects on thermal viscous incompressible flows, in *International Conference on Mathematical Fluid Mechanics a Tribute to Giovanni Paolo Galdi* on the Occasion of Professor Galdi's 60th Birthday, Estoril, IST, May 21-25, 2007.

Thesis degree philosophiae doctor

TITLE: **Análise matemática de alguns problemas de mecânica de fluidos não-Newtonianos**

Advisor: Professor *José Francisco Rodrigues*

Thesis jury members (Lisbon University, February 7, 2000):

Professor *Vsevolod Solonnikov*

Professor *Michel Chipot*

Professor *Lisa Santos*

Professor *Mário Figueira*

Professor *Luís Trabucho*

Professor *Manuel Marques*

Teaching and academic experience

Her teaching experience was primordially on the mathematical analysis at every level and continuous models constituted by elliptic and/or parabolic equations.

* Instructor (1987/88): Calculus;

* Lecturer (1988/2000): Calculus/Infinitesimal analysis (I,II,III,IV), Linear algebra and analytical geometry, Continuum mechanics, Ordinary differential equations;

* Assistant Professor (2000/09): Calculus/Infinitesimal analysis (I,II,III,IV), Elliptic and parabolic problems, Biomathematical models.

Her teaching interests were to transmit to the students the knowledge, to understand and to remove their difficulties, to improve their capacity of rigour, to exercise the perseverance, the concentration and the development of new ideas and to give them the opportunity of being better persons as individuals as well as collective in their future life.

Participated in Faculty academic and research committees always as requested. Contributed with several lectures, tutorials and seminars. Supervised research projects in *Educational Mathematics* of undergraduate and postgraduate students. In particular, she was supervisor of Master student Maria Cristina Tomé in April 27, 2005, with thesis entitled **Alguns conceitos de Análise Matemática e a concepção da forma arquitectónica**.