

## **Rui Vilela Mendes**

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## **1 University degrees**

E. E. (1961) Instituto Superior Técnico (Lisbon Technical University),  
Electrical Engineering

Ph. D. (1970) The University of Texas (Austin), Mathematical Physics

Habilitation (1980) University of Lisbon, Mathematics

## **2 Career**

1966-68 Graduate student and teaching assistant University of Texas  
(Austin)

1968-69 Graduate Fellow, University of Texas

1969-70 Instructor in Physics, University of Texas

1971-72 Research Associate at "Junta de Energia Nuclear" Sacavém -  
Portugal

1972-73 Researcher at "Instituto de Física e Matematica" Lisbon - Por-  
tugal

1973 Visiting Professor, University of Texas

1974-80 Researcher at "Instituto de Física e Matemática"

1980-93 Senior Researcher - Instituto Nacional de Investigação Científica  
- Lisbon

1983-84 Project member - Zentrum für interdisziplinäre Forschung, Uni-  
versität Bielefeld - Germany

1985 Scientific Associate - C. E. R. N. , Geneva

1985-90 Invited Professor, University of Lisbon

1986 Invited researcher - C. N. R. S., Marseille and BiBoS Research Cen-  
ter, Univ. Bielefeld

1987-89 Visiting Professorships at the University of Marseille and Uni-  
versity of Bielefeld

1991 Scientific Associate - C. E. R. N. , Geneva

1993 Visiting researcher - IHES, Bures-sur-Yvette  
1993-2008 Senior Researcher - Technical University, Lisbon  
From 2008 - Researcher at CMAF (Center for Mathematics and Applications, Univ. Lisbon) and IPFN (Institute of Plasmas and Nuclear Fusion, IST)

### **3 Teaching experience**

Advanced Laboratory - University of Texas, Austin  
Physics I - University of Texas, Austin  
Quantum Mechanics - University of Texas, Austin  
Introduction to Particle Physics - University of Texas, Austin  
Relativistic Quantum Mechanics - University of Lisbon  
Mathematical Physics - University of Lisbon  
Analytical Mechanics - University of Lisbon  
Topics in Mathematical Physics (Nonlinear dynamics) - University of Bielefeld  
Neural Networks - Instituto Superior Técnico  
Mathematics as metaphor - ISCTE 2008  
Applications of Mathematics to Socio-Economic Problems (Bielefeld 2008)  
Stochastic Analysis and Applications - ISCTE 2010  
Networks and hypernetworks - UAM, Madrid 2010  
Topics in signal analysis and process reconstruction - UAM, Madrid 2012  
# Orientation and co-orientation of Master's and Ph. D. students

### **4 Research fields**

Applied Mathematics  
Mathematical Physics  
Socio-economic mathematical models

### **5 Research publications**

Organized according to the following fields:

1. Nonlinear Dynamics: Physics and Engineering
2. Socio-economic problems

3. Theoretical and Mathematical Physics
4. Signal Processing, Data Analysis and Neural Networks
5. Computational methods

## 5.1 Nonlinear Dynamics: Physics and Engineering

- "*Decomposition of vector fields and mixed dynamics*" (with J. T. Duarte), Journal of Mathematical Physics 22, (1981)1420-1422.
- "*Critical point dependence of universality in maps of the interval*", Physics Letters 84A (1981) 1-3.
- "*Dimension reduction and universality in the period doubling route to chaos*", Univ. Bielefeld report Bi-TP 81/33.
- "*Arcs of discrete dynamics and constants of motion*" (with J. T. Duarte), Letters on Mathematical Physics 6 (1982) 249-252.
- "*On the quantization of dissipative and volume preserving dynamics*", Physical Review D26 (1982) 3446-3451.
- "*Deformation of Hamiltonian dynamics and constants of motion in dissipative systems*" (with J. T. Duarte), Journal of Mathematical Physics 24 (1983) 1772-1778.
- "*Symmetries and stable periodic orbits for one-dimensional maps*", Journal of Mathematical Physics 25 (1984) 855-857.
- "*Deformations of two-dimensional dissipative maps*", Bielefeld report ZiF 69/1984.
- "*A variational formulation for dissipative maps*", Physics Letters 104A (1984) 391-395.
- "*Generating functions for noncanonical maps*", Letters on Mathematical Physics 11 (1986) 289-292.
- "*Deformation stability of periodic and quasiperiodic motion in dissipative systems*", in "*Deformation Theory of Algebras and Structures and Applications*", M. Hazewinkel, M. Gerstenhaber, ed., Kluwer Academic Publishers, Dordrecht, 1988.

- "Stability of invariant circles in a class of dissipative maps" (with R. Lima), *Nonlinear Analysis* 12 (1988) 1061-1067.
- "Map dynamics in gearbox models" (with L. Streit and M. Faria), *Proceedings of the Second European Symposium on Mathematics in Industry*, H. Neunzert, ed., B. G. Teubner, Stuttgart, 1988.
- "Rotation number and Lyapunov exponents in two dimensional maps" (with A. Lambert and R. Lima), *Physica D* 34 (1989) 366-377.
- "Variational formulation and ergodic invariants" (with A. Carreira and M. O. Hongler), *Physics Letters* 155A (1991) 388-396.
- "Sensitive dependence and entropy for quantum systems", *Journal of Physics* A24 (1991) 4349-4358.
- "Topics in the quantum theory of non-integrable systems", in "Non-linear fields: Classical, Random, Semiclassical", page 360, P. Garbaczewski and Z. Popowicz, Eds., World Scientific, 1991.
- "Logarithmic measure, subdimension and Lyapunov exponents of cantori" (with R. Coutinho, R. Lima and S. Vaienti), *Annales de l'Institut Henri Poincaré* 56 (1992) 415-427.
- "Metric and dynamical characterization of cantori in twist maps" (with R. Coutinho), in "Complex Dynamics" pgs. 89-97, Nova Science 1992
- "Sensitive dependence in quantum systems : Some examples and results", *Physics Letters* A171 (1992) 253-258.
- "On the existence of quantum characteristic exponents", *Physics Letters* A187 (1994) 299-301
- "Sensitive dependence and quantum characteristic exponents", *Proceedings of Advanced Topics in Applied Mathematics and Theoretical Physics - Complex Systems, Classical and Quantum Aspects*, Marseille June 1994
- "Entropy and quantum characteristic exponents: Steps towards a quantum Pesin theory", in "Chaos - The Interplay between Stochastic and Deterministic Behaviour", P. Garbaczewski and A. Weron (Eds.), Springer Lecture Notes in Physics no. 457, pages 273-282, Springer, Berlin 1995.

- ” *A stochastic process for the dynamics of the turbulent cascade*” (with R. Lima), Physical Review E53 (1996) 3536-3540
- ” *Collision states and scar effects in charged three-body problems*”, Physics Letters A233 (1997) 265-273
- ” *Active control of ionized boundary layers*”, Int. Journal of Bifurcation and Chaos, 8 (1998) 2449-2455
- ” *On the computation of quantum characteristic exponents*” (with R. Coutinho), Physics Letters A239 (1998) 239-245
- ” *Boundary-layer control by electric fields*” (with J. A. Dente), Journal of Fluids Engineering 120 (1998) 626-629
- ” *Saddle scars: Existence and applications*”, Physics Letters A239 (1998) 223-227
- ” *Conditional exponents, entropies and a measure of dynamical self-organization*”, Physics Letters A248 (1998) 167-171.
- ” *On some dynamical problems related to boundary layer turbulence*”, arXiv: physics/9903047
- ” *Feigenbaum networks*” (with R. Carvalho e J. Seixas), Physica D126 (1999) 27-37.
- ” *Clustering and synchronization with positive Lyapunov exponents*”, Physics Letters A257 (1999) 132-138
- ” *Multistability in dynamical systems*”, in ” *Dynamical systems: From crystal to chaos*”, J.-M. Gambaudo, P. Hubert, P. Tisseur and S. Vaienti (Eds.), pp. 105-113, World Scientific 2000.
- ” *Characterizing self-organization and coevolution by ergodic invariants*”, Physica A 276 (2000) 550-571
- ” *Lyapunov exponent in quantum mechanics. A phase-space approach*” (with V. I. Man'ko), Physica D145 (2000) 330-348
- ” *From synchronisation to multistability in two coupled quadratic maps*” (with B. Fernandez and R. Carvalho), Physics Letters A 285 (2001) 327-338.

- "*Language identification of controlled systems: Modelling, control and anomaly detection*" (with J. Martins, J. Dente and A. Pires), IEEE Transactions in Systems, Man and Cybernetics, 31 (2001) 234-242.
- "*Classical and quantum Lyapunov exponents in a phase-space tomographic approach*", in "150 Years of Quantum Many-Body Theory"; pg. 327, R. F. Bishop, K. A. Gernoth and N. R. Walet (Ed.), World Scientific, Singapore 2001.
- "*Structure generating mechanisms in agent-based models*", Physica A295 (2001) 537-561.
- "*Using immunology principles for anomaly detection in electrical systems*" (with P. Branco and J. Dente), IEEE Transactions in Industrial Electronics 50 (2003) 362-373.
- "*Dynamical characterization of the small-world phase*" (with T. Araújo and J. Seixas), Phys. Lett. A319 (2003) 285-289.
- "*Tools for network dynamics*", Int. J. Bifurcation and Chaos 15 (2005) 1185-1213
- "*Deterministic Bak-Sneppen model. Lyapunov spectrum and avalanches as return times*", Physica D 214 (2006) 182-186
- "*Dynamics and coding of a biologically motivated network*" (with C. Aguirre and J. Martins), Int. Journal of Bifurcation and Chaos, 16 (2006) 383-394
- "*Network dynamics: Tools and examples*", Nonlinear Dynamics 44 (2006) 181-204
- "*The dynamical nature of a backlash system with and without fluid friction*" (with L. Vázquez), Nonlinear Dynamics 47 (2007) 363-366
- "*From controlled dynamical systems to context-dependent grammars: A connectionist approach*" (with J.F. Martins, J.A. Dente and A.J. Pires), Engineering Applications of Artificial Intelligence 22 (2009) 192-200
- "*Ergodic parameters and dynamical complexity*", Chaos 21 (2011) 037115.

- "*Long range dependence and the dynamics of exploited fish populations*" (with H. C. Mendes and A. Murta), *Advances in Complex Systems* 18 (2015) 1550017

## 5.2 Socio-economic problems

- "*A process-reconstruction analysis of market fluctuations*" (with R. Lima and T. Araújo), *International Journal of Theoretical and Applied Finance*, 5 (2002) 797.
- "*Reconstructing an economic space from a market metric*" (with T. Araújo and F. Louçã), *Physica A* 323 (2003) 635-650
- "*Network dependence of strong reciprocity*", *Advances in Complex Systems* 7 (2004) 357-368.
- "*The quantum ultimatum game*", *Quantum Information Processing* 4 (2005) 1-12
- "*Option pricing with fractional volatility*" (with M. J. Oliveira), arXiv: cond-mat/0404684
- "*A data-reconstructed fractional volatility model*" (with M. J. Oliveira), *Economics E-Journal*, Discussion paper 2008-22
- "*Stochastic volatility*", in the Proceedings of the "Perspectivas em Econofísica" workshop (Évora, January 2006)
- "*The fractional volatility model: An agent-based interpretation*", *Physica A: Statistical Mechanics and its Applications*, 387 (2008) 3987-3994
- "*A fractional calculus interpretation of the fractional volatility model*", *Nonlinear Dynamics* (2009) 55: 395–399
- "*Innovation and self-organization in a multi-agent model*" (with T. Araújo), *Advances in Complex Systems* 12 (2009) 233-253
- "*Cooperation, punishment, emergence of government and the tragedy of authorities*" (with C. Aguirre), *Complex Systems* 20 (2012) 363-374
- "*The fractional volatility model: No-arbitrage and risk measures*" (with M. J. Oliveira), arXiv:1007.2817

- "*Portfolios and the geometry of the market*" (with S. Eleutério and T. Araújo), Physica A: Statistical Mechanics and its Applications 410 (2014) 226–235.
- "*No-arbitrage, leverage and completeness in a fractional volatility model*" (with M. J. Oliveira and A. M. Meireles), Physica A 419 (2015) 470–478
- "*From market data to agent-based models and stochastic differential equations*", in "Particle Systems and Partial Differential Equations III", Springer 2015

### 5.3 Theoretical and Mathematical Physics

- "*Representations of local I-spin charge densities*" (with Y. Ne'eman), Journal of Mathematical Physics 11, 3371 (1970).
- "*Schwinger terms in an algebraic quark model*" (with Y. Ne'eman), Physics Letters 32B, 696 (1970).
- "*Representations of local currents and related algebras*", Ph. D. Thesis - University of Texas, 1970 University Microfilms (Ann Arbor, Michigan no 70-18, 270).
- "*An algebra of currents and gradient terms*" (with Y. Ne'eman), Annals of Physics 66, 836 (1971), reprinted in "Nuclear, Particle and Many-Body Physics", vol. II, p. 836, Academic Press, 1972.
- "*Representations of local current algebra. A constructional approach*" (with Y. Ne'eman), Springer Tracts in Modern Physics, vol. 60, 18 (1971).
- "*A unified solution to the  $\pi^0 \rightarrow 2\gamma$  and  $\eta \rightarrow 3\pi$  decay puzzles*", Proceedings "IV Simpósio Brasileiro de Física Teórica", PUC, Rio de Janeiro (1972).
- "*Deformed quark currents and anomalous Ward identities*", Physical Review D8, (1973) 3008-3018.
- "*Scaling, extended vector dominance and the existence of the neutral pion*", Portugaliae Physica 9, 21 (1974).



- "New low energy theorems for  $\gamma \rightarrow 3\pi$  and  $\gamma\gamma \rightarrow 3\pi$ ", Nuclear Physics B82, (1974) 213-220.
- "Faster than light particles and T-violation", Physical Review D14, 600 (1976).
- "Restored symmetries, quark puzzle and the pomeron as a Josephson current", International Journal of Theoretical Physics 15, 487 (1976).
- "On shadowing in electroproduction" (with J. P. Leão), Nuovo Cimento 41A (1977) 21-28.
- "Mass scales and confinement. A non-perturbative approach", Nuovo Cimento 43A, 294 (1978).
- "Asymptotic dynamics for gauge theories", Physical Review D18, (1978) 4726-4736.
- "Representations of the general covariance pseudogroup", Reports in Mathematical Physics 15, 287 (1979).
- "Infinite-dimensional Lie groups and quantum dynamical systems", in "Group Theoretical Methods in Physics", p. 296 Lecture Notes in Physics no. 94, Springer Verlag, 1979.
- "Large time behaviour of canonical quantized gauge theories", Nuclear Physics B161, 283 (1979).
- "Extended relativity, T-violation and a new kind of particles", Journal of Physics A13, (1980) 479-501.
- "Nonrelativistic bound states of the nonabelian gauge potential", Physical Review D24, (1981) 3305-3311.
- "Quantum dissipation and stochastic processes", in "Stochastic Processes in Quantum Theory and Statistical Mechanics" Lecture Notes in Physics no.173, Springer (1982) 332-336.
- "Reconstruction of dynamics from the vacuum in lattice theories", Zeitschrift für Physik C24, (1984) 45-52.

- "On potentials with fast growing point spectrum", Physics Letters 155B, (1985) 274-277.
- "Stochastic mechanics, nonlocal potentials and jump processes", Physics Letters 113A, (1985) 187-192.
- "Quantum dissipation, scattering and tunneling" (with S. Eleutério), Nuovo Cimento 96B, (1986) 26-40.
- "Reconstruction of dynamics from an eigenstate", Journal of Mathematical Physics 27, (1986) 178-184.
- "Stochastic mechanics at positive temperature", Physics Letters 116A, (1986) 216-220.
- "Numerical predictions from an  $SU(2)$  lattice stochastic model" (with S. Eleutério), Physics Letters 173B, (1986) 332-336.
- "Stochastic mechanics of abelian gauge theories" (with S. Eleutério), Journal of Physics A20, (1987) 6411-6427.
- "Stochastic models for lattice gauge theories" (with S. Eleutério), Zeitschrift für Physik C34, (1987) 451-463.
- "Is the  $\Lambda$  polarization in  $K^-p$  compatible with QCD" (with J. M. Gago and P. Vaz), Physics Letters 183B, (1987) 357-360.
- "Excited states of light hadrons as a probe of QCD", Physics Letters 196B, (1987) 207-211.
- "Non-equivalent stochastic models in lattice gauge theories", Physical Review D37, (1988) 1608-1620.
- "Euclidean gauge fields in four dimensions from stochastic differential equations", Physics Letters 202B, (1988) 369-375.
- "On a stochastic process associated to nonabelian gauge fields", Physics Letters 223B, (1989) 83-89.
- "Construction of gauge fields in four dimensions from ground state processes", in "White Noise Analysis, Mathematics and Physics", T. Hida, H. H. Kuo, J. Potthoff, L. Streit, Eds. World Scientific, 1990.

- "Analytical estimates of level spacing for the hydrogen atom in a strong magnetic field" (with L. Streit and L. Vazquez), in "Essays on Classical and Quantum Dynamics", Gordon & Breach, 1991.
- "Resonant hole configurations and hole pairing", Journal of Physics : Condens. Matter 3, (1991) 6757-6761.
- "Ergodic motion and near collisions in a Coulomb system", Modern Physics Lett. B5, 1179 (1991).
- "Topics in the quantum theory of non-integrable systems", in "Non-linear fields: Classical, random, semiclassical" (27th Winter School of Theoretical Physics, 1991 Karpacz) pages: 360-283, 1991.
- "Stochastic processes and the non-perturbative structure of the QCD vacuum", Zeitsch. Phys. C54, (1992) 273-281.
- "Near collisions in a Coulomb system: numerical simulations (A prelude to hybrid fusion)", Modern Physics Letters B7 (1993) 1929.
- "q-deformed Brownian motion" (with V. I. Man'ko), Physics Letters A180, (1993) 39-42.
- "Stochastic ground state processes" (with S. Eleutério), Physical Review B50, (1994) 5035-5040.
- "Hierarchical structures and asymmetric stochastic processes on p-adics and adeles" (with W. Karwowski), Journal of Mathematical Physics 35, (1994) 4637-4650
- "Electron-positron production in strong field pulses", Modern Physics Letters A9, (1994) 2493-2506
- "Deformations, stable theories and fundamental constants", Journal of Physics A27 (1994) 8091-8104
- "Near collisions in a Coulomb system: quantum treatment", Modern Physics Letters B8, 707 (1994)
- "Quantum mechanics and non-commutative space-time", Physics Letters A210 (1996) 232-240

- "Time dependent invariants for the Dirac equation and the Newton-Wigner position operator" (with V. I. Man'ko), *Physica Scripta* 56, (1997) 417-422
- "On the non-linearity interpretation of  $q$ - and  $f$ -deformation and some applications" (with V. I. Man'ko), *Jour. of Physics A: Math. and Gen.* 31 (1998) 6037-6044.
- "Geometry, stochastic calculus and quantum fields in a non-commutative space-time", *J. of Mathematical Physics* 41 (2000) 156-186
- "Gluon condensate and a vacuum structure for non-abelian gauge theory", in "Mathematical Physics and Stochastic Analysis", pg. 412, S. Albeverio et al. (Ed.), World Scientific, Singapore 2000.
- "Gauge strata and particle generations", arXiv: hep-th/0009027
- "Quantum computation by quantum-like systems" (with M. A. Man'ko and V. I. Man'ko), *Physics Letters A* 288 (2001) 132-138.
- "Non-commutative space-time and the uncertainty principle" (with E. Carlen), *Physics Letters A* 290 (2001) 109-114.
- "Stochastic calculus and processes in non-commutative space-time", *Progress in Probability*, vol.52, pp. 205-217, Birkhäuser Verlag, Basel 2002
- "Quantum sensitive dependence" (with V. I. Man'ko), *Physics Letters A* 300 (2002) 353-360.
- "Quantum collision states for positive charges in an octahedral cage", *International Journal of Hydrogen Energy*, 28 (2003) 125-129.
- "Fractionally coupled solutions of the diffusion equation" (with L. Vazquez), *Applied Mathematics and Computation* 141 (2003) 125-130.
- "Quantum control and the Strocchi map" (with V. I. Man'ko), *Physical Review A* 67 (2003) 053404.
- "Nongeneric strata and ground-state functionals in gauge theories", in "Roberto Salmeron Festschrift: A Master and a Friend", A. Aldrovandi, A. Santoro and J. M. Gago (Eds.), AIAFEX, Rio de Janeiro.

- *Quantum control in infinite dimensions* (with W. Karwowski), Physics Letters A 322 (2004) 282-285.
- *The nonlinear directional coupler. An analytic solution*, Optics Communications 232 (2004) 425-427.
- "*Stratification of the orbit space in gauge theories. The role of non-generic strata*", J. Phys. A: Math. Gen. 37 (2004) 11485-11498.
- *ALICE : Physics performance report, vol. 1*, J. Phys. G - Nuclear and Particle Phys. 30 (2004) 1517-1763
- "*Some consequences of a noncommutative space-time structure*", Eur. J. Phys. C 42 (2005) 445-452
- "*A nonlinear stochastic equation of convolution type*" (with F. Cipriano, H. Ouerdiane, and J. L. Silva), Proceedings of the International Conference on Mathematical Analysis of Random Phenomena, pags. 73-84, World Scientific 2006
- "*A probabilistic operator symbol framework for quantum information*" (with M. A. Man'ko and V. I. Man'ko), J. of Russian Laser Research 27 (2006) 507-532
- "*Path-integral estimates of ground-state functionals*", Proceedings of the International Conference on Mathematical Analysis of Random Phenomena, pags. 169-177, World Scientific 2006
- "*Fluctuations and control in the Vlasov-Poisson equation*" , (with R. Lima), Physics Letters A 368 (2007) 87-91
- "*A nonlinear stochastic equation of convolution type: Solution and stochastic representation*" (with F. Cipriano, H. Ouerdiane and J. L. Silva), Global J. of Pure and Applied Math. 4 (2008) 9-23.
- "*Reduction and approximation in guiding-center dynamics*" (with Ph. Ghendrih and R. Lima), J. Phys. A: Math. Theor. 41 (2008) 465501
- "*A stochastic representation for the Poisson-Vlasov equation*" (with F. Cipriano), Commun. in Nonlinear Science and Num. Simulation 13 (2008) 221-226

- "*Poisson-Vlasov : Stochastic representation and numerical codes*" (with E. Floriani and R. Lima), *European Physical Journal D* 46 (2008) 295-302 and 407
- "*Stochastic solution of a KPP-type nonlinear Fractional differential equation*" (with F. Cipriano and H. Ouerdiane), *Fractional Calculus and Applied Analysis* 12 (2009) 47-57
- "*Universal families and quantum control in infinite dimensions*", *Physics Letters A* 373 (2009) 2529–2532
- "*Stochastic solutions of some nonlinear partial differential equations*", *Stochastics* 81 (2009) 279–297
- "*Poisson-Vlasov in a strong magnetic field: A stochastic solution approach*", *J. Math. Phys.* 51 (2010) 043101
- "*The fractional Poisson measure in infinite dimensions*" (with M. J. Oliveira, H. Ouerdiane and J. L. Silva), arXiv:1002.2124
- "*On the problem of quantum control in infinite dimensions*" (with V. I. Man'ko), *J. Phys. A: Math. Theor.* 44 (2011) 135302
- "*An infinite-dimensional calculus for generalized connections in hypercubic lattices*", *J. Math. Phys.* 52 (2011) 052304
- "*Stochastic solutions of nonlinear PDE's: McKean versus superprocesses*", in "Complexity, Chaos and Transport", X. Leoncini (Ed.) World Scientific 2012
- "*The deformation-stability fundamental length and deviations from c*", *Physics Letters A* 376 (2012) 1823-1826
- "*A laboratory scale fundamental time?*", *European Physical Journal C* 72 (2012) 2239
- "*A stochastic approach to the solution of magnetohydrodynamics equations*" (with E. Floriani), *Journal of Computational Physics* 242 (2013) 777–789.

- *"Fractional Bose gas and fractional Poisson measure in infinite dimensions"*, (with M. J. Oliveira), in "Particle Systems and Partial Differential Equations II", Springer 2015.
- *"Measure and mass gap for generalized connections on hypercubic lattices"*, arXiv:1504.07798
- *"An extended Dirac equation in noncommutative space-time"*, arXiv:1502.00322
- *"Stochastic solutions of nonlinear PDE's and an extension of super-processes "*, in "Stochastic and Infinite dimensional Analysis", Birkhäuser 2016.
- *"The stability of physical theories principle"* in "The Algebraic Way. Space, Time and Quantum Beyond Peaceful Coexistence" I. Licata (Ed.), Imperial College Press 2016.

#### 5.4 Signal Processing, Data Analysis and Neural Networks

- *"Firing an adjustable-frequency three-phase inverter"*, Electronic Engineering 39, 41 (1967).
- *"Digital timing provides frequency-sensitive relay"*, Electronics 40, 94 (1967).
- *"Vector fields and neural networks"* (with J. T. Duarte), Complex Systems 6, 21 (1992).
- *"Learning from examples and generalization"* (with J. Dente), Complex Systems 6, 301 (1992).
- *"Large deviation analysis of multiplicity fluctuations"* (with J. Seixas), Nuclear Physics B383 (1992) 622-642.
- *"A new method for fast track recognition at present and future colliders"* (with T. Altherr and J. Seixas), Nuclear Instruments and Methods A332 (1993) 284-287.

- " *Unsupervised learning in networks with node parameters*" (with J. A. Dente), in *Fluctuation phenomena: Disorder and Non-linearity*", A. R. Bishop, S. Jimenez and L. Vazquez (Eds.), World Scientific, Singapore 1995
- " *Unsupervised learning in general connectionist systems*" (with J. A. Dente), *Network: Computation in Neural Systems* 7 (1996) 123-139
- " *The bi-orthogonal decomposition in image processing: signal analysis and texture segmentation*" (with J. A. Dente, A. Lambert and R. Lima), *Signal Processing: Image Communication* 8 (1996) 131-148
- " *A fully connected network of Bernoulli units with correlation learning*" (with J. A. Dente), *Physics Letters A*211 (1996) 87-93
- " *Characteristic functions and process identification from neural networks*" (with J. A. Dente), *Neural Networks* 10 (1997) 1465-1471
- " *Noncommutative time-frequency tomography*" (with V. I. Man'ko), *Physics Letters A* 263 (1999) 53-61
- " *Dynamics of networks and applications*", in "Scientific applications of neural networks", Springer Lecture Notes in Physics 522, 1999.
- " *Function and form in networks of interacting agents*" (with T. Araújo), *Complex Systems* 12 (2000) 357.
- " *A novel grammatical inference learning algorithm for automatic modelling of drive systems*" (with J. F. Martins and A. J. Pires), IAS 2000 - Conference Record of the 2000 IEEE Industry Applications Conference, pages: 1568-1572, 2000.
- " *Neural networks and logical reasoning systems. A translation table*" (with J. Martins), *International Journal of Neural Systems* 11 (2001) 179.
- " *Tomograms and other transforms: A unified view*" (with M. A. Man'ko and V. I. Man'ko), *J. Phys. A: Math. and Gen.*34 (2001) 8321-8332.
- " *Language identification of controlled systems: Modeling, control, and anomaly detection*" (with J. F. Martins, J. A. Dente and A. J. Pires),



IEEE Transactions on Systems, Man and Cybernetics 31 (2001) 234-242.

- "*Formal language control of induction motor drives*" (with J. Martins, A. Pires and J. A. Dente), IECON-2002: Proceedings of the 2002 28th Annual Conference of the IEEE Industrial Electronics Society, pages 1903-1908, 2002.
- "*Supervision language control of electromechanical drives*" (with J. F. Martins and A. J. Pires), 2003 IEEE International Symposium on Industrial Electronics, pages 662-666, 2003.
- "*Using immunology principles for fault detection*" (with P. Branco and J. A. Dente), IEEE Transactions on Industrial Electronics 50 (2003) 362-373.
- "*Automatic Language Control of Electrical Drives. Background and Applications*" (with J. F. Martins, J. A. Dente and A. J. Pires), in *Intelligent Systems at the Service of Mankind* (W. Elmenreich, J. T. Machado, I. J. Rudas (Eds)), pp. 29-39, UBooks, 2003.
- "*Short-term load forecast using trend information and process reconstruction*" (with P. J. Santos, A. G. Martins and A. J. Pires), Int. Journal of Energy Research 30 (2006) 811-822
- "*Entropy-based choice of a neural network drive model*" (with J. F. Martins, P. J. Santos and A. J. Pires), IEEE Transactions on Industrial Electronics 54 (2007) 110-116
- "*Signal reconstruction by random sampling in chirp space*" (with Eric Carlen), Nonlinear Dynamics 56 (2009) 223-229
- "*A tomographic analysis of reflectometry data: I. Component factorization*" (with F. Briolle, R. Lima and V. Man'ko), Measurement Science and Technol. 20 (2009) 105501
- "*Tomographic analysis of reflectometry data: II. The phase derivative*" (with F. Briolle and R. Lima), Measurement Science and Technol. 20 (2009) 105502.

- "*From controlled dynamical systems to context-dependent grammars: A connectionist approach*" (with J. F. Martins, J. A. Dente and A. J. Pires), *Engineering Applications of Artificial Intelligence* 22 (2009) 192-200.
- "*Non-commutative tomography: A tool for data analysis and signal processing*" (with F. Briolle, V. I. Man'ko and B. Ricaud), *J. Russian Laser Research* 33 (2012) 103-121
- "*Signal recognition and adapted filtering by non-commutative tomography*" (with C. Aguirre), *IET Signal Processing* 8 (2014) 67 - 75.
- "*Learning ambiguous functions by neural networks*" (with R. Ligeiro), arXiv:1310.1250.
- "*Signal processing on graphs: Transforms and tomograms*", (with H. C. Mendes and T. Araújo), arXiv:1406.2185.
- "*Noncommutative tomography and signal processing*", *Physica Scripta* 90 (2015) 074022.

## 5.5 Computational Methods

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