

CURRICULUM VITAE

WELINGTON DE MELO

1. PERSONAL INFORMATION

Name: Wellington Celso de Melo

Born: November 17, 1946 - Guapé - MG- Brazil

Parents: Moacyr Hostalácio de Melo and Maria José Silva de Melo

Citizenship: Brazilian

Married to Gilza de Melo

Present position:

Full Professor at IMPA

Instituto de Matemática Pura e Aplicada

Conselho Nacional de Pesquisas, Rio de Janeiro, Brazil.

Address:

Instituto de Matemática Pura e Aplicada, IMPA,

Estrada Dona Castorina 110,

Rio de Janeiro, 22460-300, BRAZIL.

Tel.(55-21) 2529-5144, Fax (55-21) 2529-5129

e-mail: demeloimpa.br

internet site: <http://www.impa.br/~demelo/>

2. DEGREES

- – Engenheiro Eletricista

Universidade Federal de Minas Gerais- Brasil, 1969

- – Doutor em Matemática (PhD)

IMPA, 1972

Thesis: Structural Stability of Diffeomorphisms on two-manifolds

Advisor: Jacob Palis

3. PERMANENT POSITIONS

Instituto de Matemática Pura e Aplicada (IMPA)

Full Professor, September 1980 – Present

Associate Professor, August 1975 – July 1980

Assistant Professor, January 1974 – July 1975

4. FELLOWSHIPS

National Research Council of Brazil (CNPq), 1970-1972, Graduate studies at IMPA

National Research Council of Brazil (CNPq), September 1972- March 1974, pos-doctor at Berkeley

National Research Council of Brazil (CNPq), March 1974 - July 1974, Pos-doctor at Warwick

5. HONOR

- – Elected member of the Brazilian Academy of Science March, 1991
- – Comendador da Ordem do Merito Cientifico (1996).
- – Invited Lecturer at the International Congress of Mathematicians, Berlin, 1998
- .. Gran Cruz da Ordem Nacional do Merito Cientifico, Ministerior de Ciencia e Tecnologia / Presidencia da Republica- 2002
- .. Third World Academy of Science Award in Mathematics, 2003
- Electe member of TWAS (the Academy of Science of Developing World) 2004

6. LIST OF PUBLICATIONS

- (1) *Structural Stability of Diffeomorphisms on Two-Manifolds*, Inv. Mathematics, vol. **21**, 1973, pp. 233–246.
- (2) *Stability and optimization of several functions*, Topology, vol. **15**, 1976 pp. 1–12.
- (3) *On the connected components of Morse-Smale vector fields on two-manifolds*, Proceedings Symp. Geometry and Topology, Springer Lectures Notes 597, 1977, pp. 230–251.
(joint with C. Gutierrez)
- (4) *On Lienard's equation*, Proceedings Symp. Geometry and Topology, Springer Lectures Notes 597, 1977, pp. 335–357.
(joint with A. Lins and C. Pugh)
- (5) *Accessibility of an optimum*, Proceedings Symp. Geometry and Topology Springer Lectures Notes 597, 1977, pp. 429–440.
- (6) *On the structure of the Pareto set*, Bol. Soc. Bras. Mat., vol. **7**, 1976, pp. 121–126
- (7) *Moduli of stability of two-dimensional diffeomorphisms*, Topology, **19**, 1980, pp. 9–21.
- (8) *Moduli of stability for diffeomorphisms*, Proc. Symp. Dynamical Systems Northwestern Springer Lecture Notes 106, 1983, pp 95–103.
(With J. Palis)

- (9) *Characterizing Diffeomorphisms with modulus of stability one*, Springer Lecture Notes 818 (Proc. Symp. Dynamical Systems and Turbulence, Warwick, 1980), 1981, pp. 266-285.
(with J. Palis and S. Van Strien)
- (10) *Equivariant diffeomorphisms with simple recurrence on two-manifolds*, Trans. Amer. Math. Soc. , **289**, 1985, pp. 793–807.
(with G. L. Reis and P. Mendes)
- (11) *A type of moduli for saddle connections of planar diffeomorphisms*, J. Diff. Eq., **75**, 1988, pp 88–102.
(with F. Dumortier)
- (12) *Diffeomorphisms on surfaces with finite number of moduli*, Ergod. Th. & Dynam. Syst., **7**, 1987, pp. 415–462.
(with S. Van Strien)
- (13) *A finiteness problem for one dimensional maps*, Proc. AMS, **101**, 1987, pp. 721–727.
- (14) *One dimensional dynamics: the Schwarzian derivative and beyond*, Bull. Am. Math. Soc., **18**, 1988, pp. 159–162.
(with S. Van Strien)
- (15) *A Structure Theorem in one Dimensional Dynamics* Annals of Mathematics, **129**, 1989, pp 519–546.
(with S. Van Strien)
- (16) *On Cherry flows*, Erg. Th. Dyn. Sys., **10**, 1990, pp. 531–554.
(with M. Martens, P. Mendes and S. Van Strien)
- (17) *Julia-Fatou-Sullivan Theory for real one-dimensional dynamics*, Acta Mathematica, **168**, 1992, pp. 273–318.
(with M. Martens and S. Van Strien)
- (18) *On the C^1 Brunovski hypothesis* J. Diff. Equations, **113**, 1994, pp. 300–337.
(with C. C. Pugh)
- (19) *Full families of circle endomorphisms*, Proc. Conf. Dyn, Syst, and Chaos, Tokyo 1994, ed. N. Aoki, K. Shiraiwa, Y. Takahashi- World Scientific, 1995, pp. 25 – 27.
- (20) *The cost of computing integers*, Proc. Am. Math. Soc. , **124**, 1996, pp. 1377–1378.
(with B. F. Svaiter)
- (21) *On the cyclicity of recurrent flows on surfaces*, Nonlinearity **10**, 1997. pp 1-9.
- (22) *Universal Models for Lorenz maps*
(with M. Martens)
Ergodic Theory Dynam. Systems **21** (2001), no. 3, 833–860
- (23) *The Multipliers of Periodic Points in One-Dimensional Dynamics* Nonlinearity, **12**, 1999, no. 2, 217—227
(with M. Martens)

- (24) *Rigidity of Critical Circle Mappings I*
J.Eur.Math.Soc. **1**, 1999, no. 4, 339–392.
(with E. de Faria).
- (25) *Rigidity of Critical Circle Mappings II*
J. Am. Amth.Soc. **13** no.2, 2000, 343–370
(with E. de Faria)
- (26) *Rigidity and Renormalization in One Dimensional Dynamical Systems*
Proc. Internationa Congress of Mathematicians, Berlim, 1998.
Documenta Mathematica, Extra Volume ICM98, vol II 765—778
- (27) *Rigidity of C^2 Infinitely Renormalizable Unimodal Maps*
Commun. Math. Phys. **208**, 1999, 91–105
(With A. A. Pinto)
- (28) *On the Dynamics of the Renormalization Operator*
(with A.Avila and M. Martens)
in Global Analysis of Dynamical Systems, Ed. by H. Broer, B. Krauskopf and G. Vegter, Institute of Physics Publishing, Bristol and Philadelphia, 2001, pp. 449–460.
Preprint: [html://www.impa.br/demelo](http://wwwimpa.br/demelo)
- (29) *Regular or Stochastic Dynamics in Real Analytic Families of Unimodal Maps*
(with A. Avila and M. Lyubich)
Inventiones Mathematicae, n.3, **154**, 2003, 451–550
preprint: [html://www.impa.br/demelo](http://www.impa.br/demelo)
- (30) *Global Hyperbolicity of Renormalization for C^r unimodal mappings*
(with E. de Faria and A.A. Pinto)
Ann. of Math. (2) **164** (2006), no. 3, 731–824.
- (31) *Bifurcation of Unimodal Maps*
Qualitative Theory of Dynamical Systems, **5**, 2004, 285–296.
- (32) *Rigidity in dynamics.*
Bull. Belg. Math. Soc. Simon Stevin **15** (2008), no. 5, Dynamics in perturbations, 789–796
- (33) *Chaotic period doubling.*
(with Chandramouli, V. V. M. S.; Martens, M.; Tresser, C. P.)
Ergodic Theory Dynam. Systems **29** (2009), no. 2, 381–418
- (34) *Renormalization in one-dimensional dynamics*
Renormalization in one-dimensional dynamics. J. Difference Equ. Appl. **17** (2011), no. 8, 1185–1197
- (35) *A full family of multimodal maps of the circle*
(with P. Salomão and E. Vargas)
Ergodic Theory Dynam. Systems **31** (2011), no. 5, 1325–1344.

7. BOOKS PUBLISHED

- (1) 1 - *Introdução aos Sistemas Dinâmicos*
Edgar Blucher 1978
190 pp.
With J. Palis
- (2) 2 - *Geometric Theory of Dynamical Systems, An Introduction*
Springer-Verlag, 1980
With J.Palis
Russian translation: Mir, 1986
Chinese translation: 1988
- (3) 3 - *Lectures on one-dimensional dynamics.*
Publ. do 17º Colóquio Brasileiro de Matemática, 1988
- (4) 4 - *One dimensional dynamics .*
Springer-Verlag, 1993
With S. Van Strien
- (5) 5 - *One dimensional dynamics. The mathematical tools*
Publicações Matemáticas do IMPA. 23rd Colóquio Brasileiro de Matemática. Instituto de Matemática Pura e Aplicada. Rio de Janeiro, 2001.
Extended version in: Cambridge Studies in Advanced Mathematics, 115
Cambridge University Press, 2008
With E. de Farias
- (6) *Mathematical aspects of quantum field theory.*
Publicações Matemáticas do IMPA. [IMPA Mathematical Publications] 26º Colóquio Brasileiro de Matemática. [26th Brazilian Mathematics Colloquium] Instituto Nacional de Matemática Pura e Aplicada (IMPA), Rio de Janeiro, 2007. ii+222 pp
Extended version :Cambridge University Press: Cambridge Studies in Advanced Mathematics, 127., xiii+298 pp
with E. de Faria

8. DESCRIPTION OF SCIENTIFIC CONTRIBUTIONS

In [1] it is proved that a surface diffeomorphism that satisfy the Axiom A and the strong transversality condition is C^1 structurally stable.

In [2], [5] and [6] one deals with some optimization problems that arises in Mathematical Economics.

In [1] and [4] we discuss the orbit structure of vector fields in two dimension that have simple recurrent behavior.

The articles [7], [8], [9], [10] [11] and [12] are dedicated to the description of some conjugacy invariants of diffeomorphisms that exhibit some non-transversal intersection between invariant manifolds.

[13] is my first contribution to my main field of research: one-dimensional dynamics. In [13] we discuss the problem of existence of wandering intervals and finiteness of attractors and relate these problems with the density of structurally stable interval endomorphisms.

In [14] and [15] we prove the non-existence of wandering intervals for smooth unimodal maps of the interval. This is in the same line as the classical result of Denjoy for circle diffeomorphisms. In this paper we use control of the distortion of the cross-ratio to bound the non-linearity for high iterates of the map. This became a fundamental tool in one-dimensional dynamics.

In [16] and [21], we study the orbit structure and perturbations of the so called Cherry flows: vector fields on the torus that exhibit an interesting recurrent behavior.

In [19] we prove the existence of parametrized families of multimodal maps whose members exhibit essentially all possible dynamical behavior of circle endomorphisms.

[17] is my most important mathematical contribution: a complete description is given of the topological behavior of 1-dimensional real dynamical systems. It turns out that the Julia-Fatou-Sullivan theory for conformal mappings of the Riemann sphere is also valid for smooth endomorphism of the interval (or the circle).

Julia gave the following description of the topological structure of 1-dimensional complex dynamics: every rational map of the Riemann sphere has periodic domains attracting an open set of points, outside this open set there is an closed invariant set, called the Julia set, and maybe some open sets wandering around and being attracted to this Julia set.

The main problems left over were

- 1)/ Can a map have infinitely many periodic domains and
- 2)/ Do these wandering domains exist?

Fatou showed that there can be only finitely many periodic domains and Sullivan showed that these wandering domains do not exist.

The first result about the topological structure of 1-dimensional real dynamics was obtained by Denjoy and Poincare. Poincare gave a description of the topological structure of the dynamics of circle

diffeomorphisms. As in the theory of complex dynamics the existence of wandering domains played an important role. Denjoy showed that they can not exist for C^{1+bv} diffeomorphisms of the circle. The topological work of Poincare could not be generalized to endomorphisms of the interval (or circle). The topological description of the dynamics of interval dynamics was done by Milnor and Thurston. The description was exactly like the one given by Julia and again the only thing left over was to answer the questions above.

A sequence of authors achieved partial results on the non-existence of wandering intervals (Denjoy, Guckenheimer, van Strien&de Melo, Lyubich&Blokh). The general non-existence of wandering intervals was proved in [17]. Furthermore [17] also gives the finiteness of periodic attractors. As a corollary of the theory developed in [17] we got the classical Denjoy-Schwarz theorem under much milder smoothness conditions.

In [18] we prove that for generic C^1 families of C^2 circle diffeomorphisms the rotation number is a piecewise monotone function.

In [20] we prove a theorem on number theory answering a question raised by Smale: most integer numbers are difficult to compute.

In [22] we exhibit parametrized families of Lorenz maps that have all possible dynamical behavior and use renormalization tools to describe the structure of the parameter space of such families.

In [23] we show that the smooth conjugacy class of an S-unimodal map which does not have a periodic attractor neither a Cantor attractor is determined by the multipliers of the periodic orbits. This generalizes a result of M. Shub and D. Sullivan for smooth expanding maps of the circle.

The articles [24] and [25] solve an important rigidity problem for circle mappings similar to the rigidity conjectures of Coullet&Tresser-Feigenbaum for interval mappings, solved by Sullivan and McMullen. It is also similar to the famous Herman's theorem for circle diffeomorphisms. We prove that two critical circle mappings that have the same rotation number of constant type are $C^{1+\alpha}$ conjugate.

In [27] we prove that given C^2 infinitely renormalizable quadratic unimodal maps f and g with the same bounded combinatorial

type, they are $C^1 + \alpha$ conjugate along the closure of the corresponding forward orbits of the critical points for some $\alpha > 0$.

In [30] we extend M. Lyubich's recent results on the global hyperbolicity of renormalization of quadratic germs to the space of C^r unimodal maps with quadratic critical points. We prove that the set of infinitely renormalizable maps with the same bounded combinatorial type is a codimension one C^1 Banach submanifold of the space of all maps.

In [28] we give a complete description of the dynamics of the renormalization operator in the space of C^r unimodal maps with bounded combinatorial type. We prove the exponential contraction of the renormalization in the C^r topology.

In [29] we prove that in any non-trivial real analytic family of unimodal maps with quadratic critical point, for Lebesgue almost any value of the parameter, the corresponding map is either regular (has an attracting periodic point) or is stochastic (has an absolutely continuous invariant measure).

The book [4] contains a rather complete exposition of the main results in one dimensional dynamics. The several aspects of the theory, the combinatorial topological and geometrical point of view, are discussed and complete proofs of the main theorems are given. The book contains also many original results.

9. VISITING POSITIONS

- –University of California, Berkeley,
September 1972 – March 1974
- – University of Warwick, England
March 1974 – July 1974
- – Université de Lille, France
March 1977 – April 1977
- –Institut des Hautes Études Scientifiques, France
April 1977 – July 1977
- – Universidad de Santiago, Chile June 1982
- –Universit'e de Paris XI, Orsay, France,
October 1982 – November 1982
- –International Center for Theoretical Physics, Trieste, Italy,
July 1983
- –University of California, Berkeley, USA,
June 1984

- – City University of New York, CUNY, USA,
May 1984
- – University of Delft, Holland August 1985
- – Institut des Hautes Études Scientifiques, France,
September 1985 – November 1985
- – City University of New York, CUNY, USA,
March 1987
- – University of California, Berkeley, USA,
April 1987
- – Institut des Hautes Études Scientifiques, France,
July 1988
- – University of Warwick, England
July 1988 – September 1988
- – International Center for Theoretical Physics, Trieste, Italy,
September 1988
- – Université Claude Bernard- Lyon I, France
May 1989
- – Institut des Hautes Études Scientifiques, France,
June 1989
- – University of Delft, Holland August 1990
- – Institut des Hautes Études Scientifiques, France,
March – April 1991
- – Limburg Universitair Centrum, Diepenbeek, Belgium
ERASMUS: European Interuniversity cooperation Programme
Mathematics and Fundamental Applications
May, 1992
Series of Lectures: One-dimensional dynamical systems.
- – City University of New York, CUNY, USA,
October 1993
- – Institut des Hautes Études Scientifiques, France,
June 1994
- – Institut des Hautes Études Scientifiques, France,
June 1995
- – Faculdade de Ciências, Universidade do Porto, Portugal,
April 1997
- – Institute for Scientific Interchange Foundation, Turin, Italy,
May 1997
- – Department of Mathematics, SUNY at Stonybrook, USA,
April 1999
- – Department of Mathematics, KTH, Stockholm, Sweden.
May-June 1999
- – Departamento de Matemática Aplicada, Universidade do
Porto, Portugal
May 2000

- – Laboratoire de Mathématique, Université Paris-Sud, Orsay, France
May 2001.
- – Department of Mathematics (Physics) of the State University of Newyork (SUNY) at Stony Brook, USA.
August, 2003
- – Lorentz Center- Leiden- Holland
September, 2004
- –
- – Hasselt University- Belgium
April 2007

10. SHORT VISITS AS INVITED SPEAKER

- – Delft University of Technology, Holland
- – Utrecht University, Holland
- – University of Groningen, Holland
- – Limburg Universitair Centrum, Belgium
- – Université de Bourgogne, Dijon, France
- – Universidad de Concepcion, Chile
- – Universidad de Chile, Santiago, Chile
- – Université de Paris VII, Paris, France
- – Boston University, USA
- – Universidad Nacional Autonoma de Mexico, Mexico
- – Universida de Santiago de Compostela, Spain
- – Royal Institute of Technology, Stockholm, Sweden
- – State University of New York at Stony Brook, USA
- – Hungary Academy of Science, Budapest, Hungary
- – Université de Niece Sophia-Antipolis, France
- – Universidad de Buenos Aires, Argentina
- – City University of Hong Kong
- – Peking University, Beijing, China
- – Instituto Superio Técnico, Lisboa, Portugal, May 1997
- – Graduate Center, CUNY, New York, November 1997
- – Yale University, USA April 1999.
- – SUNY at Stonybrook, USA October 2000
- – Université de Montreal, Canada, October 2000
- – Universidad Autonoma de Barcelona, Espanha, May 2000
- – Université de Paris Sud, Orsay, France, June 2000
- – New York University, Courant Institut, October 2000
- – SUNY at Stonybrook, USA, June 2001
- – Lorenz Center, eiden, The Netherlands, June 2001
- – Nizhny Novgorod University, Russia, July 2001
- – University of Valladolid, Spain, September 2002

- – City University of New York, Graduate Center, US,
September 2002
- – Universtiy of Porto, Potugal, June 2003
- – University of Warwick- England- April 2007
- – CUNY- New York- USA September 2007 (Workshop in
Symplectic Field Theory)

11. PARTICIPATION IN SCIENTIFIC MEETINGS AS INVITED
SPEAKER

- Dynamical Systems
Salvador, Bahia July 1971
"Structural Stability on Two-Manifolds"
- Dynamical Systems
Warwick, England, July 1974
"Optimisation of several functions "
- Warwick Rencontre Mathematics and Economics, England,
June 1974
- Global Theory of Dynamical Systems
Northwester University, USA, June 1979
"Moduli of stability for diffeomorphisms "
- Dynamical Systems and Turbulence
Warwick, England
July 1980
"Characterizing diffeomorphisms with modulus of stability one"
- Dynamical Systems - M.S.R.I, Berkeley, USA
1984
" A finiteness problem for one-dimensional maps"
- VII ELAM
Caracas, Venezuela, 1984
" A finiteness problem for one-dimensional maps"
- London Math. Society Durhan
Symposium on Dynamical Systems
Durhan, England 1988
" Finiteness of Attractors in One-Dimensional Maps"
- ICTP, Trieste, Italy
1988
" A finiteness theorem in one-dimensional dynamics"
- University of Ultrecht, Holland
Chaos
1990
" On Sullivan's renormalization theory "

- International Conference on dynamical systems
Ecole Normale Superieure de Lyon, France
June 1990
- ” Distortion of the cross-ratio in one-dimensional dynamics”
- III Escola Internationad de Sistemas Dinamicos
Santiago, Chile
November 1990
- International Conference on bifurcation in differentiable dynamics
Limburg Universitair Centrum, Belgium, June, 1992
- ” On the bifurcation of Cherry flows”
- Workshop on Dynamical Systems
Porto, Portugal
August 1992
- ” Full families of multimodal maps ”
- Low-Dimensional Dynamics
Mathematisches Forschungsinstitut Oberwolfach, Germany April
1993
- ” Renormalization of unimodal maps”
- International Conference on Dynamical Systems
IMPA, Rio de Janeiro September, 1994
- ” On the structure of geometric Lorenz attractors”
- International Conference on Dynamical Systems and Chaos
Tokyo Metropolitan University, Japan May 1994
- ” Full families of circle endomorphisms ”
-
- Istitut de Matematica y Estadistica da Universida de la Republica,
Montevideo, Uruguay Mars , 1995
- ” Rigidity of critical circle mappings ”
- Workshop on Low Dimensional Holomorphic Dynamics
Mathematical Science Research Institute (MSRI), Berkeley, USA
May 1995
- ” Rigidity of critical circle mappings”
- ICTP, Trieste, Italy
June , 1995
- ” Rigidity of critical circle mappings”
- Dynamical Systems
Stefan Banach Internationa Mathematical Center, Warsaw, Poland
July 1995
- ” Rigidity theorems in one-dimensional dynamics”
- Epsom one day conference on dynamics
City University of Hong Kong June , 14, 1996
- ” Rigidity Theorems in Dynamics”
- Beijing Dynamical Systems Conference
Beijing, June 1996
- ” Topological Universality for Lorenz Flows ”

- Contemporary Problems in Dynamical Systems
Nizhny Novgorod, Russia July 1996
- ” Topological Universality for Lorenz Maps ”
- International Conference on Dynamical Systems
Cuernavaca, Mexico June 1997
- ” Rigidity of Critical Circle Mappings”
- KTH-IMPA Conference on Dynamical Systems
Stockholm, Sweden May 1998
- ” Renormalization and Rigidity of smooth interval maps”
- International Congress of Mathematicians,
Berlin, August 1998
- ”Rigidity and Renormalization in One Dimensional Dynamical
Systems”
- Workshop on Dynamical Systems,
Trieste, Italy, September 1998.
- ”Renormalization of critical circle mappings”
- International Conference on Dynamical Systems
Porto, Portugal, May 2000
- ”Hyperbolicity of Renormalization”
- Conference ”Adrien Douady”
Montreal, Canada, October 2000
- ”Deterministic or stochastic dynamics in real analytic one
parameter families of unimodal maps”
- Workshop on Global Analysis of Dynamical Systems,
Lorenz Center, Leiden, The Netherlands, June 2001.
- ”Deterministic or stochastic dynamics in families of unimodal
maps”
- International Conference Progress in Nonlinear Science,
Nizhny Novgorod, Russia, July 2001.
- ”Regular or stochastic dynamics in real analytic families”
- International Conference on Dynamical Methods for Differential
Equations.
Valladolid, Spain, September 4-7, 2002
- ” Renormalization in Dynamics, Statistic Mechanics and Quantum
Field Theory”
- Recent Trends in Dynamics 2003
Department of Pure Mathematics, University of Porto, Portugal,
- ICTP- Trieste- Italy, November 2004
- ”‘ One-dimensional dynamics”
- Dynamics in Perturbations-
University of Hasselt- Belgium- April 2007
- ”‘ Rigidity in Dynamics”’
- Workshop in Dynamical Systems
ICTP- Trieste- Italy- July 2008

- Advances in Low dimensional dynamics
SUNY at Stony Brook- June 2009
”‘ Full family of circle maps ”‘
- Tata Institute of Fundamental Research- Bangalore- India 2009
”‘ On the dynamics of circle maps ”‘

12. PH.D. STUDENTS

- – Maria José Pacífico(1980)
Thesis: *Stability of vector fields on three dimensional manifolds with boundary.*
Appeared as
Structural stability of vector fields on 3-manifolds with boundary,
J. Differential Equations, **54**, 1984
- – Antonio Gaspar Ruas (1982)
Thesis: *Hyperbolic attractors of condimension one and isotopy classes on surfaces*
- – Edson Vargas (1989)
Thesis: *Frequency of bifurcations in unimodal families.*
Appeared as
1) *Bifurcation frequency for unimodal maps,*
Comm. Math. Phys., **141**, 1991, pp. 633–650.
2) *Markov partition in nonhyperbolic interval dynamics*
Comm. Math. Phys., **138**, 1991, pp. 521–535.
- – Daniel Smania (2001)
Thesis: *Complex bounds and renormalization for multimodal maps*
Appeared as
1) *Complex bounds for multimodal maps: bounded combinatorics*
Nonlinearity **14** (2001) n. 5, 1311–1330.
2) *Phase space universality for multimodal maps*
Bull. Braz. Math. Soc. (N.S.) 36 (2005), no. 2, 225–274.
- – Artur Avila (2001)
Thesis: *Bifurcations of Unimodal Maps: the topological and metrical point of view*
- – Alejandro Kocsard (2007)
Thesis: *Toward the Classification of Cohomology-Free Vector Fields*
Appeared as
Cohomologically rigid vector fields: the Katok conjecture in dimension 3.

Annales de l'Institut Henri Poincar. Analyse non Linéaire, v. 26, p. 1165-1182, 2009.

–Pablo Guarino Quiones (2012)

Thesis: Rigidity Conjecture For C^2 Critical Circle Maps

Membership in Scientific Societies

- – Brazilian Mathematical Society

13. COMMITTEE PARTICIPATION

- -Graduate Program Committee, IMPA, 1976–1990
- - Committee of Scientific Activities- IMPA
- - CTC (Steering committee) - IMPA 1996 –present

14. OTHER ACTIVITIES

- – Member of PhD theses committee:
Sebastian Van Strien
University of Utrecht, Holland, 1982
Marco Martens
Delft University of Technology , Holland, 1999
Member of several theses committee at IMPA
- – Member of the editorial board of the journal
Ergodic Theory and Dynamical Systems
- – Scientific coordinator of mathematics at FAPERJ (Foundation
for Research Support of the State of Rio de Janeiro) 1995 – 1999
- – Chairman of the Scientific committee of Mathematics CNPQ
2007–2010