

# CURRICULUM VITAE

**Paula Amaral**

*Departamento de Matemática - FCT NOVA - UNL*

# Contents

Personal and Institutional Data . . . . .	2
Professional activity . . . . .	2
Education . . . . .	2
Teaching . . . . .	3
Boards and Committees . . . . .	4
Main Research Interests . . . . .	4
Publications . . . . .	5
Students supervision . . . . .	7
Lectures . . . . .	8
Committees in Scientific Meetings . . . . .	9
Conferences . . . . .	11
Refereeing . . . . .	14
Editorial Activity . . . . .	14
Collaborations with Industry . . . . .	14

## Personal and Institutional Data

**Name** Paula Alexandra da Costa Amaral

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**Google scholar link** Paula Amaral

**ResearcherID** G-3985-2016

## Professional activity

- Assistant Professor with permanent position, Department of Mathematics, University Nova de Lisboa, since July 2007.
- Invited Assistant Professor, Escola Naval, Alfeite, September 2010, September 2014.
- Assistant Professor, Department of Mathematics, University Nova de Lisboa, May 2002. – July 2007.
- Invited Assistant Professor, ISEGI, University Nova de Lisboa, September 2003 – August 2005.
- Teaching Assistant, Department of Mathematics, University Nova de Lisboa, October 1991 – May 2002.

## Education

- Ph.D. in Mathematics - Operations Research, University Nova de Lisboa, Portugal, 2002.
- M.S. in Statistics and Operations Research, University of Lisbon, 1993.
- B.S. in Statistics and Operations Research, University of Lisbon, 1990.
- Third year in Applied Mathematics, University of Lisbon, 1986.

## Teaching

### Ph.D. Program

- Topics in Non Linear Programming (PhD), 2016/2017, 2017/2018.
- Seminar (PhD), 2017/2018.

### Ms.C. Program

- Non Linear Optimization (MSc, Mathematics and Applications AEIO), 2009/2010, 2011/2012, 2012/2013, 2013/2014, 2014/2015, 2015/2016, 2016/2017, 2017/2018.
- Linear Optimization (MSc - Electronic Engineering) 2006/2007.
- Non Linear Optimization (MSc Mathematics/Operations Research), 2005/2006.
- Linear Optimization 2006/2007.
- Decision Theory and Project Management (MSc), 2005/2006.

### Graduate Program - Engineering

- Calculus I (prior to Bolonha) 1995/1996, 1996/1997.
- Calculus I, 2016/2017, 2017/2018.
- Calculus (B,C, D and E), 2001/2002, 2009/2010, 2011/2012, 2012/2013, 2013/2014.
- Calculus (Annual) 2010/2011.
- Introduction to Operations Research, 2006/2007.
- Operation Research B (Engineering), 1995/1996, 1996/1997, 2001/2002, 2003/2004, 2004/2005, 2005/2006, 2006/2007, 2007/2008.
- Probability and Statistics C, 2007/2008.

### Graduate Program - Mathematics

- Complements of Mathematical Programming, 2003/2004, 2004/2005, 2005/2006, 2006/2007.
- Introduction to Mathematics and its Applications, 2002/2003, 2003/2004, 2004/2005, 2005/2006.
- Mathematical Programming, 1991/1992, 1992/1993, 1995/1996, 1996/1997, 2004/2005.
- Operation Research A (Mathematics), 1994/1995.
- Project in Operations Research, 2006/2007.

- Seminar, 2004/2005, 2005/2006.
- Systems Modelling, 2002/2003.

### **Graduate Program - General**

- Linear Algebra, (Escola Naval) 2010/2011, 2011/2012, 2012/2013, 2013/2014.
- Mathematics 0, (FCT UNL) 2009/2010, 2010/2011, 2011/2012, 2012/2013.
- Pre-Calculus (Course for International Students - UNL), 2017/2018.

## **Boards and Committees**

- Member of PT-MATHS-IN Board (since 2015).
- Member of The Faculty Council (2014-2017).
- Member of the Department Council (2014-now).
- Member of the Board of A3FCT (2009- now).
- Member of the SPM Board (South and Islands) (2008-2014).
- Member of the Assembly of Representatives FCT UNL.
- Member of the Board of APDIO (1999-2002).
- Member of the Scientific Committee of the MS Program in Applied Mathematics
- Coordinator of the Operational Research Group at CMA FCT NOVA (2005-2008)
- Coordination of the Operations Research Seminars (2006).

## **Main Research Interests**

- Optimization in Machine Learning, SVM, Classification.
- Big Data.
- Pos-infeasibility analysis - Correction of inconsistent linear systems, analysis of feasible cluster.
- Copositive Optimization. Conic Optimization in the cones of Copositive and Completely Positive Matrices.
- Global optimization of nonconvex fractional problems - RLT techniques for nonlinear programming, Branch and Bound methods, convexification techniques.

- Examination Timetabling problems – Formulations for Examination Timetabling problems, Heuristics methods, Tabu Search, Multicriteria approaches.
- Integration of Decision Theory methods in Meta-Heuristics for Combinatorial Optimization problems – Fuzzy inference rule based Systems, Aggregation Methods for multicriteria problems.

## Publications

### Journal with peer review

1. Paula Amaral and Tiago Cardal Pais. Compromise ratio with weighting functions in a tabu search multi-criteria approach to examination timetabling. *Computers & Operations Research*, 72:160–174, 2016 Abstract
2. Paula A. Amaral and Immanuel M. Bomze. Copositivity-based approximations for mixed-integer fractional quadratic optimization. *Pacific Journal of Optimization*, 11(2):225–238, 2015 Abstract
3. Paula Amaral, Immanuel M Bomze, and Joaquim Júdice. Copositivity and constrained fractional quadratic problems. *Mathematical Programming*, 146(1-2):325–350, 2014 Abstract
4. Tiago Cardal Pais and Paula Amaral. Managing the tabu list length using a fuzzy inference system: an application to examination timetabling. *Annals of Operations Research*, 194(1):341–363, 2012 Abstract
5. Paula Amaral, Luís M Fernandes, Joaquim Júdice, and Hanif D Sherali. On optimal zero-preserving corrections for inconsistent linear systems. *Journal of Global Optimization*, 45(4):645, 2009 Abstract
6. Paula Amaral, Joaquim Júdice, and Hanif D Sherali. A reformulation–linearization–convexification algorithm for optimal correction of an inconsistent system of linear constraints. *Computers & Operations Research*, 35(5):1494–1509, 2008 Abstract
7. Paula Amaral and Pedro Barahona. Connections between the total least squares and the correction of an infeasible system of linear inequalities. *Linear algebra and its applications*, 395:191–210, 2005 Abstract
8. Paula Amaral and Pedro Barahona. A framework for optimal correction of inconsistent linear constraints. *Constraints*, 10(1):67–86, 2005 Abstract

### Proceedings

1. JMG Salmerón, P Amaral, LG Casado, EMT Hendrix, and J Žilinskas. On regular simplex refinement in copositivity detection. In *XIII global optimization workshop GOW2016 4-8 September 2016*, pages 163–166, 2016

2. P. Amaral. On fractional quadratic problems. In *XII global optimization workshop MAGO 2014, 1-4 September 2014*, pages 113–116, 2014
3. Eligius MT Hendrix, Leocadio G Casado, and Paula Amaral. Global optimization simplex bisection revisited based on considerations by reiner horst. In *International Conference on Computational Science and Its Applications*, pages 159–173. Springer, 2012
4. Tiago Cardal Pais and Paula Amaral. Using weight aggregation in tabu search for multiobjective exams timetabling problem. *MTISD 2008. Methods, Models and Information Technologies for Decision Support Systems*, 1(1):81–84, 2008
5. Tiago Cardal Pais and Paula Amaral. Managing the tabu list length using a fuzzy inference system: an application to exams timetabling. In *The 7th International Conference for the Practice and Theory of Automated Timetabling*, pages 1–6, 2008
6. Paula Amaral and Pedro Barahona. On optimal correction of inconsistent linear constraints. In *International Conference on Principles and Practice of Constraint Programming*, pages 33–46. Springer, 2002
7. Paula Amaral and Pedro Barahona. About infeasibility in the constraints of a linear model. *Ricerca Operativa*, 92:49–67, 1999

## Thesis

1. Paula Amaral. Contribuições para o estudo de sistemas lineares inconsistentes. *PhD Dissertation, Faculty of Science and Technology, UNL, Lisbon, Portugal (in Portuguese)*, 2001
2. Paula Amaral. O algoritmo dos k-caminhos mais curtos na relaxação do espaço de estados. *MsC Dissertation, Faculty of Science, UL, Lisbon, Portugal (in Portuguese)*, 1993

## Reports

1. P. Amaral, M.W. Trosset, and P. Barahona. Correcting an inconsistent system of linear inequalities by nonlinear programming. Technical Report 00-27, Department of Computational & Applied Mathematics, Rice University, TX 77005, Houston, 2000
2. Isabel Gomes, Jorge Santos, Luís Caviqúe, Nelson C. Martins, Manuel Vieira, Paula Amaral, Raquel Barreira, and Vitor H. Fernandes. Amt (airline maintenance technicians) timetabling optimization- esgi101 - relatório final- tap-amt. Technical report, ESGI 101, FCT, UNL, 2014, 2014

## National Proceedings

1. Margarida M Gomes, Rita A Ribeiro, and Paula Amaral. Reducing the number of membership functions in linguistic variables. In *Livro de actas do 14<sup>o</sup> Congresso da Associação Portuguesa de Investigação Operacional, IO 2009, 7-9 September 2009*, pages 75–82, 2009
2. Tiago C Pais and Paula Amaral. A tabu search based approach for exams timetabling problem. In *Livro de actas do 14<sup>o</sup> Congresso da Associação Portuguesa de Investigação Operacional, IO 2009, 7-9 September 2009*, pages 155–162, 2009

## Others

1. P. Amaral. O admirável mundo novo do big data. *Gazeta de Matemática*, 182, 2017
2. P. Amaral. Matemática industrial em rede. *Gazeta de Matemática*, 181, 2017

## Students supervision

### PhD

1. Rui Jorge Fernandes Malha, (under supervision) Size reduction in Support Vector Machine.

### Master

1. Tiago José Valente Nunes (under supervision with Isabel Correia) Problema de Afetação de Recursos com diferentes competências.
2. Carla Patrícia Bento Simões, (co-supervisor Isabel Gomes) Molelação e otimização de escalas de pessoal: um caso de estudo, Dissertação apresentada na Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa para obtenção do grau de Mestre em Matemática e Aplicações – Actuariado, Estatística e Investigação Operacional, (13 valores), 2016.
3. Tiago Cardal Pais, Uma abordagem baseada na Pesquisa Tabu para o problema da geração de horários de exames, Dissertação apresentada na Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa para obtenção do grau de Mestre em Matemática e Aplicações – Actuariado, Estatística e Investigação Operacional, (20 valores), 2008. (**APDIO Best MSc Thesis AWARD 2009**).
4. Margarida Santos Mattos Marques Gomes, (co-supervisor Rita Ribeiro) Reducing the number of membership functions in linguistic variables, Dissertação apresentada na Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa para obtenção do grau de Mestre em Matemática e

Aplicações – Actuariado, Estatística e Investigação Operacional, (19 valores), 2009.

5. Bruno Luís Castilho Riscado, Geração de Calendários de Exames: Uma Abordagem para a FCT-UNL, Mestrado em Matemática – Investigação Operacional, 2007.

## Curricular professional internships

Supervision of several curricular professional internships with the duration of nine months in several financial, industrial and consulting companies such as Telepac, Águas de Portugal, CGD,

## Lectures

### Industry

- Big Data, Morning talks with Manuel Cruz and Paula Amaral, IFB (Instituto Formação Bancária), Lisbon, 5 June, 2018.

### Graduate Schools

- Conic Optimization course (3h) Ph.D. Spring . School on Mixed Integer Nonlinear Programming and Applications, Organizers: Claudia D’Ambrosio (CNRS & Ecole Polytechnique), Sourour Elloumi (ENSIEE), Amelie Lambert (CNAM), Leo Liberti (CNRS & Ecole Polytechnique), CNAM Paris, April 2016.  
[link](#)
- Coordinator of a working group in the III Iberian Modeling Week, FC UP Porto, April 2016.  
[link](#)
- (Plenary Session) A Investigação Operacional, Paula Amaral, Escola de Verão da SPM, Departamento de Matemática, Universidade do Algarve, Faro. 2001.

### Seminars

- International
  - On Copositive optimization and applications, University of Almeria, Spain, 2016.
  - Infeasibility, Fractional Quadratic Problems and Copositivity, University of Wien, Austria, 2015.
  - Infeasibility, Fractional Quadratic Problems and Copositivity, University of Wien, Austria, 2015.

- The role of eigenvalues perturbation in inconsistent linear systems, College of William and Mary, Williamsburg, USA, 1999.
- National
  - A short survey on Copositive and Completely Positive optimization, CMUC, University of Coimbra, 2016.
  - A Investigação Operacional: algumas aplicações reais. Seminar of the Master in Mathematics program, Department of Mathematics, University of Algarve. 2000.

## Conferences

- Reformulating inconsistent linear systems, Iberian Conference in Optimization, Coimbra Portugal 2006.

## Committees in Scientific Meetings

### Organizing Committee

- Member of the organizing committee of Jornada da Matemática, FCT, UNL, March 7, 2018.
- Co-chair of the organizing committee of Big Data - Mathematics in Industry 4.0, PT-MATHS-IN conference, ISEP, Porto, June, 2, 2017.
- Co-Chair of the organizing committee of ENSPM, July, 2014.
- Co-Chair of the organizing committee of ESGI101, May, 2014.
- Co-Chair of the local organizing committee of ICCOPT2013, July, 2013.
- Co-Chair of the organizing committee of Optimization11, July, 2011.
- Organizer of Global Optimization Workshop, lectured by Prof. Eligius Hendrix (University of Malaga), FCT/UNL, September, 2009.
- Member of the organizing committee of IO2009, September, 9-11, 2009.
- Organizer of the Summer School – “Verão com Matemática2”, September 5-10, 2005, FCT, Universidade Nova de Lisboa.
- Organizer of the Summer School – “Verão com Matemática”, September 1-15, 2004, FCT, Universidade Nova de Lisboa.
- Member of the organizing committee of the Summer School of SPM, September, 1-15, 1999.

## Program Committee

- ICoMS2018, The International Conference on Mathematics and Statistics, Porto, Portugal, July 15-17, 2018.
- LeGO2018 - LeGO 2018 - 14th Int. Workshop on Global Optimization, Leiden, The Netherlands, September 18-21, 2018.
- LOD 2018 - The Fourth International Conference on Machine Learning, Optimization, and Data Science, Volterra, Tuscany, Italy, September 13-16, 2018.
- ICCSA2018 - The 18th International Conference on Computational Science and Its Applications, Melbourne, Australia, July 2 - 5, 2018.
- OPTIMIZATION2017 - Lisboa, Portugal, September 6-8, 2017.
- ICCSA2017 - The 17th International Conference on Computational Science and Its Applications, Trieste, Italy, July 3 - 6, 2017.
- CLAIO2016 - XVIII Latin-Iberian-American Conference on Operations Research, Chile, October, 2016.
- ICCSA2016 - The 16th International Conference on Computational Science and Its Applications, Beijing, China, July 4-7, 2017.
- MOD2015 - International Workshop on Machine learning, Optimization and big Data – July 21-23, Taormina – Sicily, Italy, 2015.
- ICCSA2015 - The 15th International Conference on Computational Science and Its Applications, Banff, Canada July 3 - 6, 2017.
- ICCSA2014 The 14th International Conference on Computational Science and Its Applications, Banff, Canada, June 30 – July 3, 2014.
- ICCSA 2013, The 13th International Conference on Computational Science and Its Applications, Ho Chi Minh City, Vietnam, June 24-27, 2013.
- OPTIMIZATION2014 - Guimarães, Portugal, July 28-30, 2014.
- ICCSA2012, The 12th International Conference, Salvador de Bahia, Brazil, June 18-21, 2012.
- OPTIMIZATION2011, Caparica, Portugal, July 24-27, 2011.
- OPTIMIZATION2007, Porto, Portugal, July 22-25, 2007.
- OPTIMIZATION2004, Lisboa, Portugal, July 25-28, 2004.

## Stream and session organizer

- Europ 2018, stream Reduction and efficient bounding in conic optimization.
- Optimization 2017, session Copositive and MINLP.
- Europt 2017, stream "Copositive Optimization and Applications".
- IFORS 2017, session Reduction and efficient bounding in conic optimization in stream Copositive and Conic Optimization.

## Conferences

### Invited Presentations at Conferences

- Amaral,P. , K-Best Feasible Clusters - Ranking optimal solutions from an infeasible LP, Special Session SEIO-APDIO, SEIO 2018, Oviedo, Spain, May 29-June 1, 2018.
- Amaral,P., Bomze, I., Efficient Bounds for Min-Max fractional problems, EUROPT 2018, Almeria, July 11-13, 2018.
- Amaral,P., Bomze, I., Min-Max fractional quadratic over linear problems, EUROPT 2017, Montreal, Canada 2017.
- Dias, S., Brito, P., Amaral P. and Freitas, A., New insights in political and biological problems by symbolic discriminant analysis. Workshop on Symbolic Data Analysis, Ljubljana, Slovenia, June 12nd to 14th, 2017.
- Amaral,P., Bomze, I., Completely positive lower bounds for Min-Max fractional quadratic problems, IFORS2017, Quebec, Canada, 2017.
- Amaral,P., Bomze, I., Completely Positive formulations for Minimax fractional quadratic problems, Optimization 2017, Lisboa, Portugal, 2017.
- Dias, S., Brito, P. and Amaral P., A linear discriminant method for distributional data. International Workshop on High Dimensional Data Mining, Naples, Italy, June 7th , 2016.
- Dias, S., Brito, P. and Amaral P., Discriminant analysis and classification of distributional and interval data. JOCLAD 2016, Évora, Portugal, March 31st to April 2nd, 2016.
- Dias, S., Amaral P. and Brito, P. Linear Discriminant Analysis for Interval and Histogram Data. Workshop on Symbolic Data Analysis, Orleans, France, November 17th to 19th, 2015.
- Amaral,P., Bomze, I., Copositivity and constrained fractional quadratic problems, EURO2013, Rome, Italy 2013.

- Amaral,P., Bomze, I., Copositivity and constrained fractional quadratic problems, SIAM Op11 – Darmstadt, May 2011.
- Amaral,P., Lower bounds for quadratic fractional functions, CVA2008, FCT UNL, Caparica, Portugal, 2008.
- Amaral,P., Special Session Celebrating the 60th Anniversary of Joaquim João Júdice, The Analysis and Repair of Inconsistent Linear Systems using Global Optimization, Melia, Caparica, 2011.
- Amaral,P., Júdice, J., From infeasibility in LP to global optimization, EURO2009, Bonn, Germany, 2009.
- Amaral,P., Júdice, J., On the solution of the fractional quadratic problems by copositive programming EUROPT09, Remagen, Germany 2009.
- Amaral,P., Pais, T.,Using weight aggregation in tabu search for multi-objective exams timetabling problem, MTISD 2008, Methods, Models and Information Technologies for Decision Support Systems, 2008.
- Amaral, P., Judice, J. , Serali, H. ,A Reformulation-linearization Technique for the Correction of Systems, INFORMS 2005 Annual Meeting, Nov. 13-16, San Francisco USA, 2005.

### **Contributed Presentations at Conferences**

- On regular simplex refinement in copositivity detection, GOW2016, Braga, Portugal, 2016.
- Clustering in infeasible LP problems, MOD15, Taormina, Sicily, 2015.
- On Fractional Quadratic Problems, MAGO14, Málaga, Spain, 2014.
- Optimization of constrained fractional quadratic problems, Optimization 2014, Minho, Portugal 2014.
- Global Optimization simplex bisection revisited based on considerations by Reiner Horst, ICSSA, Salvador, Brasil, 2012.
- Copositividade em Problemas de Programação Quadrática Fraccionária, IO2011, Coimbra, 2011.
- Managing the Tabu List Length Using a Fuzzy Inference System: An Application to Exams Timetabling, PATAT 2008, The 7th International Conference on the Practice and Theory of Automated Timetabling, Université de Montréal, August 18 - 22, 2008, Canada.
- A global approach for the optimal correction of an inconsistent linear system, NCP07, 17-21 December 2007, Rouen, France.

- A Global Optimization Procedure for Reconstruction of Inconsistent Linear Models, Optimization2007, 22-25 Julho 2007, Porto
- Solving a nonlinear nonconvex problem with fractional objective function EURO XXI 21st (European Conference on Operational Research) in Iceland July 2-5, 2006.
- Solving inconsistencies preserving the zero-structure 5th Europt Workshop - Advances in Continuous Optimization, University of Iceland - Reykjavik 2006.
- An application of Reformulation-Linearization Technique in the correction of inconsistent linear inequalities, 17th EURO Mini Conference: Continuous Optimization in Industry in Pécs, Hungary, June 29, July 1, 2005.
- A Reformulation-Linearization-Convexification Algorithm for Optimal Correction of an Inconsistent System of Linear Equations, Optimization 2004, Universidade de Lisboa ,Lisboa,2004.
- On optimal correction of inconsistent linear constraints, CP'02, 8a Conferência Internacional de Princípios e Prática de Programação por Restrições, Ithaca, NY, Estados Unidos, 2002.
- On infeasibility in linear systems; an approach based on the TLS, Optimization 2001, Universidade de Aveiro,Aveiro,2001
- After infeasibility in linear programming problems, CP-AI-OR99 workshop on integration of AI and OR techniques in Constraint Programming for Combinatorial Optimization Problems, Università degli studi di Ferrara, Ferrara, 1999.
- Model correction of infeasible linear programming problems caused by introduction of a new constraint, EURO XVI, Bruxelas, Bélgica 1998.
- Improvement of the lower bound provided by state space relaxation for set covering problems, Optimization 1995 na Universidade do Minho, Braga, 1995.
- Correção de modelos lineares inconsistentes: uma abordagem baseada no método dos mínimos quadrados totais, no IO2000 no Instituto Politécnico de Setúbal em Setúbal, em 2000.
- Correção de modelos em programação linear, no IO98 na Universidade do Algarve em Faro, em 1998.
- Relaxação do espaço de estados, no IO96 na Universidade de Aveiro em Aveiro em 1996
- Algoritmo dos k-caminhos mais curtos na relaxação do espaço de estados, no IO94 na Universidade do Minho, em Braga em 1994.

## Refereeing

Applied Mathematics and Computation, Mathematical Problems in Engineering, European Journal of Operations Research, International Journal of Production Research, Computational Optimization and Applications, Annals of Operations Research, Journal of Mathematical Extension, Optimization Letters, Discrete Optimization, Open Mathematics, Optimization, Vietnam Journal of Mathematics, Journal of Industrial and Management Optimization.

## Editorial Activity

Responsible for the edition of PT-MATHS-IN section in Gazeta de Matemática since 2017.

## Collaborations with Industry

- TAP Maintenance and engineering, Workforce Scale. ESGI 2014
- Auto-Europa – Design of an algorithm for defining queue strategy.
- Telepac- Location of servers.
- Águas de Portugal – Production model for minimizing energy cost.
- Quimigal Adubos – Design and analysis of a client survey.

## Educational activities for undergraduate students

ExpoFCT 2018-2013, Noite dos investigadores, Expo 2017, Jornada da Matemática, MathNova 2010, Jogos de Espelhos.