Curriculum Vitae of Rui Pedro Carvalho
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Research Interests: My research focuses on the integration of methods of convex optimization and statistical machine learning.

Application Areas: Electric Vehicle charging.

Funding and services to RCUK: Researcher Co-investigator on EPSRC grants totalling over £1.1M. Member of the EPSRC Peer Review College (2012–). Panel member in:

- EPSRC Mathematics Prioritisation Panel Meeting on the 29th and 30th of November 2017.

- EPSRC UK Korea smart grids Panel Meeting on the 18th of February 2016.

- EPSRC Maths in Healthcare Outline Panel Meeting on the 26th of March 2015.

- EPSRC Mathematics Prioritisation Panel Meeting, on the 5th March 2014.

Impact of Research: I have given invited talks at the Universities of Bath, Bristol, Cambridge, Edinburgh, Durham, Imperial College London, Open University, Oxford, Southampton, Surrey, UCL, and Warwick. My work on energy networks was featured in the influential textbook 'Networks: An Introduction' by Mark Newman (OUP, 2010), in Phys.org (2015), MIT Technology Review (2013), and reviewed (2009) by Phillip F. Schewe, author of The Grid (National Academies Press, 2006). My work on urban networks was reviewed in Nature News (2004) by Philip Ball.

Key Collaborators: Prof. Frank Kelly, CBE, FRS (Professor of the Mathematics of Systems in the Statistical Laboratory, University of Cambridge, and Master of Christ's College, Cambridge), Prof. Dr. rer. nat. Dr. h. c. Dirk Helbing (ETHZ, member of the German Academy of Sciences "Leopoldina"), Marcelo Masera (Head of Unit of "Energy Security" at the Institute for Energy and Transport of the Joint Research Centre, European Commission).

Meetings: I co-organised the "Cambridge Meeting on Energy Systems" on the 24th of October 2014. I co-organized a FuturICT talk at faculty level by Prof. Dirk Helbing at QMUL on the 29th March 2011, which attracted 52 attendees from seven UK Universities.

CAREER:

- March 2015–Present: Assistant Professor at the Department of Engineering, Durham University. Mid Career Fellow of the Durham Energy Institute.

- March 2014–February 2015: Senior Research Associate, Statistical Laboratory, University of Cambridge.

- May 2013–February 2014: Research Fellow, School of Mathematical Sciences, Queen Mary, University of London.

- May 2010–May 2013: Post-doc. Researcher Co-Investigator in the RAVEN Project, School of Mathematical Sciences, Queen Mary, University of London.

- January 2010–May 2010: Post-doc supported by ImpactQM, School of Mathematical Sciences, Queen Mary, University of London.

- January 2008–December 2009: Post-doc, Manmade EU Project, School of Mathematical Sciences, Queen Mary, University of London.

- April 2005–December 2007: Senior Research Fellow, Centre for Advanced Spatial Analysis (University College London). Researcher Co-Investigator in Novel Computation Initiative Grant EP/C513703/1.

- July 2004–March 2005: Research Fellow, Bartlett School of Graduate Studies (University College London). Researcher Co-investigator in EPSRC Platform Grant GR/S64561/01.

- April 2001–June 2004: Research Fellow, Bartlett School of Graduate Studies (University College London). Funded by EPSRC Platform Grant GR/N21376/01.

- November 1996–October 2001: PhD Student in Theoretical Physics, Instituto Superior Técnico, Lisbon, Portugal. Thesis advisors: Profs. Rui Vilela Mendes and João Seixas. Dissertation: "Coupled and extended dynamical systems. Generating complexity from simple dynamics"

- September 1993–October 1996: MSc in Mechanical Engineering, Instituto Superior Técnico, Lisbon, Portugal. Thesis advisor: Prof. João Seixas. Final Mark: A with Distinction. Dissertation: "Feigenbaum Networks"

- September 1987–July 1992: Undergraduate degree in Engineering Physics (Licenciatura), Instituto Superior Técnico, Lisbon, Portugal. ;

PUBLICATIONS:
Thomson ISI-listed peer-refereed journals:

- Lubos Buzna, **Rui Carvalho**, "Controlling congestion on complex networks: fairness, efficiency and network structure", Scientific Reports 7, 9152 (2017);

- **Rui Carvalho**, Lubos Buzna, Richard Gibbens, Frank Kelly, "Critical behaviour in charging of electric vehicles", New J. Phys. 17 (2015) 095001;
  Second most downloaded paper in the NJP over the last 30 days in Oct 2015.

- **Rui Carvalho**, Lubos Buzna, Flavio Bono, Marcelo Masera, David Arrowsmith, Dirk Helbing, "Resilience of natural gas networks during conflicts, crises and disruptions", PLoS ONE 9(3): e90265 (2014);

- **Rui Carvalho**, Lubos Buzna, Wolfram Just, Dirk Helbing, David Arrowsmith, "Fair sharing of resources in a supply network with constraints", *Phys. Rev. E* **85**, 046101 (2012);

- **Rui Carvalho**, Lubos Buzna, Flavio Bono, Eugenio Gutierrez, Wolfram Just, David Arrowsmith, "Robustness of Trans-European Gas Networks", *Phys. Rev. E* **80**, 016106 (2009);

- Michael Batty, **Rui Carvalho**, Andy Hudson-Smith, Richard Milton, Duncan Smith, Philip Steadman, "Scaling and allometry in the building geometries of Greater London", *Eur. Phys. J. B* **63**, 303-314 (2008);

- **Rui Carvalho** and Giulia Iori, "Socioeconomic Networks with Long-Range Interaction", *Phys. Rev. E* **78**, 016110 (2008);

- **Rui Carvalho** and Michael Batty, "The Geography of Scientific Productivity: Scaling in U.S. Computer Science", *J. Stat. Mech.* P10012 (2006);

- **Rui Carvalho** and Michael Batty, "Encoding geometric information in road networks extracted from binary images", *Environment and Planning B*, **32**(2), 179 - 190 (2005);

- **Rui Carvalho** and Alan Penn, "Scaling and universality in the micro-structure of urban space", *Physica A* **332**, 539-547 (2004);

- **Rui Carvalho**, B. Fernandez, R. Vilela Mendes, "From synchronization to Multistability in two coupled quadratic maps", *Physics Letters A* **285**, 327-338 (2001);

- **Rui Carvalho**, R. Vilela Mendes, João Seixas, "Feigenbaum Networks", *Physica D* **126**, 27-37 (1999);

Thomson ISI-listed conference proceedings:

- Lubos Buzna, **Rui Carvalho**, Flavio Bono, Marcelo Masera, David Arrowsmith
  Congestion dependencies in the European gas pipeline network during crises, Complexity in Engineering (IEEE, COMPENG), 2014

- **Rui Carvalho** and Michael Batty, *Automatic extraction of hierarchical urban networks: a micro-spatial approach*, in Computational Science - ICCS 2004: 4th International Conference (Eds Bubak, M., van Albada, G. D., Sloot, P.M. and Dongarra, J.J.), Lecture Notes in Computer Science, Springer-Verlag, Volume 3038/2004, pp 1109-1116 (2004).

Book Chapters:

- **Rui Carvalho**, *"The dynamics of the linear random Farmer model"*, in Economic Complexity: Nonlinear Dynamics, Multi-agents Economies and Learning, W.A. Barnett, C. Deissenberg, G. Feichtinger (eds.), Elsevier (2004)

Conferences:

- **Rui Carvalho**, Shinichi Iida and Alan Penn, "Scaling and universality in the micro-structure of urban space", Proceedings of the 4th International Space Syntax Symposium, London, 17-19 June 2003, Julienne Hanson (ed), Space Syntax Laboratory, University College London, (2003)

- J. Barbosa, **Rui Carvalho**, João Seixas, "A cellular automata algorithm for pattern recognition in HMPID", Proceedings of the 6th Advanced Computing Conference in Physics Research (i.e. AIHENP'99), Heraklion, Crete, Greece (1999)

GRANTS AND PROPOSALS:

- CoI on EPSRC's Mathematical foundations for energy networks: buffering, storage and transmission EP/I016953/2, April 2013–September 2015 (£56K award);

- Researcher Co-investigator on EPSRC's RAVEN: Resilience, Adaptability and Vulnerability of complex Energy Networks EP/H04812X/1, May 2010–May 2013 (£355K award);

- Recognized Researcher on EPSRC's Novel Computation Initiative grant EP/C513703/1, April 2005–December 2007. Only two awards were made and our proposal was ranked first (£330K awarded to UCL for 3+1/2 years, £1.5M total);

- Recognized Researcher on EPSRC's Platform Grant GR/S64561/01, July 2004–March 2005 (£427K award);

- Portuguese National Science Foundation (PRAXIS XXI) Post-graduate Fellowship, 1996–2000, to conduct Postgraduate studies leading to my PhD degree;

- Portuguese National Science Foundation (JNICT) Fellowship for Young Researchers in 1992 while an undergraduate at IST;

SERVICES TO RCUK:

- Panel member in the EPSRC Mathematics Prioritisation Panel Meeting on the 29th and 30th of November 2017;

- Panel member in the EPSRC-KETEP Smart Grids on the 18th of February 2016;

- Panel member in the EPSRC Maths in Healthcare Outline Panel Meeting on the 26th of March 2015;

- Panel member in the EPSRC Mathematics Prioritisation Panel Meeting on the 5th March 2014;

- Member of the EPSRC Peer Review College (September 2012 –);

- Invited to the DST-EPSRC Applied Mathematics Meeting 11-13th July 2012, International Centre for Mathematical Sciences (ICMS), Edinburgh;

- Grant reviewer for the *EPSRC* (30 grants reviewed since October 2009, among which one Programme grant).

VISITS AND RESIDENCIES:

- 22nd Aug – 26th Aug 2016. I visited Dr. Giacomo Como at the Department of Automatic Control in Lund (Sweden).

- 17th Oct – 18st Oct 2015. I visited Prof. James Gleeson at the University of Limerick (Ireland)

- 23rd Aug – 1st Sep 2015. I visited Dr. Giacomo Como at the Department of Automatic Control in Lund (Sweden).

- July 23 – Aug 8 2015. I visited Prof. Munther Dahleh, director of the MIT Institute for Data Systems and Society.

- Sept 29 – Oct 17 2014. Visiting scholar of Lund University during the Focus Period devoted to Dynamics and Control in Networks.

- March 2013 to 2014. Invited by Prof. Dirk Helbing to visit ETHZ (7 trips in 2013 and one trip February 2014, of 2 days each)

- 20–27 August 2011, 19–28 August 2012. Invited by Prof. Dirk Helbing (Scientific Coordinator of FuturICT) to participate on his Annual Workshop in Goldrain Castle (Goldrano, Italy).

- 1–18 May 2008. Visiting post-doctoral scientist at the Chair of Sociology, in particular of Modeling and Simulation at ETHZ;

- 15–31 January 2007. Visiting post-doctoral scientist at the Institute for Transport and Economics at Dresden University of Technology;

- 1–15 July 2005. "Thematic Institute on Information and Material Flows in Complex Networks" Goldrain Castle (Italy);

- July 19–September 17, 2004: EXYSTENCE Thematic Institute (TI) "From Many-Particle Physics to Multi-Agent Systems", Max Planck Institute for the Physics of Complex Systems, Dresden, Germany;

- October 2000, August 2001: "The Sciences of Complexity: From Mathematics to Technology to a Sustainable World", International Collaborative Research Year, Centre for Interdisciplinary Research (ZIF), Bielefeld University, Germany;

- May 1998: CERN (Centre European pour Recherche Nucleaire).

MEETINGS ORGANIZED:

- I co-organised the "Cambridge Meeting on Energy Systems" on the 24th of October 2014 (12 attendants from Cambridge, Herriot-Watt and Durham).

- I co-organised a FuturICT talk at faculty level by Prof. Dirk Helbing at QMUL on the 29th March 2011, which attracted 52 attendees from seven UK Universities.

SELECTED PRESENTATIONS:

- *Statistical Data Science*, Imperial College London, 5th of July 2017;

- (**Invited talk**) *Department of Engineering Mathematics*, University of Bristol, 19th of January 2017;

- (**Invited talk**) *Department of Automatic Control*, Lund University, 24th of August 2016;

- (**Invited talk**) *MACSI, Department of Mathematics and Statistics*, University of Limerick, 16th of October 2015;

- (**Invited talk**) *Durham Energy Institute Research Symposium*, Durham University, 30th of September 2015;

- (**Invited talk**) *Department of Automatic Control*, Lund University, 26th of August 2015;

- (**Invited talk**) *Laboratory for Information & Decision Systems*, MIT, 4th of August 2015;

- (**Invited talk**) *2nd IMA Conference on Mathematics in Finance*, University of Manchester, 18th of June 2015;

- (**Invited talk**) *NetONets2015*, a satellite meeting of NetSci 2015, Zaragoza, 1st of June 2015;

- (**Invited talk**) *EPRG Energy and Environment (E&E) Seminar*, 27th of October 2014;

- (**Invited talk**) *LCCC Focus Period on Dynamics and Control in Networks*, *Lund University*, 14th of October 2014;

- (**Invited talk**) *Coinets'14*, a satellite meeting of *ECCS14*, Lucca, 25th of September 2014;

- (**Invited talk**) *CoSyDy* Meeting *Dynamics of Energy Networks*, University of Bath, 12th September 2014;

- (**Invited talk**) *Cambridge Networks Day*, University of Cambridge, 23rd May 2014;

- (**Invited talk**) *Energy Research Two-Day Conference*, Open University, 3rd and 4th April 2014;

- (**Invited talk**) *CABDyN Complexity Centre*, University of Oxford, 3th December 2013;

- (**Invited talk**) *Risk and Reliability Modelling of Energy Systems*, Durham University, 13th November 2013;

- (**Invited talk**) *UCL Energy Institute*, Lunch Time Seminar, 7th November 2013;

- (**Invited talk**) *Energy Research Day Conference*, Open University, 6th March 2013;

- *ERGO Forum: Optimization in Energy Day*, ICMS, Edinburgh, 5th March 2013;

- (**Invited talk**) *Risk and Reliability Modelling of Energy Systems*, Durham University, 27th November 2012;

- (**Invited talk**) *Emerging TOGETHER Science for Efficient Buildings*, UCL Energy Institute, 30th October 2012;

- (**Invited talk**) *Workshop on Information Flows and Information Bottlenecks*, Queen Mary, University of London, 12th September 2012;

- (**Invited talk**) *Graph-theoretic methods in electrical power systems*, University of Southampton, 19th-20th June 2012;

- (**Invited talk**) *The ERIE EPSRC Project* seminar series, University of Surrey, 28th September 2011;

- *Researcher's Night*, Queen Mary, University of London, 23th September 2011;

- International Workshop on Coping with Crises in Complex Socio-Economic Systems, ETHZ, 20th June 2011;

- (**Invited talk**) *The Brooke Sessions* seminar series, Bath Centre for Nonlinear Mechanics, University of Bath, 11 June 2011;

- (**Invited talk**) *Making It Real* seminar series, Department of Engineering Mathematics, University of Bristol, 26 November 2010;

- Dynamic Days Europe 2010, University of Bristol, 7 September 2010;

- (**Invited talk**) PGR Seminar, Department of Computer Science, University of Bath, 6 November 2009;

- (**Invited talk**) European Conference on Complex Systems 2009 (ECCS '09), University of Warwick, 21-25 September 2009;

- International Workshop on Network Science (NetSci09), Venice, 29 June to 3 July 2009;

- (**Invited talk**) CABDyN Network Journal Club, Oxford University, 12 October 2007;

- European Conference on Complex Systems 2007 (ECCS '07), TU Dresden, 1-5 October 2007;

- European Conference on Complex Systems 2006 (ECCS '06), University of Oxford, 26-29 September 2006;

- Complex Behavior in Economics: Modeling, Computing and Mastering Complexity", La Baume-les-Aix, Aix en Provence, 18 May 2006;

- Physics and the City, University of Bologna, 15-17 December 2005;

- EU Thematic Institute on "Information and Material Flows in Complex Networks", Goldrain Castle, 27 June 2005;

- Association of American Geographers Annual Meeting, AAG 2005, Denver, CO, 6 April 2005;

- EU Thematic Institute on "From Many-Particle Physics to Multi-Agent Systems", Max Planck Institute for the Physics of Complex Systems, Dresden, 30 August 2004

- The Sciences of Complexity: From Mathematics to Technology to a Sustainable World, ZIF, Universität Bielefeld, August 2001.

OTHER SCIENTIFIC ACTIVITIES:

- Reviewer for *PNAS* (1 review), *IEEE Transactions on Control of Network Systems* (2 reviews), *IEEE Transactions on Power Systems* (1 review), *SN Applied Sciences* (1 review), *Journal of Complex Networks* (1 review), *IMA Journal of Applied Mathematics* (1 review), *Proceedings of ICE - Energy* (1 review), *New Journal of Physics* (1 review), *European Physical Journal B* (2 reviews), *Physica A* (1 review), *Physica Scripta* (7 reviews), *Advances in Complex Systems* (1 review), *Journal of Economic Behavior & Organization* (1 review), *Environment and Planning B* (14 reviews), *Computers Environment and Urban Systems* (1 review), *Urban Studies* (2 reviews) and *Journal on Urban Sustainable Development* (1 review);

- Grant reviewer for the *EPSRC* (15 grants reviewed since October 2009, among which one Programme Grant), the *Netherlands Organisation for Scientific Research (NWO)* (1 review) and the *Israel Science Foundation* (1 review).

SUPERVISION:
Final year projects:

- Benjamin Culverwell, 'A data-driven analysis of electric vehicle charging behaviour', MEng 2018
  now Investment Banking Analyst at Houlihan Lokey (June 2019)

- Benjamin Rodman, 'EV Charging Point Linear Predictive Model Development and Interpretation', MEng 2018
  now Consultant at FTI Consulting (June 2019)

- Francesc Mora, 'Data Analysis and Data-Centric Modelling in Energy and Transport', MEng 2018
  now Business Analyst for European Development at Lightsource BP (June 2019)

- William Rigby, 'Data Analysis and Data-Centric Modelling in Energy and Transport', MEng 2018
  now Technical Business Analyst for Acturis (June 2019)

- William Stephenson, 'Critical Behaviour in the Charging of Plug-In Electric Vehicles Using Optimal Power Flow', MEng 2018
  now Incoming Energy Technologies student at the University of Cambridge (June 2019)

- April Chen, 'Compressed Sensing: Electricity Consumption Data', MEng 2017
  now Data and Analytics Associate at PwC (June 2019)

- Benjamin Tucker, 'Pricing Strategies on electric vehicle charging stations for the management of network congestion', MEng 2017,
  now Investor Relations Analyst at RELX (June 2019)

- Harry Tyler, 'Statistical Learning from Disaggregated Smart Meter Data', MEng 2017,
  now Investment Management Assistant at NW Brown Group Ltd (June 2019)

- Michael Wilson, 'A Mathematical Analysis of Disaggregated Smart Meter Data', BEng 2017,
  now Assistant Engineer at JBA Consulting (June 2019)

- Samuel Stradling, 'Game Theoretic Tools for the Management of Congestion of Energy Networks in the Charging of Electric Vehicles', MEng 2017,
  now Graduate Software Developer at Skycanner (June 2019)

- Adam MacNeil, 'User strategies for charging electric vehicles', MEng 2016
  now Systems Engineer at Siemens Rail Automation (June 2019)

- Ben Zacaroli, 'User strategies for charging electric vehicles', MEng 2016
  now Technical Analyst at FlexTrade (June 2019)

- Stefan Kotz, 'Data Analytics for Personal Energy Consumption', BEng 2016
  now at RWTH Aachen University (Jan 2017)

Student awards:

- Tamara Barker-Privalova, third prize for her L1 essay 'Why are there so few women in engineering?' (Durham, 2016)

TEACHING:

- Assistant Professor at the Department of Engineering, Durham University

  – Optimisation (part of Level 4 'Low Carbon Technologies') 2016–.
  – Energy Markets and Risk (part of Level 4 'Energy Markets, Low Carbon and Thermal Technologies') Epiphany Term 2015–2016.
  – Systems, Stability and Control (part of Level 2 'Electrical Engineering') 2015–.

- Tutor at the School of Mathematical Sciences, QMUL:

  – MTH773P Advanced Computing in Finance, Spring 2014 (postgraduate module);
  – MTH6142 Complex Networks, Spring 2013;
  – MTH5121 Probability Models, Fall 2012;
  – MTH4102 Differential Equations, Spring 2012;
  – MTH4105 Introduction to Mathematical Computing, Fall 2011;
  – MTH5110 Introduction to Numerical Computing, Spring 2011;
  – MTH4105 Introduction to Mathematical Computing, Fall 2010;
  – MTH4104 Introduction to Algebra, Spring 2010;
  – MTH4105 Introduction to Mathematical Computing, Fall 2009;
  – MTH4102 Differential Equations, Spring 2009.

- Tutor at Instituto Superior Técnico, Lisbon, Portugal:

  – Teaching Assistant in Physics I (2000 Electric Engineering);
  – Teaching Assistant in Computational Physics (1996 and 1997 Physics Engineering);
  – Teaching Assistant in Physics I (1995 Computer Science);
  – Teaching Assistant in Physics II (1994 Territory Engineering);
  – Teaching Assistant in Classical Mechanics (1991 Mechanics Engineering);
  – Teaching Assistant in Experimental Physics I (1991 Physics Engineering).

LANGUAGE PROFICIENCY: Proficiency in Portuguese and English. Fluent communication skills in French and good communication skills in Spanish and Italian.

ALGORITHMIC AND COMPUTATIONAL EXPERIENCE:

- Excellent knowledge of R, Python, and Matlab, and good knowledge of Mathematica. User of Mac OS X, Windows and Linux (Ubuntu);

- I am a user of distributed high-throughput computing (*HTCondor* and the *Brutus Supercomputer at ETHZ*) which I use in some of my simulations of large graphs.