Dr Dante Kalise

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Research Areas: Computational Optimization & Control

FOUNDATIONS. Dynamic optimization with ODE/PDE constraints; large-scale and sparse optimization; mathematical control theory; high-dimensional approximation; numerical methods for Hamilton-Jacobi PDEs and dynamic programming; optimal transport, mean-field control/games.

APPLICATIONS. Scientific Machine Learning: data-driven control design in trajectory optimization, epidemiology, and large-scale dynamics. Agent-based models: nonlocal PDES, collective behaviour, consensus control. Nonlinear control design: power electronics, swarm robotics, reinforcement learning. Control of PDEs: fluid flow and vibration control, optimal actuator design.

Appointments

Assistant Professor	School of Mathematical Sciences University of Nottingham, United Kingdom	6/2019–
Honorary Lecturer	Department of Mathematics Imperial College London, United Kingdom	6/2019–
Academic Fellow	Data Science Institute Imperial College London, United Kingdom	4/2018–
ICL Research Fellow	Department of Mathematics Imperial College London, United Kingdom	9/2017–5/2019
Research Scientist	Optimization and Optimal Control Group RICAM, Linz, Austria	5/2013–8/2017
Postdoctoral Researcher with Secondment	Sapienza University of Rome, Italy University of Bayreuth, Germany	11/2011–10/2012 11/2012–4/2013
Ph.D. Researcher	Research and Development Department Storm Weather Center, Norway	8/2008–10/2011
Lecturer	Department of Mathematics Federico Santa María University, Chile	3/2007–7/2008

Education

PhD	Mathematics	University of Bergen, Norway	6/2012
MSc	Electronic Engineering	Federico Santa María University, Chile	7/2008
BSc	Engineering Mathematics	Federico Santa María University, Chile	12/2006

Further Relevant Qualifications

- 11/2020: attained Fellow status from Advance HE after completing 40 credits of PGCHE.
- 8/2018: obtained the National Scientific Habilitation in Numerical Analysis from the Italian Ministry of Education, certifying eligibility for tenured academic positions in Italy.

Grants and Awards

- ICIAM 2019 Travel Award, QJMAM Travel Grant.
- ITN-SADCO Postdoctoral Grant, European Union 7th Framework Programme (2011–2013).
- Bicentenary Ph.D. Fellowship, Chilean Ministry of Education (2009–2011).
- Full M.Sc. Scholarship, Federico Santa María University (2007–2008).
- Dean's List, Federico Santa María University (2004–2007).
- Academic Merit Award, Federico Santa María University (2004–2007).
- Starr Foundation Full Scholarship (2003–2007).
- Highest National Score in Mathematics, Entrance Exams to Chilean Universities (2002).

Funded Research Projects

- CoI, EPSRC New Horizons Award, Project: Overcoming the Curse of Dimensionality with Tensor Decompositions, 3/2021–3/2024.
- CoI, UKRI-EPSRC COVID-19 Fund, Project: Optimal Lockdown, 8/2020–2/2021.
- CoI, EPSRC Grant, Project: Elastic Manufacturing Systems, 9/2020–9/2023.
- PI, Gaspard Monge Program for Optimization, Operations Research and Data Science, Project TIDAL: Taming the Curse of Dimensionality in Dynamic Programming Equations, 7/2019–7/2022.
- PI, Imperial College Research Fellowship: Multiscale optimal control of collective behaviour phenomena, 9/2017–8/2021.
- PI, Ser Cymru II Fellowship: Advanced computational methods for optimal feedback control with applications in engineering and life sciences, funded by Welsh-European Funding Office, 9/2018–8/2021.
- Research Grant: Numerical Optimization for Consensus Control, funded by the Chilean National Commission for Scientific and Technological Research, 8/2013–5/2015.

Participation in Research Projects

- Research Scientist, ERC-Advanced Grant OCLOC: From Open to Closed Loop Optimal Control of PDEs, PI: Karl Kunisch, 3/2016–7/2017.
- Research Scientist, START Project: Sparse Approximation and Optimization in High Dimensions, funded by the Austrian Research Fund (FWF), PI: Massimo Fornasier, 4/2009–6/2015.
- Experienced Researcher, Initial Training Network SADCO: Sensitivity Analysis for Deterministic Controller Design, funded by the European Union FP7, 1/2011–12/2014.
- Research Scientist, eVITA-EnKF Network: Forecasting non-linear systems using the ensemble Kalman filter and related methods, funded by the Research Council of Norway, 9/2007–9/2011.

Recent Undergraduate and Graduate Teaching experience

- *School of Mathematical Sciences, University of Nottingham, UK* Spring 2022
  Lecturer and course designer, *Computational Methods in Data-driven Science and Engineering.* Design of a new service course for Engineering, Physics, and Computer Science.
- *MAGIC Mathematics Taught Course Centre, UK* Autumn 2020
  Lecturer and course designer, *graduate course: Optimal Control and Reinforcement Learning.*

- *School of Mathematical Sciences, University of Nottingham, UK* Autumn 2020
  Lecturer and course designer, *Optimization*. Includes a full syllabus re-design to account for current optimization trends in machine learning and data science.
- *Department of Computer Science, University of Verona, Italy* June 2020
  Lecturer, *short graduate course: Mathematical Foundations of Reinforcement Learning*.
- *School of Mathematical Sciences, University of Nottingham, UK* Spring 2020
  Lecturer, *Computerised Mathematical Methods in Engineering*.
- *Department of Mathematics, Imperial College London* October-December, 2018
  Lecturer and designer, *graduate course: Mathematical Foundations of Reinforcement Learning*.

Research Supervision

- 3 PhD Projects. Topics include: Optimization, Control and Estimation for Nonlinear PDEs in Transport Phenomena, Minimal-residual Methods and Optimization, and Optimization of Aircraft Trajectories and Fuel Consumption, supervised at the University of Nottingham and Imperial College London.
- 10 MSc Projects. Topics include: Deep Learning for State-Dependent Riccati Equations, Clustering Algorithms for Financial Risk Analysis, Agent-based Models for Volatility Clustering, A Statistical Machine Learning Framework for High Dimensional PDEs, Computational Methods for Optimal Transport, and Optimal Cooperative Strategies in Multi-agent Systems, supervised at the University of Nottingham and Imperial College London.

Professional Service and Administration

Editorial duties

Since 12/2019, Associate Editor of Mathematics of Control, Signals, and Systems (Springer). Co-editor of 2 special issues: "Machine Learning for Control Systems and Optimal Control" and "Optimal Control and Dynamic Games: Large Time Behavior and Geometry".

Leadership and management roles

- Since August 2020, Course Director for the Machine Learning in Science MSc (University of Nottingham). I oversee our teaching provision and coordinate with the departments of Physics and Computer Science.
- Since July 2019, Scientific Computation Seminar organizer (University of Nottingham).

Outreach

2020 Speaker at "Ciencias para la Innovación" (Science for Innovation) Event, Sub-Antartic Consortium of Chilean Universities, Ciencia 2030 Programme.

2018 Mathematics Speaker, Open Days at Imperial College London.

2018 Participant at Science in Parliament - STEM for Britain: `http://www.setforbritain.org.uk`.

2016 An article by the Austrian Press Agency about my research on a computational approach for the control of social dynamics and collective behavior is available at: `http://science.orf.at/stories/2815032/`.

2016 The paper *Invisible control of self-organizing agents leaving unknown environments* has received considerable attention by the media: six popular science magazines including the Italian version of Scientific American (`http://tinyurl.com/z59kujm`), and a press release at the Technical

University of Munich (`http://tinyurl.com/zf9sw5g`), highlighting our research in agent-based modelling of social dynamics.

2014 Within the workshop *Geometric control and related fields* (November 17-21, 2014 at RICAM), I co-organized the public lecture *Historical chronology: Truth or fable?*, which attracted a diverse audience interested on the links between Mathematics, Celestial Mechanics, and Historical Chronology. More details can be found at `http://tinyurl.com/ztg5fau`.

2014 I gave the public talk *High-resolution numerical methods and applications in Optimization and Control* at the Science/Technology Interaction Cycle of the Chilean Nuclear Energy Commission, raising awareness within nuclear research practitioners on the use of state of the art computational methods.

2012 My Ph.D. in computational methods for atmospheric modelling was developed in co-supervision with the R&D Department of StormGeo AS (`www.stormgeo.com`), a leading weather forecast company in Scandinavia. During this period I participated in the formulation of tender bid proposals for high-resolution wind forecast systems for wind farms in South America.

Organization of scientific meetings

- Member of the Programme Committee, 25th International Symposium on Mathematical Theory of Networks and Systems MTNS2022., Bayreuth, DE.
- Co-organizer of the minicourse *Optimization and Control of Agent-based Models*, August 2021, 24th MTNS, Cambridge, UK.
- Co-organizer of the session *Optimal Actuator Shape and Design*, August 2021, 24th MTNS, Cambridge, UK.
- Co-organizer of the workshop *Feedback Control of PDEs*, November 2019, RICAM, Linz, Austria.
- Co-organizer of the minisymposium *Novel Concepts in Model-driven Optimization and Control of Agent-based Systems* at the International Congress of Industrial and Applied Mathematics ICIAM, July 15–19 2019, Valencia, Spain.
- Co-organizer of the minisymposium *Computation methods for model-driven optimization and control under uncertainty* at the 28th Biennial Numerical Analysis Conference, June 25th–28th 2019, University of Strathclyde, Glasgow, United Kingdom.
- Co-organizer of the minisymposium *Numerical Methods for PDE-Constrained Optimization* at the 27th Biennial Numerical Analysis Conference, June 27th–30th 2017, University of Strathclyde, Glasgow, United Kingdom.
- Co-organizer of the minisymposium *Numerical Approximation and Optimization of Agent-based Models* at the 27th Biennial Numerical Analysis Conference, June 27th–30th 2017, University of Strathclyde, Glasgow, United Kingdom.
- Co-organizer of the workshop *Numerical methods for Hamilton-Jacobi equations in optimal control and related fields*, November 21st–25th 2016, RICAM, Linz, Austria.
- Co-organizer of the minisymposium *Recent developments in numerical methods for Hamilton-Jacobi-Bellman equations and multi-agent systems*, at the 5th Workshop on Numerical Analysis of Partial Differential Equations, January 11th –15th 2016, University of Concepción, Chile.
- Member of the Organizing Committee of the *Workshop on Optimal Control of Partial and Ordinary Differential Equations*, November 16th–17th 2015, École Polytechnique, Palaiseau, France.
- Co-organizer of the minisymposium *Optimal control and Hamilton-Jacobi-Bellman equations*, at the 27th IFIP TC7 Conference, June 29th–July 3rd 2015, Sophia-Antipolis, France.
- Co-organizer of the minisymposium *Modelling and Control of Multi-agent Systems*, at the 27th IFIP TC7 Conference, June 29th–July 3rd 2015, Sophia-Antipolis, France.
- Organizer of the minisymposium *Numerical methods for feedback control of dynamical systems and related topics* at the 26th Biennial Numerical Analysis Conference, June 23rd–26th 2015, University of Strathclyde, Glasgow, United Kingdom.

- Member of the Local Organizing Committee of the workshop *Geometric Control and Related Fields*, November 17th–21st 2014, RICAM, Linz, Austria.
- Organizer of the session: *Numerical Methods for Atmospheric Models* at the 14th International Conference on Hyperbolic Problems, June 25th–29th 2012, Padova, Italy.

Participation in PhD Thesis Committees

Luca Saluzzi (PhD Mathematics, Gran Sasso Science Institute, Italy), 2020.
Guillermo Albuja (PhD Mathematics, Universidad de la Frontera, Chile), 2019.
Daniel Inzunza (PhD Mathematical Engineering, Universidad de Concepción, Chile), 2019.

Refereeing for research funding agencies

National Commission for Scientific and Technological Research (CONICYT-Chile), Engineering and Physical Sciences Research Council (EPSRC-UK).

Refereeing for peer-reviewed journals

Foundations of Computational Mathematics
SIAM Journal on Numerical Analysis
SIAM Journal on Optimization and Control
SIAM Journal on Scientific Computing
Multiscale Modeling and Simulation
Inverse Problems
Automatica
Journal of Optimization Theory and Applications
Kinetic and Related Models
ESAIM: COCV
ESAIM: M2AN
Computational Optimization and Applications
Computers and Mathematics with Applications
Advances in Computational Mathematics
Mathematical Control & Related Fields
Numerical Linear Algebra with Applications
Journal of Mathematical Biology
IMA Journal on Applied Mathematics
Book Reviews for SIAM Review
Set-Valued and Variational Analysis
Discrete and Continuous Dynamical Systems - A
BIT Numerical Mathematics
IEEE Transactions on Control Systems Technology
ZAMM
Calcolo
Physica A
Applied Mathematics and Computation
Applied Numerical Mathematics
Mathematics and Computers in Simulation
Computational and Applied Mathematics
Optimization and Engineering
Royal Society Open Science
Optimization
Operational Research: An International Journal
European Control Conference
Analysis and Mathematical Physics
Reviewer for MathScinet
Book Proposals Reviewer for CRC Press