Maria Strazzullo

Postdoc at DISMA, Politecnico di Torino

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Academic Experience

Visiting Invited researcher at Virginia Tech, Interdisciplinary Center for Applied Mathematics (ICAM) (Octorber 2022 - November 2022)

Postdoc Excellence project fellowship at DISMA, Politecnico di Torino, Turin, Italy (January 2022 - ongoing)

Fellowship MathLab group, SISSA, Trieste, Italy (October 2021- December 2021)

Ph.D. Mathematical Analysis, Modelling, and Applications, mathLab group, SISSA, Trieste, Italy (October 2017 - September 2021)

Predoc mathLab group, SISSA, Trieste, Italy (April 2017 - September 2017)

Education

International School for Advanced Studies (SISSA)

Trieste, Italy

PhD in Mathematical Analysis, Modelling, and Applications — *September 24, 2021.*

- **Grade**: cum laude.
- **Thesis Title**: "Model Order Reduction for Nonlinear and Time-Dependent Parametric Optimal Flow Control Problems" — ***Advisor***: *Prof. Gianluigi Rozza*, — ***Co-Advisor***: *Dr. Francesco Ballarin*.

Università degli studi di Trieste

Trieste, Italy

Master's degree in Mathematics — *Sep 2014 - Mar 2017*

- **Grade**: 110/110 cum laude.
- **Thesis Title**: "Reduced order methods for parametrized optimal flow control problems" — ***Advisor***: *Prof. Gianluigi Rozza* — ***Co-Advisors***: *Prof. Renzo Mosetti, Dr. Francesco Ballarin*.

Università degli studi di Camerino

Camerino, Italy

Bachelor's degree in Mathematics — *Sep 2011 - Jul 2014*

- **Grade**: 110/110 cum laude.
- **Thesis Title**: "La Teoria Dei Codici Autocorrettori" ("The theory of error-correcting codes") — ***Advisor***: *Prof. Carlo Toffalori*.

Liceo Classico "Giacomo Leopardi"

Macerata, Italy

Classical Certificate — *Sep 2006 - Jul 2011*

- **Grade**: 100/100.

Scientific Interests

reduced order methods, applied mathematics, optimal control theory, inverse methods, uncertainty quantification, environmental and ecological sciences, neural networks for partial differential equations.

Publications

[17] Paper M. Strazzullo and F. Vicini "POD-based reduced order methods for optimal control problems governed by parametric partial differential equation with varying boundary control", submitted, 2022, https://arxiv.org/abs/2212.10654.

[16] Paper F. Zoccolan, M. Strazzullo and G. Rozza "Stabilized Weighted Reduced Order Methods for Parametrized Advection-Dominated Optimal Control Problems governed by Partial Differential Equations with Random Inputs", submitted, 2022, https://arxiv.org/abs/2301.01975.

[15] Paper F. Zoccolan, M. Strazzullo and G. Rozza "A Streamline upwind Petrov-Galerkin Reduced Order Method for Advection-Dominated Partial Differential Equations under Optimal Control", submitted, 2022, https://arxiv.org/abs/2301.01973.

[14] Chapter D. Torlo, M.Strazzullo, F. Ballarin and G. Rozza, "Chapter 12: Weighted Reduced Order Methods for Uncertainty Quantification", in *Advanced Reduced Order Methods and Applications in Computational Fluid Dynamics*, https://doi.org/10.1137/1.9781611977257.ch12.

[13] Chapter M.Strazzullo, F. Ballarin and G. Rozza, "Chapter 2: Finite Element-Based Reduced Basis Method in Computational Fluid Dynamics", in *Advanced Reduced Order Methods and Applications in Computational Fluid Dynamics*, https://doi.org/10.1137/1.9781611977257.ch4.

[12] Chapter F. Pichi, M.Strazzullo, F. Ballarin and G. Rozza , "Chapter 2: Finite Element-Based Reduced Basis Method in Computational Fluid Dynamics", in *Advanced Reduced Order Methods and Applications in Computational Fluid Dynamics*, https://doi.org/10.1137/1.9781611977257.ch2.

[11] Proceeding E. Donadini, M. Strazzullo, M. Tezzele and G. Rozza, "A data-driven partitioned approach for the resolution of time-dependent optimal control problems with dynamic mode decomposition", accepted in ICOSAHOM proceedings, 2022, https://arxiv.org/abs/2111.13906.

[10] Paper N. Demo, M. Strazzullo and G. Rozza "An Extended Physics Informed Neural Network For Preliminary Analysis of Parametric Optimal Control Problems", submitted, 2021, https://arxiv.org/abs/2110.13530.

[9] Paper M. Strazzullo, M. Girfoglio, F. Ballarin, T. Iliescu and G. Rozza "Consistency of the Full and Reduced Order Models for Evolve-Filter-Relax Regularization of Convection-Dominated, Marginally-Resolved Flows", International Journal for Numerical Methods in Engineering, 2022, https://doi.org/10.1002/nme.6942.

[8] Paper M. Strazzullo, F. Ballarin, and G. Rozza "A Certified Reduced Basis Method for Linear Parametrized Parabolic Optimal Control Problems in Space-Time Formulation", submitted, 2021, https://arxiv.org/abs/2103.00460.

[7] Paper G. Carere, M. Strazzullo, F. Ballarin, G. Rozza, R. Stevenson. "Weighted POD-reduction for parametrized PDE-constrained Optimal Control Problems with random inputs and its applications to environmental sciences", Computers & Mathematics with Applications, volume 102, pp. 261-276, 2021, https://doi.org/10.1016/j.camwa.2021.10.020.

[6] Chapter F. Ballarin, G. Rozza and M. Strazzullo, "Space-time POD-Galerkin approach for parametric flow control", in press, Handbook of Numerical Analysis, Elsevier,2022, https://doi.org/10.1016/bs.hna.2021.12.009.

[5] Paper F. Pichi, M. Strazzullo, F. Ballarin, and G. Rozza "Driving bifurcating parametrized nonlinear PDEs by optimal control strategies: application to Navier-Stokes equations and model reduction", ESAIM: M2AN, 2022, https://doi.org/10.1051/m2an/2022044.

[4] Paper M. Strazzullo, F. Ballarin, and G. Rozza, "POD-Galerkin Model Order Reduction for Parametrized Nonlinear Time Dependent Optimal Flow Control: an Application to Shallow Water Equations", accepted in Journal of Numerical Mathematics, 2021, https://doi.org/10.1515/jnma-2020-0098.

[3] Paper M. Strazzullo, F. Ballarin, and G. Rozza, "POD–Galerkin Model Order Reduction for Parametrized Time Dependent Linear Quadratic Optimal Control Problems in Saddle Point Formulation", Journal of Scientific Computing, 83(3), pp. 55, 2020, https://doi.org/10.1007/s10915-020-01232-x.

[2] Proceeding M. Strazzullo, Z. Zainib, F. Ballarin, and G. Rozza, "Reduced order methods for parametrized non-linear and time dependent optimal flow control problems, towards applications in biomedical and environmental sciences", in ENUMATH2019 proceedings, 2020, https://doi.org/10.1007/978-3-030-55874-1_83.

[1] Paper M. Strazzullo, F. Ballarin, R. Mosetti and G. Rozza. "Model Reduction for Parametrized Optimal Control Problems in Environmental Marine Sciences and Engineering", SIAM J. Sci. Comput., 40(4), B1055–B1079 (25 pages), 2018, https://doi.org/10.1137/17M1150591.

Talks at Conferences and Seminars

Matematica per l'Intelligenza Artificiale e il Machine Learning *Politecnico di Torino, Italy*

Contributed Talk *November 24, 2022*

- **Talk title**: "Physics-informed Neural Networks for partial differential equations and optimal control in a parametric setting.".

Virginia Tech Math colloquium *Blacksburg, USA*

Invited Speaker *November 17, 2022*

- **Talk title**: "Model order reduction for nonlinear and time-dependent parametrized optimal control problems.".

Emory mathematics seminars *Atlanta, USA*

Invited Speaker *October 17, 2022*

- **Talk title**: "Model order reduction for parametrized optimal control problems: from time-dependency to nonlinearity.".

GIMC SIMAI YOUNG 2022 *Pavia, Italy*

Invited Speaker *September 29-30, 2022*

- **Talk title**: "Physics-informed Neural Networks for parametric partial differential equations and optimal control".

MORE 2022 *Berlin, Germany*

Contributed Talk *September 19-23, 2022*

- **Talk title**: "Full Order Model and Reduced Order Model Consistency for Evolve-Filter-Relax Regularization".

ECCOMAS 2022 *Oslo, Norway*

Invited Speaker *June 5-9, 2022*

- **Talk title**: "Optimal control and bifurcating systems: an application to Navier-Stokes equations".

Friedrich-Alexander-Universität Mini-Workshop on Model Reduction and Control *Online*

Invited Speaker *May 24, 2022*

- **Talk title**: "Model order reduction for time-dependent parametrized optimal control problems".

SIAM Uncertainty Quantification Conference 2022 *Online*

Invited Speaker *April 12-15, 2022*

- **Talk title**: "Stabilized Reduced Order Methods for Transport Control Problems with Random Inputs".

Analysis Junior Seminar *Online*

Invited Speaker *February 18, 2022*

- **Talk title**: "Full Order Model and Reduced Order Model Consistency for Evolve-Filter-Relax Regularization".

Pitt AWM Student Seminar Series *Online*

Invited Speaker *December 3, 2021*

- **Talk title**: "The role of optimal control in bifurcating phenomena: an application to Navier-Stokes equations".

COUPLED 2021 *Online*

Contributed Talk *June 14-16, 2021*

- **Talk title**: "Reduced Order Methods for Uncertainty Quantification Problems applied to Optimal Control in Environmental Sciences".

FEniCS Conference 2021 *Online*

Contributed Talk *March 22-26, 2021*

- **Talk title**: "Reduced order methods for optimal flow control: FEniCS-based applications".

DISMA Seminar Series *Online*

Invited speaker *March 22, 2021*

- **Talk title**: "A Glimpse Of Reduced Order Methods For Parametrized Optimal Control Problems".

SIAM-CSE Congress 2021 *Online*

Invited speaker *March 1-5, 2021*

- **Talk title**: "Reduced Order Methods for Space-Time Parametric Optimal Control Problems in Computational Fluid Dynamics".

SIAM-CSE Congress 2021 *Online*

Invited speaker *March 1-5, 2021*

- **Talk title**: "Reduced Order Methods for Optimal Flow Control Problems: from time-dependency to nonlinearity".

WCCM-ECCOMAS Congress 2020 *Online*

Invited speaker *January 11-15, 2021*

- **Talk title**: "Reduced Order Methods for Optimal Flow Control Problems: from time-dependency to nonlinearity".

MORSS 2020 - Model Order Reduction Summer School 2020 *Online*

Contributed Talk *September 7-10, 2020*

- **Talk title**: "Advances in Reduced Order Methods for Optimal Flow Control Problems".

SAMM 2020 - Learning Models from Data: Model Reduction, System Identification and Machine Learning — *Online*

Poster presentation — *July 19-24, 2020*

- **Poster title**: "POD-Galerkin reduction for nonlinear time dependent optimal flow control problems with applications in environmental sciences" — ***co-authors***: *F. Ballarin and G. Rozza*.

Summer School on Reduced Order Methods in Computational Fluid Dynamics — *SISSA, Trieste, Italy*

Lecturer and poster presentation — *July 8-12, 2019*

- **Lecture title**: "Reduced order methods for parametrized optimal flow control problems: applications in biomedical and environmental sciences" — ***co-lecturer***: *Z. Zainib*.
- **Poster title**: "Reduced Order Methods Applied to Nonlinear Time Dependent Optimal Flow Control Problems in Environmental Marine Sciences and Engineering" — ***co-authors***: *F. Ballarin, R. Mosetti and G. Rozza*.

ADMOS 2019 - International Conference on Adaptive Modeling and Simulation — *El Campello (Alicante),Spain*

Invited speaker — *May 27-29, 2019*

- **Talk title**: "Reduced Order Methods for Nonlinear Time Dependent Optimal Flow Control Problems Applied to Environmental Marine Sciences and Engineering".

Analysis, Control and Inverse Problems for PDEs — *Università Federico II, Napoli, Italy*

Invited speaker — *November 26-3, 2018*

- **Talk title**: "Reduced Order Methods for Optimal Flow Control Problem with Application in Environmental Marine Sciences and Engineering".

MoRePas 2018 - Model Reduction for Parametrized System IV — *École Centrale, Nantes, France*

Poster presentation — *April 10-13, 2018*

- **Poster title**: "POD–Galerkin reduced order methods for inverse problems and multi-physics problems in fluid dynamics" — ***co-authors***: *M. Nonino, Z. Zainib, F. Ballarin and G. Rozza*.

QUIET 2017 - Quantification of Uncertainty: Improving Efficiency and Technology — *SISSA, Trieste, Italy*

Poster presentation — *July 18-21, 2017*

- **Poster title**: "Reduced Order Methods for Environmental Marine Problems by Optimal Flow Control" — ***co-authors***: *F. Ballarin, R. Mosetti and G. Rozza*.

Teaching and Other Tasks

Teaching and co-advisoring

- **Lecturer** Basic course on reduced order modelling at "Summer School on Reduced Order Methods in Computational Fluid Dynamics (Second edition)", Trieste (July 2022).
- **Lecturer** Monographic Lecture on reduced order modelling for Optimal Control at "Summer School on Reduced Order Methods in Computational Fluid Dynamics (Second edition)", Trieste (July 2022).
- **Support Lecturer** - AMMA Phd- MHPC course on "Reduced Order Methods for Computational Mechanics", SISSA, 2022.
- **Support Lecturer** - Course of "Metodi e Modelli Numerici", master degree in mechanical engineering, Politecnico di Torino, 2022.
- **Co-advisor** - Master thesis of Fabio Zoccolan: "Stabilised reduced order methods for advection-diffusion optimal control problems with random inputs". Master degree in Mathmatics, University of Trieste, Italy, December (2021).
- **Co-advisor** - Master thesis of Eleonora Donadini: "A Data-Driven Approach for Time-Dependent Optimal Control Problems by Dynamic Mode Decomposition". Master degree in Data Science and Scientific Computing, University of Trieste, Italy, (May 2021).
- **Lecturer** Monographic Lecture on reduced order modelling for Optimal Control at "Summer School on Reduced Order Methods in Computational Fluid Dynamics", Trieste (July 2019).
- **Co-advisor** - Master thesis of Giuseppe Carere: "Reduced Order Methods for Optimal Control Problems constrained by PDEs with random inputs and applications". Master degree in mathematics, Korteweg-de Vries Institute for Mathematics , the Netherlands, (January 2019).
- **Support Lecturer** - Course of "Numerical Analysis", master degree in Data Science and Scientific Computing, (January 2018).

Other tasks

- **Reviewer**: Computers and Mathematics with Applications (2023), Applied Mathematics and Computation (2023), International Journal of Heat and Fluid Flow (2022), Journal of Scientific computing (2022), Advances in Computational Mathematics (2022), Journal of Computational Physics (2022), Frontiers in Applied Mathematics and Statistics (2022), Proceedings in Applied Mathematics and Mechanics (2020), International Journal of Computational Fluid Dynamics (2019).
- **Organizer**: Analysis Junior Seminars, SISSA, 2019 - 2021. SISSA Women in Mathematics 2021.
- **Student Association President**: SISSA SIAM Student Chapter, October 2020 - October 2021.
- **Student Association Vicepresident**: SISSA SIAM Student Chapter, October 2019 - September 2020.
- **Educational volunteer**: SISSA 4 SCHOOLS program, 2019 - present.
- **Educational Seminar**: "Pint of Science Festival".
- **Internship**: formulation of a Finite Element simulation of Quasi-Geostrophic equation in the North-Atlantic Ocean at OGS (National Institute of Oceanography and Applied Geophysics), 2016.

Awards and Grants

Grant GNCS grant for partecipating to ECCOMAS 2022.

Award Finalist: BGCE Prize at SIAM-CSE Congress, March 1-5, 2021.

Award Student Travel Award to partecipate to the SIAM Conference on Computational Science and Engineering, March 1-5, 2021.

Scholarship ECCOMAS Scholarship for partecipating at the Virtual Congress WCCM-ECCOMAS January 11 to 15, 2021.

Award Special Mention to PhD4Innovating contest. ESOF 2020, Trieste, Italy.

Grant MIT-Fiuli Venezia Giulia (FVG) Seed Fund 2019-2020: Data Assimilation, Models for Prediction and Control of Massachussets Bay Water Acidification.

Grant 2018 INDAM GNCS: Model Reduction in Medical Applications.