

Dr. Francesco Romor

Computational Engineer | Applied Mathematician | Numerical Simulation & AI

[Website](#) | [GitHub](#) | [Scholar](#)

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ABOUT ME

Have a look at my [website](#). I am a computational scientist with hands-on experience in high-performance computing, scientific machine learning, stochastic modelling and numerical simulations for real-world engineering problems. I develop and deploy scalable numerical solvers (C++, MPI, GPU via Kokkos/CUDA) and AI/machine learning/data-driven models (surrogate models, generative models). My work targets concrete applications, most recently patient-specific aortic blood flows and data assimilation from medical images.

PERSONAL INFORMATION

Nationality	Italian
Place of birth	Brunico (Bruneck), Italy

POSITIONS

Weierstrass Institute for Applied Analysis and Stochastics

Postdoctoral researcher

November 2023 –
Berlin, Germany

Research group: Numerical Mathematics and Scientific Computing.

Head: Prof. Volker John, **Coworker:** Dr. Alfonso Caiazzo.

Description: We have improved the current state of the art of surrogate modelling, shape generative modelling, and data assimilation for inter-patient aortic blood flows, combining high-performance numerical solvers with novel registration methods, data assimilation algorithms, and machine learning architectures.

International School for Advanced Studies (SISSA)

Ph.D. in Mathematical Analysis, Modelling and Applications

October 2019 – October 2023
Trieste, Italy

Thesis: [Nonlinear Parameter Space and Model Order Reductions enhanced by scientific machine learning](#)

Advisor: Prof. Gianluigi Rozza. **Co-advisor:** Prof. Giovanni Stabile.

Description: We improved the state of the art of the nonlinear manifold method in model order reduction by combining OpenFOAM's numerical solvers for CFD with machine learning models that approximate the solution manifold. The improvements were achieved through novel techniques in hyper-reduction, numerical and optimization methods, and machine learning architectures.

EDUCATION

University of Trieste

Master's degree in Mathematics, 110/110 cum laude

September 2017 – October 2019
Trieste, Italy

Thesis: [Reduction in Parameter Space for Problems approximated by the DG Method in CFD](#)

Advisor: Prof. Gianluigi Rozza.

University of Trieste

Bachelor's degree in Mathematics, 110/110 cum laude

September 2014 – September 2017
Trieste, Italy

Thesis: "Geodesics on Lie Groups with invariant Metrics"

Advisor: Prof. Giovanni Landi.

SOFTWARE

- Inter-patient generative AI (2026)** : Main developer. C++/python pipeline for generating new aortic shapes affected by coarctation with diffusion models/flow matching/stochastic interpolants. Key technology: generation of patient-specific hierarchy of hexahedral grids for geometric multigrid matrix-free preconditioners. Speedup of **3x** on average patient-specific shape against state-of-the-art full-order solver via exadg and the mesh generation pipeline ([publication](#)).
- SOT (2025)** : Main developer. C++ library for semi-discrete optimal transport using deal.II, geogram, Kokkos/CUDA. Speedup of entropy-regularized semi-discrete optimal transport via a multigrid implementation, domain decomposition (MPI), cut-off filters and Kokkos/CUDA: **65x** ([GitHub](#),[publication](#)).
- Inter-patient data assimilation (2024)** : Main developer. C++/python library for inter-patient data assimilation of aortic blood flows from medical images. Novel registration method (PyTorch, CGAL), parallel reduced-order model for data assimilation (deal.II, lifex-cfd, pybind, mpi4py), geometry-informed graph neural network surrogate (PyTorch, physicsnemo): **180x** speedup in inference time with respect to full-order model ([publication](#)).
- ITHACA-FV (2023)** : Contributor. C++ library for model reduction based on OpenFOAM. Implementation of a novel over-collocation hyper-reduction method in OpenFOAM, testing of novel nonlinear manifold method (petsc4py, PyTorch) as reduced-order model based on autoencoders and hyper-reduction. Speedup of **10x** on coarse Ahmed body benchmark ([GitHub](#),[publication](#)).
- Domain decomposition for ROMs (2022)** : Main developer. Python library (petsc4py) with C++ interface to deal.II via pybind for MPI domain decomposition implementation of reduced-order models ([GitHub](#)).
- ATHENA (2020)** : Main developer. Python library for active subspaces: implementation of kernel-based active subspaces for dimension reduction in parameter space. Application to speed up shape optimization of NACA airfoil: parameter space dimension from **7** to **1** ([GitHub](#), [publication](#)).

TECHNICAL SKILLS

- Languages** : C++, Python
- PDE Frameworks** : deal.II (lifex-cfd, exadg), OpenFOAM, FEniCS
- ML Libraries** : PyTorch, JAX
- GPU Computing** : Kokkos, CUDA
- Dev Tools** : Git

LANGUAGES

- Italian** : Native
- English** : C1 (First Certificate, Grade A, 2014)
- German** : B1.2 (2025)

RESEARCH TOPICS AND EXPERTISE

Numerical modelling and scientific computing:

- Numerical methods for PDEs Reduced-order models High-performance computing Domain decomposition
Computational fluid dynamics Cardiovascular models Stochastic modelling Stochastic differential equations
Uncertainty quantification Data assimilation Computational optimal transport

Scientific machine learning / Digital twins / AI4Science:

- Machine learning for PDEs Physics-informed machine learning Surrogate models Digital twins
Generative modelling Diffusion models/Flow matching/Stochastic interpolants AI4fluids Graph neural networks
Neural operators Probabilistic programming Solution manifold learning

RECENT RELEVANT PUBLICATIONS

LDDMM stochastic interpolants: domain uncertainty quantification in hemodynamics

S. Katz, F. Romor, J.-J. Zhu, A. Caiazzo, [arXiv:2603.28324](https://arxiv.org/abs/2603.28324)

2026

Shape-Informed GNNs and Data Assimilation: Application to Aortic Blood Flow

F. Romor, F. Galarce, J. Brüning, L. Goubergrits, A. Caiazzo, [SIAM Journal on Imaging Sciences](https://doi.org/10.1137/19M119710) 19(2), 710-751

2026

Efficient numerical strategies for entropy-regularized semi-discrete optimal transport

M. Khamlich, F. Romor, G. Rozza, [CMAME](https://doi.org/10.1007/s00033-025-02182-1) 453, 118821

2026

GRANTS AND SCHOLARSHIPS

MATH+ AA-Health-3 Grant

Randomization of Surrogate Models for Cardiovascular Models. PI with A. Caiazzo, A. Djurdjevac.

Berlin, Germany

2025–2027

INdAM Scholarship

Scholarship for the Bachelor degree in mathematics.

Trieste, Italy

2014–2017