Lorenzo Campoli

Personal details
Date of birth: 05/04/1986
Age: 39
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Personal webpage: https://lkampoli.github.io/Lorenzo.Campoli.github.io

Research areas
CFD, hypersonics, thermo-chemical non-equilibrium flows, magnetohydrodynamics, numerical methods for shock flows, shock-fitting, data-driven turbulence modelling, machine learning for fluid dynamics, space rocket vehicle propulsion design and aerothermodynamics.

Current employment
Senior System Modelling Engineer Sept. 2024 - present
Gilmour Space Technologies (https://www.gspace.com)

Research Fellow May 2022 - June 2024
University of Melbourne, Faculty of Engineering and Information Technology (https://energy.unimelb.edu.au)

- Data-driven turbulence closure modeling

Assoc. Professor June 2023 - present
Macquarie University, Faculty of Engineering (https://www.mq.edu.au)

Professional development
CSIRO ON Prime 15 Program Apr. 2024 - Jun. 2024
https://research.csiro.au/onalumni/hypersocks
https://hypersocks.quarto.pub/hypersocks-team

Previous work experience
Assistant Professor Jun. 2020 - Jun. 2022
Saint Petersburg State University, Faculty of Mathematics and Mechanics (http://gam.spbu.ru)

- Research activity (computational fluid dynamics and machine learning code development for non-equilibrium flows in state-to-state and multi-temperature formulations)
- Teaching activity (see section below)

Assistant researcher Nov. 2018 – Apr. 2020
Saint Petersburg State University, Faculty of Mathematics and Computer Science

(https://chebyshev.spbu.ru)

- Numerical modelling and investigation of viscous finger phenomenon and enhanced recovery methods for flows in porous media.

Supervisors: Prof. S. Tikhomirov

PostDoc researcher Nov. 2017 – Nov. 2020

Saint Petersburg State University, Faculty of Mathematics and Mechanics (http://gam.spbu.ru)

- Code developement for high speed non-equilibrium reacting flows with state-to-state approach.

Supervisors: Prof. E. Kustova

Visiting researcher Jun. – Jul. 2015

NASA Ames, Wescoat Rd, Mountain View, CA 94043, USA (www.nasa.gov/centers/ames/home)

- Implement a boundary version of the shock-fitting technique onto the high-order finite differences NASA code ADPDIS3D

Supervisors: Dott. H. C. Yee, Dott. D. Kotov and Prof. B. Sjogreen

Visiting researcher Mar. – Jun. 2015

INRIA, 200 Avenue de la Vieille Tour, 33405 Talence, France (www.inria.fr/centre/bordeaux)

- Coupling of a shock-fitting algorithm with the Residual Distribution (RD) INRIA code RD-RK2 for the study of unsteady two-dimensional flows on moving and deforming unstructured grids with an Arbitrary Lagrangian-Eulerian (ALE) formulation

Supervisors: Dott. M. Ricchiuto and Prof. R. Paciorri

Research assistant May – Dec. 2013

AVIO, Corso G. Garibaldi 22, 00034, Colleferro, Italy (www.aviogroup.com)

- Pressure oscillations numerical simulations of P80 Vega Solid Rocket Motor (SRM)
- Aerothermodynamic numerical simulations on Vega launcher fairing

Supervisor: Dott. F. Paglia

Technical consultant Feb. – Apr. 2013

NHAZCA, Via Cori snc, 00177, Rome, Italy (www.nhazca.it)

- Algorithms development and implementation for terrestrial and satellite interferometric radar applications (SAR, TinSAR, DinSAR)

Stagist Jun. – Jul. 2004

INFN, Via E. Fermi, 00044, Frascati, Italy (www.infn.it)

- Homogeneity measurements of a MultiWire Proportional Chamber (MWPC)

Supervisor: Dott. M. Anelli

Teaching experience

Saint Petersburg State University, Faculty of Mathematics and Mechanics (https://gam.spbu.ru)

- Hypersonics Sep. 2020 – Sep. 2022
- Machine Learning for Fluid Mechanics Mar. 2021 – Sep. 2022

- Modern Scientific Visualization Mar. 2021 – Jun. 2021
- Scientific Paper Writing Mar. 2021 – Jun. 2021
- Concepts of Modern Natural Science Mar. 2021 – Jun. 2021

Degrees

Ph.D. in Theoretical and Applied Mechanics Nov. 2013 – Nov. 2016
Sapienza University of Rome (Dept. of Mechanics and Aeronautics)
Thesis: A shock-fitting technique for two-dimensional unsteady flows on unstructured grids
Date of the defense of the Ph.D.: 08/02/2017
Supervisor: Prof. R. Paciorri
Advisor: Prof. C. M. Casciola

Second level Master in Space Transportation Systems Feb. 2012 – Dec. 2012
Sapienza University of Rome
`https://web.uniroma1.it/mastersts`
Thesis: Solid rocket motor's internal fluid dynamics: fluid-structure interaction
Date of the defense of the Master: 20/01/2013
Supervisor: Dott. F. Paglia
Advisor: Prof. F. Nasuti

Master in Space Engineering Sept. 2008 – Feb. 2012
Sapienza University of Rome
Thesis: Modeling and simulation of base flows in subsonic regime
Date of the defense of the Master: 20/02/2012
Supervisor: Prof. R. Paciorri

Bachelor in Aerospace Engineering Sept. 2005 – Dec. 2008
Sapienza University of Rome
Thesis: Ablative materials: types and characterization
Date of the defense of the Bachelor: 20/12/2008
Supervisor: Prof. G. Rinaldi

Technical skills

OS: Linux
Programming languages: Fortran, C/C++, Matlab, Mathematica
Parallel programming models: MPI, OpenMP, Coarray, CUDA, OpenACC
Profiling, debugging and performance analysis tools: gprof, perf, gdb, Valgrind, Vtune, Advisor, Paraver, Scalasca, Extrae, LIKWID, PAPI
Version-control software: svn, bzr, git
Scripting languages: linux shell, Perl, Python, Jupyter, Colab, R
Machine learning and data mining: TensorFlow, Keras, PyTorch, Pandas, Scikit-learn, Numpy
Document processors: Latex, Lyx, Office, Overleaf
Fluid dynamic solvers: STAR CCM+, CFD++, Comsol, Dumux, Fluent, Ansa, OpenFOAM, Nektar++, SU2, COOLFluid, FronTier++, MRST, Overture and in-house developed codes
Mesh generators Triangle, Tetgen, Delaundo, Yams, Gmsh, GRUMMP, mmg3d, Fluent, MeshLab
Visualization tools: Tecplot, Gnuplot, VisIt, ParaView, Matplotlib, Blender
CAD tools: AutoCAD, FreeCAD, SolidWorks, Catia, SpaceClaim

Language skills
Italian (mothertongue), English proficiency (C1), upper intermediate Russian (B2), intermediate Spanish (A2), intermediate French (A2), Chinese (HSK 3).

Research outputs
L. Campoli, A. Assonitis, M. Ciallella, R. Paciorri, A. Bonfiglioli, M. Ricchiuto. UnDiFi-2D: an Unstructured Discontinuity Fitting code for 2D grids. Computer Physics Communications, 2021, https://doi.org/10.1016/j.cpc.2021.108202, IF=3.4, Q1.

L. Campoli, L., Assonitis, A., Ciallella, M., Paciorri, R., Bonfiglioli, A., Ricchiuto, M. (2021). UnDiFi-2D: an Unstructured Discontinuity Fitting code for 2D grids. arXiv preprint arXiv:2105.14269.

L. Campoli, Kustova, E., Maltseva, P. (2021). Assessment of machine learning methods for state-to-state approaches. arXiv preprint arXiv:2104.01042.

L. Campoli, Kunova, O., Kustova, E., Melnik, M. (2020). Models validation and code profiling in state-to-state simulations of shock heated air flows. Acta Astronautica. https://doi.org/10.1016/j.actaastro.2020.06.008, IF=3.4, Q1.

Bakharev, F., Campoli, L., Enin, A., Matveenko, S., Petrova, Y., Tikhomirov, S., & Yakovlev, A. (2020). Numerical Investigation of Viscous Fingering Phenomenon for Raw Field Data. Transport in Porous Media, 1-22. https://doi.org/10.1007/s11242-020-01400-5, IF=2.6, Q1.

L. Campoli, G. Oblapenko, M. Mekhonoshina, E. Kustova: Numerical investigation of hypersonic non-equilibrium flow around blunt body by COOLFluiD-Kappa coupling. AIP Conference Proceedings. 31st International Symposium on Rarefied Gas Dynamics (RGD31), 23rd-27th July 2018, University of Strathclyde, Glasgow, UK.

L. Campoli, G. P. Oblapenko and E. V. Kustova. KAPPA: Kinetic Approach to Physical Processes in Atmospheres library in C++. Computer Physics Communications, 2018, https://doi.org/10.1016/j.cpc.2018.10.016, IF=3.4, Q1.

L. Campoli, Quemar, P., Bonfiglioli, A., & Ricchiuto, M. (2017). Shock-fitting and predictor-corrector explicit ALE Residual Distribution. In Shock Fitting (pp. 113-129). Springer, Cham., (Book).

A. Bonfiglioli, R. Paciorri, L. Campoli, Unsteady shock-fitting for unstructured grids. International Journal for Numerical Methods in Fluids, 2015, https://doi.org/10.1002/fld.4183, IF=2.6, Q1.

Conferences
L. Campoli, Richard D. Sandberg, Yuan Fang, Xiaowei Xu. Enhancement of gene expression programming for Reynolds-Averaged Navier-Stokes equations turbulence modeling with unsupervised clustering. 23rd Australasian Fluid Mechanics Conference Sydney, Australia, 4 – 8th December 2022.

L. Campoli, Oblapenko, G. P., & Kustova, E. V. (2019, August). Overview and perspectives of KAPPA library. In AIP Conference Proceedings (Vol. 2132, No. 1, p. 150005). AIP Publishing LLC. https://doi.org/10.1063/1.5119645

L. Campoli, G. Oblapenko, M. Mekhonoshina, E. Kustova: Numerical investigation of hypersonic non-equilibrium flow around blunt body by COOLFluiD-Kappa coupling. 31st Int. Symposium on Rarefied Gas Dynamics (RGD31), 23rd-27th July 2018, University of Strathclyde, Glasgow, UK.

O. V. Kunova, L. Campoli. On the implementation of the software library Kappa and its interface with COOLFluiD. International scientific conference on mechanics "The Eighth Polyakhovs Reading". 30th Jan - 2nd Feb. 2018, Saint Petersburg, Russia.

A. Bonfiglioli, R. Paciorri, L. Campoli, V. De Amicis, M. Onofri, Development of an unsteady Shock-fitting technique for unstructured grids. 30th International Symposium on Shock Waves (ISSW30), July 19-24, 2015, Tel-Aviv, Israel.

A. Bonfiglioli, R. Paciorri, L. Campoli, Unstructured shock-fitting calculations of transonic turbo-machinery flows. Proceedings of 11th European Conference on Turbomachinery Fluid dynamics & Thermodynamics ETC11, March 23-27, 2015, Madrid, Spain.

A. Bonfiglioli, R. Paciorri, L. Campoli, (2014). An unsteady shock-fitting technique for unstructured grids. In Onate, E., Oliver, J., and Huerta, A., editors, 6th. European Congress on Computational Fluid Dynamics (ECFD VI), pages 4864–4872, Barcelona, Spain. ECCOMAS, International Center for Numerical Methods in Engineering.

M. Onofri, R. Paciorri, L. Campoli, A. Bonfiglioli, An unsteady shock-fitting technique for unstructured grids. 21st International Shock Interaction Symposium ISIS21, August 3-8, 2014, Riga, Latvia.

R. Paciorri, L. Campoli, Numerical Simulations of Flows Past the IXV Capsule. 5th International ARA Days, May 18-20, 2015, Arcachon, France.

Research funding and grants

Dog_2019: Development of tools for determining the definition of optimal EOR: connection of EOR and mechanisms of influence, methods of monitoring
13/03/19 → 16/05/19

RSF_RG_2019 - 1: Modeling of non-equilibrium carbon dioxide flows in modern problems of space aerodynamics and ecology of the Earth: 2019 stage 1
6/05/19 → 31/12/19

Dog_2019: Development of methods for increasing the predictive ability of three-dimensional digital geological models
31/05/19 → 30/09/19

Dog_2019: Development of tools for determining the optimal EOR in terms of the SAW-polymer and alkaline-polymer flooding, estimates of Kohv in a 5-point system work, evaluation of the optimal size of the polymer fringe
22/10/19 → 31/12/19

Dog_2019: Development of methods for increasing the predictive ability of three-dimensional digital geological models

16/12/19 → 19/03/20

RSF_RG_2019 - 2: Modeling of non-equilibrium flows of carbon dioxide in modern tasks of space aerodynamics and ecology of the Earth: 2020 stage 2
1/01/20 → 31/12/20

Dog_2019: Donation agreement No. 117/19-BP
1/01/20 → 31/12/20

RSF_RG_2019 - 3: Modeling of non-equilibrium flows of carbon dioxide in modern tasks of space aerodynamics and ecology of the Earth: 2021 stage 3
1/01/21 → 31/12/21

M1_2021 - 1: Machine learning in problems of non-equilibrium aeromechanics: 2021 stage 1
24/08/21 → 31/12/21

Awards and honours
Certificate of participation in several PRACE Training Centre's courses.
`https://training.prace-ri.eu`

Partnership of a European Group of Aeronautics and Space UniversitieS (PEGASUS), 2012.
`https://www.pegasus-europe.org`

About me
I do sport (running, biking and swimming) on daily basis. I love nature, trekking and alpinism and I've been a boy-scout for 10 years. I play classical, electrical guitar and drum. I'm interested in reading and writing prose and poetry, astronomy and travelling. I enjoy discovering new cultures, languages, traditions. I'm gratified in helping people.