Michele Buzzicotti

Curriculum Vitae

Personal details

Name **Michele Buzzicotti**.

Birth **21 July 1987, Terni**.

E-mail **michele.buzzicotti@roma2.infn.it**.

Professional experience

13/12/2018-Present **Researcher, (RTDa)**, University of Rome "Tor Vergata", Dept. of Physics.

14/01/2020-16/02/2020 **Visiting Scholar**, University of Rochester, Dept. of Mechanical Engineering. collaboration with **Prof. Hussein Aluie**

01/03/2017-12/12/2018 **PostDoc**, University of Rome "Tor Vegata", Dept. of Physics. Funded by ERC Advanced Grant "Newturb". **PI Prof. Luca Biferale**

Teaching experience

2020/21 **Applied Cybernetics (Machine Learning)**, *lecturer*, Department of Physics, University of Rome Tor Vergata.

2019/20 **Statistical Mechanics**, *lecturer*, Department of Physics, University of Rome Tor Vergata.

2019/20 **Physics of complex flows and turbulence**, *lecturer*, Department of Physics, University of Rome Tor Vergata.

Students Supervision

2021 **Alessandro De Santis**, *co-supervisor*, Master degree.

2020 **Martino Scarpolini**, *co-supervisor*, Master degree.

2019 **Chiara Calascibetta**, *co-supervisor*, Bachelor degree.

Education

01/2017 **Ph.D. degree in Physics**, *University of Rome*, "Tor Vergata".

Title Effects of Fourier mode reduction on small-scales turbulent fluctuations; Robustness and modelling

Thesis Advisor Prof. Luca Biferale, Department of Physics and INFN, University of Rome "Tor Vergata"

2013 **Master degree in Physics**, *University of Rome*, "Tor Vergata", 110/110 cum laudem.

Title Analysis and Diagnostic of the Calibration Techniques of water vapour measurements from two LIDAR Raman belonging to the international network NDACC

Thesis Advisor Prof. G.L. Liberti, CNR ISAC, Roma Tor Vergata and Prof. Philippe Keckhut, CNRS-LATMOS Paris

2010 **Bachelor degree in Physics of the Atmosphere**, *University of Rome*, "Tor Vergata".

Research interest

Understanding **complex flows** and **complex systems** is at the core of my research, which I carry out using state of the art **direct numerical simulations** (DNS) and **artificial intelligence** (AI) tools. My activity ranges from the development of non-linear, out of equilibrium models, for small-scale closure for high Reynolds flows up to the solution of **control problems**. The latter I have tackled with a theoretical point of view, ie aiming the control of intense fluctuations, as well as asking applied questions such as optimal navigation in complex environments. Recently I have started working on **data assimilation** problems, ie reconstruction of missing data from partial information/measurements. I am responsible for the development of High-Performance Computing codes for DNS. From the AI side, I am involved in the application of the newest **deep learning** algorithms for the solution of open questions in fluid dynamics. At the same time, I use **reinforcement learning** methods to solve decision problems like navigation optimization of smart swimmers.

Awards

1/12/2019-1/5/2021 **Project Awarded: Beyond Borders**, *Project Title: "Machine Learning Techniques for Optimal Navigation in Complex flows"*, duration: 18 months, funds awarded: 16000 euro.

2019 **Best Scientific Presentation Award**, *Presentation Title: "Energy cascade in rotating turbulent flows"*, PRACEdays19 during the EuroHPC Summit Week 2019, funds awarded: 1500 euro.

Memberships

2016-present **APS**, *American Physical Society*.

2013-present **EUROMECH**, *European Mechanics Society*.

2013-present **INFN**, *Istituto Nazionale di Fisica Nucleare*.

Key Numbers (scientific impact, Google Scholar)

Number of published papers, *20*.

Hirsch-index (H), *8*.

i10-index (# publications with more than 10 citations), *8*.

Citations (total), *212*.

Computer Skills

OS **Unix**, *expert user*.

Programming languages **C, Python, Cython, MPI, OpenMP**.

Main software for data analysis **FFTW**, **P3DFFT** Fast Fourier Transform; **GSL-Blas** Gnu Scientific Libraries; **HDF5** parallel I/O; Gnuplot; awk; Paraview

AI libraries **Tensorflow** and **Keras**

Publications

20) **Buzzicotti,M.**, & Tauzin,G. (2021). Inertial range statistics of the Entropic Lattice Boltzmann in 3D turbulence. Physical Review E, 104(1), 015302.
19) **Buzzicotti,M.**, Bonaccorso,F., Clark Di Leoni,P., & Biferale,L. (2021). Reconstruction of turbulent data with deep generative models for semantic inpainting from TURB-Rot database. Physical Review Fluids 6.5: 050503.
18) **Buzzicotti,M.**, Biferale, L., Bonaccorso, F., di Leoni, P. C., & Gustavsson, K. (2020). Optimal Control of Point-to-Point Navigation in Turbulent Time Dependent Flows Using Reinforcement Learning. In International Conference of the Italian Association for Artificial Intelligence (pp. 223-234). Springer, Cham.
17) **Buzzicotti,M.**, & Clark Di Leoni,P. (2020). Synchronizing subgrid scale models of turbulence to data. Physics of Fluids 32.12 (2020): 125116
16) Clark Di Leoni,P., Alexakis,A., Biferale,L., & **Buzzicotti,M.** (2020). Phase transitions and flux-loop metastable states in rotating turbulence. Physical Review Fluids 5.10 (2020): 104603.
15) Biferale,L., Bonaccorso,F., **Buzzicotti,M.**, & Clark Di Leoni,P. (2020). TURB-Rot. A large database of 3d and 2d snapshots from turbulent rotating flows. arXiv preprint arXiv:2006.07469.
14) Biferale,L., Bonaccorso,F., **Buzzicotti,M.**, Clark Di Leoni,P. & Gustavsson,K. (2019). Zermelo's problem: Optimal point-to-point navigation in 2D turbulent flows using reinforcement learning Chaos: An Interdisciplinary Journal of Nonlinear Science 29(10):103138.
13) **Buzzicotti, M.**, Biferale, L., & Toschi, F. (2019). Statistical properties of turbulence in the presence of a smart small-scale control. Physical Review Letters 124.8 (2020): 084504.
12) Biferale, L., Bonaccorso, F., **Buzzicotti, M.**, Iyer, K. P. (2019). Optimal sub-grid model for accurate determination of intermittent inertial range properties of turbulent flows. Physical review letters 123 (1), 014503.
11) Offermans, J., Linkmann, M., **Buzzicotti, M.** & Biferale, L. (2018) *A-priori* study of the subgrid energy transfers for small-scale dynamo in kinematic and saturation regimes. Physics of Plasmas 25 (12), 122307.
10) **Buzzicotti, M.**, Clark Di Leoni, P., & Biferale, L. (2018). On the inverse energy transfer in rotating turbulence. The European Physical Journal E 41.11: 131.
9) Linkmann, M., **Buzzicotti, M.**, & Biferale, L. (2018). Multi-scale properties of large eddy simulations: correlations between resolved-scale velocity-field increments and subgrid-scale quantities. Journal of Turbulence, 1-35.
8) **Buzzicotti, M.**, Aluie, H., Biferale, L., & Linkmann, M. (2018). Energy transfer in turbulence under rotation. Physical Review Fluids, 3(3), 034802.
7) Linkmann, M., **Buzzicotti, M.**, & Biferale, L. (2018). Nonuniversal behaviour of helical two-dimensional three-component turbulence. The European Physical Journal E, 41(1), 4.
6) **Buzzicotti, M.**, Linkmann M., Aluie H., Biferale L., Brasseur J. & Meneveau C. (2018). Effect of filter type on the statistics of energy transfer between resolved and subfilter scales from a-priori analysis of direct numerical simulations of isotropic turbulence. Journal of Turbulence 19.2: 167-197.
5) Biferale, L., **Buzzicotti, M.** & Linkmann, M. (2017). From two-dimensional to three-dimensional turbulence throughout two-dimensional three-component structures. Physics of Fluids 29, 111101.
4) **Buzzicotti, M.**, Bhatnagar, A., Biferale, L.,Lanotte, A.S. & Ray S.S. (2016). Lagrangian Statistics for Navier-Stokes Turbulence under Fourier-mode reduction: Fractal and Homogeneous Decimations. New Journal of Physics, 18(11), 113047.
3) **Buzzicotti, M.**, Biferale, L., Frisch, U., & Ray, S. S. (2016). Intermittency in fractal Fourier hydrodynamics: Lessons from the Burgers equation. Physical Review E, 93(3), 033109.
2) **Buzzicotti, M.**, Murray, B. P., Biferale, L., & Bustamante, M. D. (2016). Phase and precession evolution in the Burgers equation. The European Physical Journal E, 39(3), 1-9.
1) Liberti, G. L., Transerici, C. & **Buzzicotti, M.** (2012). Validation of TMI derived total precipitable water vapour with operational soundings. Microwave Radiometry and Remote Sensing of the Environment (MicroRad), 2012 12th Specialist Meeting on. IEEE.

Talks - Conferences (most relevant)

Feb. 2020 **Seminar at the Department of Mechanical Engineering of Rochester University; Rochester (NY, USA)**, *Title: 'Optimal navigation in complex flows'*.

Jan. 2020 **3rd Physics Informed Machine Learning; Santa Fe (NM, USA)**, *Title: 'Zermelo's problem using Reinforcement Learning'*.

Sept. 2019 **17th European Turbulence Conference; Torino (Italy)**, *Title: 'Optima sub-grid-scale models for inertial range turbulence'*.

Jun. 2019 **EuroHPC Summit Week 2019/PRACEdays19; Poznan (Poland)**, *Title: 'Energy transfer in turbulence under rotation'*.

Jan. 2019 **Seminar at the University of Marburg; (Germany)**, *Title: 'Energy transfer in turbulence under rotation'*.

Nov. 2018 **APS Division of Fluid Dynamics; Atlanta (GA, USA)**, *Title: 'Optimal sub-grid model for inertial range turbulence'*.

Sep. 2018 **12th European Fluid Mechanics Conference (EFMC12); Vienna (Austria)**, *Title:'Energy transfer in turbulence under rotation'*.

Jul. 2018 **HPC-LEAP Conference; Cambridge (England)**, *Title:'On the inverse energy transfer in rotating turbulence'*.

Nov. 2017 **APS Division of Fluid Dynamics; Denver (CO, USA)**, *Title: 'From to 2D to 3D turbulence through 2D3C configurations'*.

Aug. 2017 **16th European Turbulence Conference; Stockholm (Sweden)**, *Title: 'Eulerian and Lagrangian turbulence on reduced Fourier sets'*.

May, 2017 **Fluids and Structures: Interaction and Modeling; Naples (Italy)**, *Title: 'Transition from 3D to 2D turbulence by Fourier space decimation'*.

Nov. 2016 **APS Division of Fluid Dynamics; Portland (OR, USA)**, *Title: 'On the statistics of backscatter from sub-grid fluctuations at high Reynolds numbers'*.

Nov. 2016 **Seminar at the Department of Mechanical Engineering of Rochester University; Rochester (NY, USA)**, *Title:'Eulerian and Lagrangian statistics in Fourier-reduced Navier Stokes equations'*.

Oct. 2016 **HPC Applications to Turbulence and Complex Flows; Rome (Italy)**, *Title:'Coherent structures and phases synchronization in non linear Burgers equation'*.

Sep. 2016 **11th European Fluid Mechanics Conference (EFMC11); Sevilla (Spain)**, *Title:'Eulerian and Lagrangian turbulence on fractal Fourier set'*.

Sep. 2016 **iTi conference on Turbulence 2016 ; Bertinoro (Italy)**, *Title:'Extreme events and phases synchronization in Navier-Stokes equations and in non-linear models'*.

Jun. 2016 **7th Summer school; Complex Motion in Fluids; Twente (Netherlands)**, *Title:'Coherent structures and phases synchronization in non linear Burgers equation'*.

Jan. 2016 **COST Flowing Matter; Porto (Portugal)**, *Title:'Intermittency in the Fractal Fourier Burgers Equation'*.

Nov. 2014 **APS Division of Fluid Dynamics; San Francisco (CA, USA)**, *Title: 'Burgers Turbulence on a Fractal Fourier set'*.

Oct. 2014 **Seminar at the ICTS; Bangalore (India)**, *Title: 'Burgers equation and Fourier Fractal Decimation'*.

Jun. 2014 **Seminar at the observatoire de Nice; Nice (France)**, *Title: 'Burgers equation and Fourier Fractal Decimation'*.

May, 2014 **"New Frontiers in Theoretical Physics"; Cortona (Italy)**, *Title: 'Burgers' equation, a model for turbulence'*.

Invited Talks - Schools

Oct. 2020 **Webinar organized by IIT Hyderabad, http://physics.iith.ac.in/APML/ (ONLINE)**, *Title: 'Artificial Intelligence meets complex flows, from optimal navigation to reconstruction of turbulent data'*.

Oct. 2020 **Webinar organized by Laboratoire de Mécanique des Fluides de Lille, https://lmfl.cnrs.fr/en/evenement/seminaire-michele-buzzicotti-2/ (ONLINE)**, *Title: 'Artificial Intelligence meets complex flows, from optimal navigation to reconstruction of turbulent data'*.

Sept. 2020 **STIMULATE PhD School on Machine and Reinforcement Learning, Rare Events and Tensor Networks (ONLINE)**, *Title: 'Deep Learning and RL applications'*.

Oct. 2019 **Seminar at the CNR ISAC of Rome; (Italy)**, *Title: 'Optimal navigation in complex flows'*.

Mar. 2016 **COST Lagrangian transport: from complex flows to complex fluids; Lecce (Italy)**, *"Invited speaker", title:'Eulerian and Lagrangian turbulence on fractal Fourier set'*.

DATE
13/08/2021

SIGNATURE
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