Dr. Bernat Font

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Research interests

Computational fluid dynamics, turbulence modelling, deep learning & data-driven models, numerical methods, high-performance computing.

Experience

Postdoctoral Researcher, Large-scale Computational Fluid Dynamics Group, Barcelona Supercomputing Center, Spain. 2021-
Topic: NextSim EU project – Next generation of industrial aerodynamic simulation code.

Postdoctoral Researcher, Mathematical Institute, Oxford University, UK. 2020-2021
Topic: Transport of porous particles in fluid flow.

Visiting PhD Researcher, Institute of High-Performance Computing, A*STAR, Singapore. 2017-2020

Education

Ph.D. Computational Fluid Dynamics, University of Southampton, UK. 2015-2020
Thesis: Modelling of Flow Past Long Cylindrical Structures. (download)
Supervisors: Prof. G.D. Weymouth, Prof. O.R. Tutty, Dr. V.-T. Nguyen.
Visiting Researcher: Research attachment funded by the ARAP mobility scheme, Institute of High-Performance Computing, A*STAR, Singapore.

M.Sc. Computational Fluid Dynamics, Cranfield University, UK. 2014-2015
Thesis: High-order Shock-capturing Schemes for Micro Shock Tubes. (download)
Supervisor: Dr. L. Könözsy.
Double Degree with Ingeniería Superior in Aeronautical Engineering.

Ingeniería Superior Aeronautical Engineering, Universitat Politècnica de Catalunya, Spain. 2012-2015
Mentor: Prof. C.-D. Pérez-Segarra.
Equivalent to Master of Engineering.

Ingeniería Técnica Aeronautical Engineering, Universitat Politècnica de Catalunya, Spain. 2009-2012
Equivalent to Bachelor of Engineering.

Publications

Peer-reviewed journal articles

3. Varela, P., Suárez, P., Alcántara-Ávila, F., Miró, A., Rabault, J., Font, B., García-Cuevas, L.M., Lehmkuhl, O., Vinuesa, R (2022) Deep reinforcement learning for flow control exploits different physics for increasing Reynolds number regimes. *Actuators* 11, 359. (doi)

2. Font, B., Weymouth, G.D., Nguyen, V.-T. & Tutty, O.R. (2021) Deep-learning of the spanwise-averaged Navier–Stokes equations. *Journal of Computational Physics* 434, 110199. (doi | preprint)

1. Font, B., Weymouth, G.D., Nguyen, V.-T. & Tutty, O.R. (2019) Span effect on the turbulence nature of flow past a circular cylinder. *Journal of Fluid Mechanics* 878, 306–323. (doi | preprint)

Peer-reviewed symposium proceedings

2. Radhakrishnan, S., Gyamfi, L.A., Miró, A., Font, B., Calafell, J., Lehmkuhl, O. & Tutty, O.R. (2021) A data-driven wall-shear stress model for LES using gradient boosted decision trees *ISC High Performance 2021* pp. 105–121. (doi | preprint)

1. Font, B., Weymouth, G.D., Nguyen, V.-T. & Tutty, O.R. (2020) Turbulent wake prediction using deep convolutional neural networks *33rd Symposium on Naval Hydrodynamics*, Osaka, Japan. (doi)

Conference proceedings

1. Font, B., Weymouth, G.D. & Tutty, O.R. (2017) Analysis of two-dimensional and three-dimensional wakes of long circular cylinders. *OCEANS MTS/IEEE*, Aberdeen, UK. (doi)

Published abstracts

3. Font, B., Weymouth, G.D. & Tutty, O.R. (2019) Deep learning the spanwise-averaged wake of a circular cylinder. *72nd Meeting of the APS Division of Fluid Dynamics*, Seattle, US. (url | presentation)
2. Font, B., Castells, I., Weymouth, G.D., Nguyen, V.-T. & Tutty, O.R. (2019) Turbulence dynamics transition of flow past a circular cylinder and the prediction of vortex-induced forces. *European Turbulence Conference 17*, Torino, Italy. (url)
1. Font, B., Weymouth, G.D. & Tutty, O.R. (2016) A two-dimensional model for three-dimensional symmetric flows. *UK Fluids Conference*, London, UK. (url)

Invited Talks

PPPL Computer Science Department's Machine Learning seminar, Princeton University, September 2021.
Engineering Mind Podcast: CFD + Machine Learning, Turbulence & PhD Life, June 2021. (url)
Applied Mathematics in Aerospace Engineering seminar, Universidad Politecnica de Madrid, Spain, April 2021.
Applied Math Colloquium, University North Carolina, US, March 2021.
Ocean Engineering, University Rhode Island, US, February 2021.
Fluid Dynamics Group Institute of High Performance Computing (A*STAR), Singapore, November 2020.
Fluid Structure Interactions Group seminar series, University of Southampton, UK, July 2020.

Teaching and supervision

Supervisor of PhD students, *TU Delft* 2023-
- Physics-based machine learning of marine hydrodynamics

Lecturer at the PUMPS+AI Summer School, *Barcelona Supercomputing Center* 2022
- Machine learning for computational fluid dynamics (url)

Supervisor of undergrad projects, *Universitat Politècnica de Catalunya* 2021-
- Discovering new scaling laws in turbulent boundary layers via multi-expression programming. (url)
- Discovering new expressions for the vortex trajectories and velocity profiles of synthetic jets. (url)

Supervisor of MSc projects, *University of Southampton* 2019-2020
- Machine learning wall model for bluff bodies forces calculation.
- Accurate flow interpolation using optimal transport theory.

Demonstrator, *University of Southampton* 2015-2017
- Aerodynamics: Nozzle lab.
- Propulsion: Ramjet, turbojet and rocket engine labs.
- Aerothermodynamics: Marking of lab reports.

Software skills

Programming languages: Fortran (including MPI), Julia, Python (including PyTorch, Keras, and Tensorflow), C, Java, Matlab.
Tools: Git, LaTeX, Inkscape, Paraview.

References

Gabriel D. Weymouth, Professor of Ship Hydromechanics.
TU Delft, Netherlands.
g.d.weymouth@tudelft.nl

Carles-David Pérez-Segarra, Professor at the Heat and Mass Transfer Technological Center.
Universitat Politècnica de Catalunya, Spain.
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Vinh-Tan Nguyen, Senior Scientist at the Institute of High Performance Computing.
A*STAR, Singapore.
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F. Xavier Trias, Associate Professor at the Heat and Mass Transfer Technological Center.
Universitat Politècnica de Catalunya, Spain.
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Owen R. Tutty, Professor at the Aerodynamics and Flight Mechanics Group.
University of Southampton, UK.
o.r.tutty@soton.ac.uk