Andrea Carloni

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CONTACTS

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PERSONAL INFORMATION

Place of birth: Rome (RM), Italy
Citizenship: Italian
Language proficiency: Italian (native), English (excellent), Spanish (beginner)

1. EDUCATION

Type	Year	Institution	Grade
Energy and Environment PhD. Course	2025-ongoing	Sapienza University of Rome	-
Master's degree in Mechanical Engineering	2025 (11/10)	Sapienza University of Rome	110/110
Bachelor's degree in Mechanical Engineering	2022 (28/01)	Sapienza University of Rome	96/110

2. RESEARCH EXPERIENCE

Year	Name	Grant Value
2025-ongoing	Sapienza University of Rome Scholarship, BS-J/8	10.820,00 euros

3. GRANTS

3.1 As principal investigator (PI)

Year	Name	Destination	Grant Value
2025-ongoing	CINECA ISCRA-C, agreement nr. HP10CHSSR2	National	33.333 CPU hours

4. CONFERENCES

PA=Presenting Author, A=Auditor

Year	Conference Name	Location
2025	4^{th} National Workshop on Turbomachinery, University of Bergamo, AIMSEA, **PA** in the poster session	Bergamo, IT
2025	New directions in complex flows, Accademia Nazionale dei Lincei, **A**	Roma, IT

5. CONTRIBUTIONS

Year	Project Name	Type of Contribution
2025	Development of pyRES: a Python library for time-dependent energy analysis and optimization of Renewable Energy Communities	Python implementation
2025-ongoing	Off-shore Wind Energy Course 2025, Sapienza University of Rome	Technical tutor in the project works

6. RESEARCH ACTIVITIES

6.1 Relevant research skills

- Expert expertise in CFD solvers: OpenFOAM
- Advanced knowledge of numerical methods for Computational Fluid Dynamics
- Expert user of software and data-driven methods for CFD data post-processing
- Expert user of high-performance computing systems
- Expert programmer of Python including AI modules: SciPy, Scikit-learn, TensorFlow, PyTorch
- Advanced programmer of C++

6.2 Academic research activities

The following list refers to the most recent relevant academic research activities, grouped by topic.

Year(s)	Keywords	Brief Description
2024	- Unsupervised Learning - Machine Learning (ML) - Clustering - Wind turbine wakes	This work aims to test the effectiveness of clustering algorithms for decomposing wind turbine wakes. Multiple combinations of clustering algorithms, hyperparameter settings, features, and scalers were tested to highlight the potential of this approach. Each combination exhibits different characteristics in terms of accuracy and computational load, illustrating how some of these favours one aspect over the other. The results are consistent with the known physical characteristics of wake regions and demonstrate an optimal computational load suitable for real-time use during CFD simulations of wind turbines.
2025-ongoing	- Supervised Learning - Neural Network (NN) - Multilayer Perceptron (MLP) - CFD - Large-eddy simulations (LES) - Raynolds-Averaged Navier-Stokes simulations (RANS) - Actuator line method (ALM) - Atmospheric Boundary Layer (ABL) - High-performance computing (HPC)	This work aims to integrate machine learning methods into CFD simulations to improve the accuracy of RANS models based on LES results, without significantly increasing the computational load. To achieve this, numerous CFD simulations were performed for various combinations of wind turbines and operating conditions. Both RANS and LES models were used, employing the ALM to discretize the turbine blades and accounting for terrain presence and the influence of the ABL. Subsequently, the RANS simulations were corrected using the main LES fields of pressure and velocity, and a timestep was simulated with a modified version of the SIMPLE solver. The simulations were carried out both on the computing infrastructure of Sapienza University of Rome and on the CINECA GALILEO100 HPC system, following the awarding of a project grant. The results will be used to develop a regression model to translate RANS outputs into LES-like results using an MLP, which will be integrated with the previously developed clustering model to create a new CFD-ML-based simulation framework.