Christian Santoni, PhD

Postdoctoral Associate EEBFD Lab at Stony Brook University
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Education

2013-2018 Ph.D. in Mechanical Engineering, **The University of Texas at Dallas**
Thesis: "Wind farm modeling: From the Meso-scale to the Micro-scale"
Advisor: Prof. Stefano Leonardi
GPA: 3.6/4

2010-2013 M. Sc. in Mechanical Engineering, **University of Puerto Rico—Mayagüez**
Thesis: "Brownian Dynamics Simulation of Colloidal Particles in a Gay-Berne Suspension"
Advisor: Prof. Gustavo Gutierrez
GPA: 3.9/4

2005-2010 B. Sc. in Mechanical Engineering, **University of Puerto Rico—Mayagüez**
GPA: 3.9/4 Magna Cum Laude

Research Experience

2019-Present Energy, Environmental & Bio Fluid Dynamics Lab – Stony Brook University
Large Eddy simulation for control co-design of wind farms. Wind turbine advanced control design. Machine learning based – reduced order modeling. Modeling of porous materials.

2013-2019 HPCFD Research Group – The University of Texas at Dallas
Direct Numerical Simulation and Large Eddy simulation of bluff and streamlined bodies. Wind turbine modeling. Large Eddy simulation of wind turbines. Numerical weather prediction models for wind farm modeling. Wildland Fire propagation modeling.

2011-2013 UCF Research Group – University of Puerto Rico at Mayagüez
Brownian and Stokesian dynamics simulation of spherical and non-spherical colloidal particles and rheology.

Teaching Experience

2023 Adjunct Instructor, Stony Brook University
Computational Fluid Dynamics – Graduate course on the numerical discretization, error and stability analysis of mass and momentum transport equations.
Lecture, office hours, and grading.

2022 Instructor, Stony Brook University
Fundamentals of Offshore Wind Energy Master Teacher Workshop –
Introduction to wind energy and turbine aerodynamics

2021 Instructor, Stony Brook University
Fundamentals of Offshore Wind Energy – New York State's Offshore Wind Training Institute – Wind turbine technology basics, Introduction to Wind Turbine Aerodynamics, Windfarm aerodynamics, Windfarm measurements

2011 Teaching Assistant, University of Puerto Rico
Momentum Transfer - Introduction to mass, momentum, and energy transport.
Lecture, office hours, and grading.

2010 Teaching Assistant, University of Puerto Rico
Thermodynamics II - Application to the study of power and refrigeration cycles and combustion processes.
Lecture, office hours, and grading.

Computer Skills

Programming Skills:	FORTRAN, C, C++, Python, Matlab/Octave, Bash
Parallel Computing:	MPI, OpenMP, CUDA
Visualization Software:	Paraview, Gnuplot, QMGA, POV-Ray, Vapor
Machine Learning:	PyTorch
Commercial / Open Software:	Comsol, FLUENT, OpenFOAM, WRF
Word Processors:	MS Word, Open/Libre Office, and LaTeX

Languages

English:	Full Professional Proficiency
Spanish:	Native

Peer-Reviewed Publications

Google Scholar Profile

- C Santoni, T Viren, L Shen, F Sotiropoulos, A Khosronejad. "*Large-eddy simulations of a utility-scale offshore wind farm under neutral atmospheric conditions*", Physical Review Fluids, 2024 (Submitted).
- M Aksen, H Seyedzadeh, M Anjiraki, J Craig, K Flora, C Santoni, F Sotiropoulos, A Khosronejad. *"Large eddy simulation of a utility-scale horizontal axis turbine with woody debris accumulation under live bed conditions",* Renewable Energy, vol. 239, p. 122110, Feb. 2025, doi: 10.1016/j.renene.2024.122110.
- C Santoni, D Zhang, Z Zhang, D Samaras, F Sotiropoulos, A Khosronejad. "*Toward ultra-efficient high-fidelity predictions of wind turbine wakes: Augmenting the accuracy of engineering models with machine learning*", Physics of Fluids 1 June 2024; 36 (6): 065159. doi: 10.1063/5.0213321
- C Santoni, F Sotiropoulos, and A Khosronejad. "*A Comparative Analysis of Actuator-Based Turbine Structure Parametrizations for High-Fidelity Modeling of Utility-Scale Wind Turbines under Neutral Atmospheric Conditions.*" Energies, 2024. doi: 10.3390/en17030753.
- C Santoni, Z Zhang, F Sotiropoulos, A Khosronejad. *"A data-driven machine learning approach for yaw control applications of wind farms",* Theoretical and Applied Mechanics Letters, 2023, 100471. doi: 10.1016/j.taml.2023.100471
- C Santoni, A Khosronejad, X Yang, P Seiler, F Sotiropoulos, "*Coupling turbulent flow with blade aeroelastics and control modules in large-eddy simulation of utility-scale wind turbines*", Physics of Fluids, 2023. doi: 10.1063/5.0135518
- Z Zhang, X Hao, C Santoni, L Shen, F Sotiropoulos, A Khosronejad, *"Toward prediction of turbulent atmospheric flows over propagating oceanic waves via machine-learning augmented large-eddy simulation",* Ocean Engineering, 2023, 280. doi: 10.1016/j.oceaneng.2023.114759
- C Santoni, A Khosronejad, P Seiler, F Sotiropoulos, "*Toward control co-design of utility-scale wind turbines: Collective vs. individual blade pitch control*", Energy Reports, 2023. *9*, 793–806. doi: 10.1016/j.egyr.2022.12.041
- Z Zhang, C Santoni, T Herges, F Sotiropoulos, A Khosronejad, "*Time-Averaged Wind Turbine Wake Flow Field Prediction Using Autoencoder Convolutional Neural Networks*", Energies, 2021, 15: 1, 41. doi: 10.3390/en15010041
- K Flora, C Santoni, A Khosronejad, "*Numerical Study on the Effect of Bank Vegetation on the Hydrodynamics of the American River under Flood Conditions*", Journal of Hydraulic Engineering, 2021, 147, 9, 05021006. doi: 10.23919/ACC.2019.8814766
- A Khosronejad, C Santoni, K Flora, Z Zhang, S Kang, S Payabvash, F Sotiropoulos, *"Fluid dynamics simulations show that facial masks can suppress the spread of COVID-19 in indoor environments"*, AIP Advances, 2020, 10, 12, 125109. doi: 10.1063/5.0035414

- C Santoni, EJ García-Cartagena, U Ciri, L Zhan, GV Iungo, S Leonardi, *"One-way mesoscale-microscale coupling for simulating a wind farm in North Texas: Assessment against SCADA and LiDAR data"*, Wind Energy, 2020, 23, 3, 691-710. doi: 10.1002/we.2452
- U Ciri, C Santoni, F Bernardoni, MV Salvetti, S Leonardi, *"Development of a surrogate model for wind farm control"*, 2019 American Control Conference (ACC), Philadelphia, PA, 2019, pp. 2849-2854. doi: 10.23919/ACC.2019.8814766
- C Santoni, EJ Garcia-Cartagena, U Ciri, GV Iungo, and S Leonardi, *"Coupling of mesoscale Weather Research and Forecasting model to a high fidelity Large Eddy Simulation"*, Journal of Physics: Conference Series, 2018,1037; 6.
- U Ciri, MV Salvetti, K Carrasquillo, C Santoni, GV Iungo, S Leonardi, "*Effects of the subgrid-scale modeling in the Large-Eddy simulations of wind turbines*", Direct and Large-Eddy Simulation X. ERCOFTAC Series, 2018, vol 24.
- M Debnath, C Santoni, S Leonardi, and GV Iungo, "*Development of a reduced order model for prediction of flow dynamics within wind turbine wakes*", Phil. Trans. R. Soc. A, 2017, 375 20160108. doi: 10.1098/rsta.2016.0108.
- U Ciri, M Rotea, C Santoni and S Leonardi, "*Large-Eddy simulations with extremum-seeking control for wind turbines array power optimization"*, Wind Energy, 2017, 20: 1617–1634. doi: 10.1002/we.2112
- C Santoni, K Carrasquillo, I Arenas-Navarro and S Leonardi, *"Effect of tower and nacelle over the flow past a wind turbine"*, Wind Energy, 2017, 20, 1927–1939. doi: 10.1002/we.2130
- U Ciri, M Rotea, C Santoni and S Leonardi, *"Large Eddy Simulation for an array of turbines with Extremum Seeking Control"*, 2016 American Control Conference (ACC), Boston, MA, 2016, pp. 531-536. doi: 10.1109/ACC.2016.7524968
- GV Iungo, C Santoni-Ortiz, M Abkar, F Porté-Agel, MA Rotea, S Leonardi, *"Data-driven Reduced Order Model for prediction of wind turbine wakes"*, Journal of Physics: Conference Series 625 (1), 2015, 012009
- C Santoni, U Ciri, M Rotea, and S Leonardi, *"Development of a high fidelity CFD code for wind farm control"*, American Control Conference (ACC), 2015, 1715-1720.

Conference Presentations

- C Santoni, D Zhang, Z Zhang, D Samaras, F Sotiropoulos, A Khosronejad, "High-fidelity prediction of wind turbine wakes: Enhancing wake models using LES-trained machine learning algorithms", 77th Annual Meeting of the American Physics Society Division of Fluid Dynamics, Nov 24-26, (2024).
- C Santoni, T Viren, L Shen, F Sotiropoulos, and A Khosronejad, "Swell effects on the performance of a utility-scale offshore wind farm", 76th Annual Meeting of the American Physics Society Division of Fluid Dynamics, Nov 19-21 (2023).
- C Santoni, X Yang, P Seiler, F Sotiropoulos, and A Khosronejad, "Two-way fluid-structure interaction for the study of advanced turbine control systms", 2nd Spanish Fluid Mechanics Conference, Jul 2-5 (2023).
- C Santoni, A Khosronejad, Z Zhang, P Seiler, and F Sotiropoulos, "Development of deep learning-based reduced order model for turbine yaw control", 75th Annual Meeting of the American Physics Society Division of Fluid Dynamics, Nov 20-22 (2022).
- C Santoni, "Physics-based simulation of turbines for control co-design of wind farms: mesoscale to microscale modeling", Future Leaders in Mechanical and Aerospace Engineering, April 6 (2022).
- C Santoni, A Khosronejad, F Sotiropoulos, "On the effect of atmospheric stability on the efficacy of wind turbine blade pitch control strategies", 74th Annual Meeting of the American Physics Society Division of Fluid Dynamics, Nov 21-23 (2021).

- C Santoni, EJ Garcia-Cartagena, U Ciri, GV Iungo, and S Leonardi, "Turbulence generation in a large eddy simulation of a wind farm coupling meso-and micro-scale", 71st Annual Meeting of the American Physics Society Division of Fluid Dynamics, Nov 18-20 (2018).
- C Santoni, EJ Garcia, U Ciri, GV Iungo, and S Leonardi, "Coupling of meso-scale weather and research forecasting model to a high fidelity Large Eddy Simulation", The Science of Making Torque from Wind (TORQUE 2018) Milano, 20-22 June (2018).
- C Santoni, U Ciri, S Leonardi, "Effect of Topography on the Power Production and Wake Recovery of a Wind Turbine". 13th World Congress in Computational Mechanics, New York City, NY, USA 22nd-27th July (2018).
- C Santoni and S Leonardi, "Effect of topography on the power production and wake recovery of a wind turbine". 55th Annual Technical Meeting Society of Engineering Science, Madrid, Spain, October 10-12th (2018).
- C Santoni, EJ Garcia-Cartagena, L Zhan, GV Iungo and S Leonardi, "Weather Research and Forecasting model simulation of an onshore wind farm: assessment against LiDAR and SCADA data", 70th Annual Meeting of the American Physics Society Division of Fluid Dynamics, Nov 19-21 (2017).
- C Santoni, U Ciri and S Leonardi, "Performance of a wind turbine over a ridged terrain", 69th Annual Meeting of the American Physics Society Division of Fluid Dynamics, Nov 20-22 (2016).
- C Santoni, U Ciri and S Leonardi, "Flow past a wind turbine over a wavy terrain", European Mechanics Society Colloquium 576 Wind Farms in Complex Terrains, 8-10 June (2016).
- U. Ciri, M.A. Rotea, C. Santoni, and S. Leonardi, "Extremum-Seeking Control for Power Production Optimization", Windfarms 2016: International Colloquium on wind-power plants, May 23rd-25th. Dallas, TX, USA, (2016).
- C Santoni, U Ciri, A William and S Leonardi, "Performance of a Wind Turbine on a Wavy Terrain", Windfarms 2016: International Colloquium on wind-power plants, May 23rd-25th. Dallas, TX, USA, (2016).
- C Santoni, U Ciri and S Leonardi, "Effect of topography on wind turbine power and load fluctuations", 68th Annual Meeting of the American Physics Society Division of Fluid Dynamics, Nov 22-24 (2015).
- C Santoni, U Ciri and S Leonardi, "Effect of topography on wind turbine power fluctuations and blade loads", WindFarms 2015: International colloquium on Large Wind-Power Plants: Interaction, Control, and Integration, 8-10 July 2015, Leuven, Belgium.
- C Santoni and S Leonardi, "Large Eddy Simulation of wind turbines using the actuator line model and immersed boundary method", 59th Annual Meeting of the American Physics Society Division of Fluid Dynamics, Nov 23-25 (2014).
- C Santoni, K Carrasquillo, M Rotea, Y Li and S Leonardi, "Effect of the tip speed ratio in the power production of aligned wind turbines", 59th Annual Meeting of the American Physics Society Division of Fluid Dynamics, Nov 23-25 (2014).