

Sara Muggiasca, PhD

EDUCATION

2006: PhD in Mechanical System Engineering, Politecnico di Milano, Italy (with honors, Thesis title: *Vortex induced vibrations on cylindrical bodies: from experimental analysis to the development of a numerical model*, Tutor: Prof. Giorgio Diana)

1997: Degree in Mechanical Engineering (5-year program), Politecnico di Milano, Italy (100/100 with honors, Thesis title: *Characterization of aerodynamic loads related to cross wind on railway trains through wind tunnel measurements*, Tutors: Prof. Federico Cheli; Prof. Marco Bocciolone, Prof. Roberto Corradi).

ACADEMIC POSITION

2021 – Present: Associate Professor at Department of Mechanical Engineering, Politecnico di Milano, Italy

2011 – 2021: Researcher at Department of Mechanical Engineering, Politecnico di Milano, Italy

2003 – 2011 Technician at Politecnico di Milano Wind tunnel.

RESEARCH INTERESTS

The scientific activity was mainly developed in the areas of wind engineering and wind energy, referring more specifically to experimental and numerical studies on cable dynamics, fluid-structure interaction of civil structures, sails aerodynamics and wind turbine aerodynamics. Eng. Muggiasca participated in several projects as responsible for a single task as experimental setup design, data-process and numerical model development or as responsible for the overall project. Hereafter the summary of the most relevant research topics.

Cables Aerodynamics:

Eng. Muggiasca began to study cable aerodynamic behavior during her PhD, both in terms of basic research topic and engineering application (circular-shaped civil structures, overhead transmission lines, stays of cable-stayed bridges, spokes of observation wheel). She participated in wide experimental campaigns in Politecnico di Milano wind tunnel performed to investigate vortex-induced vibrations and galloping instability on circular cylinders by means of rigid and flexible models. The so obtained data were used as a benchmark for numerical models developed on purpose to reproduce these phenomena. Part of these researches was included in the Eng. Muggiasca's PhD Thesis. Performed studies on basic research were further developed for specific applications as overhead transmission providing tools and guidelines for their design: within this context Eng. Muggiasca took part in a collaboration with *EDF (Électricité de France)* supervising a young engineer hosted by Politecnico di Milano for one year. Further projects on applied cable dynamics research concerned

aerodynamic characterization of Large Observation Wheel spokes (*Dubai and New York Large observation wheels*) followed by Eng. Muggiasca as responsible.

Wind Effects on Civil Structures:

Eng. Muggiasca was involved, as a responsible or participant, in several projects aimed at investigate the fluid-structure interaction of civil structures, like bridges, footbridges, buildings, solar panels. Global aerodynamic behavior was evaluated in terms of static forces, local actions and dynamic response through an experimental approach and numerical modeling.

Bridges and footbridges

Experimental tests were carried out in Politecnico di Milano wind tunnel for aerodynamic design of long-span bridges: Eng. Muggiasca participated in the design of sectional and aeroelastic models of decks and towers, in data analysis and in the optimization process of the final design.

The most relevant projects in which she was involved are: *Messina Bridge, Forth Replacement Crossing Bridge, deck and tower, Lusail Bridge.*

She was also involved in studies concerning the aerodynamic design of footbridges and the characterization of the required damping system to control wind-induced vibrations.

The most relevant projects in which she was involved are: *Pescara footbridge, Nomi and San Michele footbridges, Swan River Footbridge.*

Buildings, roofs and solar trackers:

She participated in several experimental studies on global and local forces on buildings, considering the effects of atmospheric boundary layer and of the surrounding, analyzing the pedestrian comfort in the adjacent urban area and evaluating the aeroelastic behavior of roofs.

The most relevant projects in which she was involved are: *Porta Nuova Isola, European Extremely Large Telescope, Palazzo Italia building for EXPO 2015, Unipol Sai building, Nuovo Polo fieristico di Milano, Cometa roof, Maggiolina building.*

Recently Eng. Muggiasca actively participated in aerodynamic studies concerning large solar tracker farms: the growing request for green energy pushed the use of this technology, requiring wind tunnel tests as no standards are available for an aerodynamic design. The studies performed for *ENEL GP* and for tracker suppliers are aimed at investigating the critical behavior of these structures due to the wind, through experimental wind tunnel tests and numerical simulations.

Modal analysis and monitoring:

Eng. Muggiasca contributed as a participant and responsible for studies related to the modal characterization and monitoring of full-scale structures: these activities are aimed at tuning the TMD system and checking structure and damping system behavior, under wind excitation, over time.

The main projects in which she was involved are: *Aesthetical arches built for EXPO 2015 and Torino Fashion Village Tower.*

Yachts aerodynamics and sails optimization:

Eng. Muggiasca was involved in basic and applied research activities related the experimental and numerical analysis of sails aerodynamics for their design optimization: these studies permitted to collaborate with *Prada Challenge and BMW Oracle for the America's Cup*.

She was also involved in experimental campaigns performed in collaboration with the *Technical Committee (ITC) of the Offshore Racing Congress (ORC)*, aimed at obtaining the needed data to improve aerodynamic forces definition in numerical codes (VPP, Velocity Prediction Program), used for the definition of sailing yacht performances.

She participated in the *Sailing Yacht Lab* project for the realization of a real sailing yacht completely instrumented. She followed the boat design, its construction and several measurement campaigns. Gathered data were included in the Master Thesis discussed by Francesco Giacobone at KTH: *Aerodynamics of Sailing Yachts: Force, Pressure and sail shape measurements as bridge between experiments and numerical simulations*. Within this project, a new setup for measurement of surface pressures on sails for wind tunnel and full-scale tests was developed and patented (*A Device For Pressure Measurements On Yacht Sails*, U.S.A.: no. 15/462,621, Australia: no. 2017201840).

Eng. Muggiasca performed also wind tunnel tests on High-Speed Small Craft and Mega-Yachts.

Wind energy:

In the last 7 years, the Mechanical Department of Politecnico di Milano increased its expertise in wind energy systems thanks to the participation in several projects.

Eng. Muggiasca was involved in the "*Blue Growth Farm*" Project, call H2020-BG-2017-1 Project 774426, related to the design of a multipurpose floating platform. In particular, she coordinated the research group in charge of the design of a 1:15 scaled model of a wind turbine to be installed on the platform prototype.

She also participated in *Nenuphar* project aimed at designing an innovative system for floating vertical axis wind turbines, with two counter-rotating turbines installed on the same floater: wind tunnel tests were performed to define the far wake in order to design wind farm arrangements.

Eng. Muggiasca collaborated with *TU Delft* within a project focused on propulsors for wind-assisted propulsion commercial ships. In particular, she was involved in the design of different setups for wind tunnel tests on Flettner rotors, devices that exploit Magnus effect to produce large lift forces: Reynold number effects on local pressure distribution and on global forces were evaluated, together with wake effects on the rotors in double arrangements.

RESEARCH GRANT

The Blue Growth Farm: Development and demonstration of an automated, modular and environmentally friendly multi-functional platform for open sea farm installations of the Blue Growth Industry, European Commission (Brussels), 2018-06-01 to 2021-09-3, Grant Number: 774426, **Role:** Participant for the Polimi

Unit. Polimi unit is in charge of designing and realizing a 1/15 scale model of the DTU 10 MW wind turbine to be installed on a scale model of the multipurpose floating platform.

STEP4WIND (Novel deSign, producTion and opEration aPproaches for floating WIND turbine farms): A European Industrial Doctorate programme, granted under the H2020 Marie-Curie Innovative Training Network initiative (H2020-MSCA-ITN-2019, grant agreement [860737](#)). The programme runs between April 2020 and March 2024 and will deliver 10 PhD degrees, in joint supervision and training between the public and private sectors. The main objective is to address both technological and economical challenges related to the development of floating offshore wind farms. **Role:** Supervisor of ESR7. Polimi unit is in charge of supervising ESR5 and ESR7 and it is responsible for the training program.

SIGNIFICANT RESEARCH PROJECT AS RESPONSIBLE

Eng. Muggiasca participated in several projects related to her research fields, hereafter a summary of the main projects she followed as responsible.

PHILIPS LIGHTING B.V, Wind tunnel tests on the Dubai Eye Spoke Cables (2017, 2018): Wind tunnel tests to define the aerodynamic behavior of the Dubai Eye spokes, checking possible instabilities due to the wind and defining the required damping level to control wind-induced vibrations. Aerodynamic effects of LED system applied to the spokes were evaluated and the system was optimized in order to reduce wind-induced vibrations

Redaelli Tecna SpA, Wind tunnel tests on the New York Spoke Cables (2016): Wind tunnel tests to define the aerodynamic behavior of the New York observation wheel spokes, checking possible instabilities due to the wind and defining the required damping level to control wind-induced vibrations. Spokes were tested both with and without the LED system.

TU Delft, Wind tunnel test on Flettner rotors (2017, 2019): Within a collaboration with the 3ME School of TU Delft, two experimental campaigns on Flettner rotors were carried out in order to evaluate their performances as propulsor for wind- assisted propulsion commercial ships. An innovative setup was designed to study the rotor behavior at very high Reynolds numbers, then two smaller rotors were tested to evaluate their mutual actions.

CONVERT ITALIA S.p.A., Wind tunnel tests on PV trackers/ Wind loads evaluation on PV trackers/ Stability analysis under wind conditions for PV trackers (2019, 2021): A wide study on solar trackers aerodynamics was performed through wind tunnel tests on rigid models of a solar farm to evaluate the local load distribution and on a sectional model the check possible instabilities. The obtained data were used to numerically define the wind loads acting on the panels and to identify guidelines for structural design under wind action.

TORINO FASHION VILLAGE, Monitoring and identification of the structural parameters of the Torino Fashion Village Stele (2016): Field tests were performed in order to characterize the structure behavior with and without the TMD system. Tests were also used to tune the TMD system in consideration of the actual parameters of the structure. A continuous monitoring system was then installed and checked for a period of one year.

Metalltech Srl, Wind tunnel tests on the porous covering of Università Bocconi (2018): Wind tunnel tests on the covering net to measure its static aerodynamic coefficients as a function of the wind angle of attack.

Navico RBU Italia s.r.l., Wind Tunnel tests on radar scanner (2014, 2015, 2016): Wind tunnel tests on different models of radar scanners to evaluate their performances under strong wind conditions.

GEM elettronica srl, Wind Tunnel tests on radar scanner (2017): Wind tunnel tests on different models of radar scanners to evaluate their performances under strong wind conditions.

TEACHING AND SUPERVISING

Teaching activities are focused on Applied Mechanics.

Principal lecturer in:

- Applied Mechanics for Biomedical Engineering Degree, 2016 – present

Assistant lecturer in:

- Applied Mechanics for Chemical Engineering Degree, 2003 – present
- Mechanics of Vibrations for Mechanical Engineering Degree, 2007 – 2014

Eng. Muggiasca in the last four years oversaw 6 Master Degree students for their Master Thesis:

- AA 2017/2018: Aerodynamic and Structural Design of a Large-Scale Rotor Wind Turbine, Marco Bollati, *Co-Supervisor*
- AA 2018/2019: 'Aerodynamic and mechanical design of an offshore wind turbine prototype, Matteo Usai, *Supervisor*
- AA 2018/2019: VIV modelling techniques : a comparison between equivalent oscillator and deep learning, Giacomo Notaro, *Co-Supervisor*
- AA 2018/2019: Aerodynamic and mechanical design of a 1:15 scale floating wind turbine rotor, Giorgia Lattanzio, *Supervisor*
- AA 2020/2021: Structural testing and mechatronic design of a large-scale floating wind turbine model rotor, Francesco Fuochi, Lorenzo Amadori, *Supervisor*

Eng. Muggiasca is currently supervising three Master Degree students and she is the academic supervisor for one ESR (Early Stage Researcher) within H2020 Marie-Curie Project Step4Wind.

OTHER ROLES

2019 – Present: Member of the Steering Committee of ANIV, Italian national wind engineering association.

EDITORIAL ACTIVITIES

Editorial Board Member of:

- Shock and Vibrations, Hindawi
- Journal of Sailing Technology, SNAME
- Frontiers in Energy Research

REVIEWER FOR THE FOLLOWING JOURNAL

- Journal of Wind Engineering and Industrial Aerodynamics
- Journal of Fluid and Structures
- Ocean Engineering
- Shock and vibrations
- Journal of Sailing Technology
- Wind and Structures
- Energies
- International Journal of Naval Architecture and Ocean Engineering

LANGUAGES

Italian: Primary language; English: Good; French: Good

PATENTS

M. Boccione, M. Belloli, S. Muggiasca, I. Bayati, "A Device For Pressure Measurements On Yacht Sails", U.S.A.: no. 15/462,621, Australia: no. 2017201840.

PUBLICATIONS

Citations in Scopus: 834

Scopus h-index: 15

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