HOT TOPIC 2: Aeroacoustics

Experimental and numerical advancements in aeroacoustics

Organizer: Renzo Arina, Politecnico di Torino (Italy)
Co-organizer: Francesco Avallone, Politecnico di Torino (Italy)
Industrial Partners: Pinifarina (Italy), Siemens Gamesa Renewable Energy (Denmark)

ABSTRACT

Aeroacoustics is one of the challenges for engineers approaching either an industrial or an academic career in propulsion, wind energy and aerodynamics. The aim of the summer school is to provide the attendees with the fundamental knowledge about the most recent advancements in experimental and numerical methods in the field.

The first part of the summer school will focus on the recent development of beamforming techniques for acoustic measurements both in closed and open wind tunnel test sections. The industrial perspective from a leading wind energy industry, where aeroacoustics is a key challenge, will be given by Dr. Oerlemans (Head of Aeroacoustics at Siemens Gamesa Wind Power). The first part of the course will conclude with a practical experience in the Pinifarina aeroacoustic wind tunnel facility.

Computational methods in aeroacoustics are becoming widely used in both academia and industry. The second part of the course will focus on the fundamental of computational aeroacoustics and will provide an overview of the recent advancements in computational methods. Focus will be given to the selection of the best numerical approach for a given aeroacoustic problem. Examples from recent applications in both the industrial and academic environment will be provided.

TRAINING FLOW
08/09/2023
15:30-17:00 Theoretical: Beamforming for source identification and in ducted system (Dr. Zamponi and Prof. Schram, Von Karman Institute, Belgium)

09/09/2023
10:30 – 12:00 Theoretical: Advanced non-intrusive techniques for aeroacoustics (Dr. Ragni, Delft University of Technology, The Netherlands)
13:30 – 15:00 Theoretical: Aeroacoustics measurements and simulations in wind energy applications (Dr. Oerlemans, Siemens Gamesa, Denmark)

15:30 – 17:30 Applied: Aeroacoustics measurements in large wind tunnel facilities (Prof. Di Marco, Roma3, Italy, and Ing. Aquili, Head of Wind Tunnel, Pininfarina, Italy)

10/09/2023
8:30 – 10:00 Theoretical: Computational aeroacoustics and acoustic analogies (Prof. Avallone, Politecnico di Torino, Italy)
10:30 – 12:00 Theoretical: Applications of LBM to aeroacoustic problems of industrial relevance (Prof. Casalino, Delft University of Technology, The Netherlands)

**KEY TRAINERS**

Dr. Riccardo Zamponi (VKI)

Riccardo Zamponi graduated in Mechanical Engineering from the Polytechnic University of Marche (2016). He carried out his Ph.D. in the Environmental and Applied Fluid Dynamics Department at the von Karman Institute for Fluid Dynamics (VKI), in collaboration with the Faculty of Aerospace Engineering at TU Delft, where he obtained the title in 2021. He worked as a postdoc at TU Delft for the project NWO-STW IPER-MAN and at VKI for the EU project INVENTOR. He was appointed as Research Engineer at VKI in 2023. His research interests cover the modeling and development of noise-mitigation strategies for aeronautic applications.

Prof. Christophe Schram (VKI)

PhD in aeroacoustics in cotutelle between the Eindhoven University of Technology and the Free University of Brussels in 2003. Post-Doc on thermo-acoustic instabilities at Cambridge in 2004. 6 years in industry as Aeroacoustics Project Manager. Back to VKI in 2010 as Assistant Prof.Now Prof and head of the aeroacoustics research group at VKI.

Dr. Daniele Ragni (TU Delft)
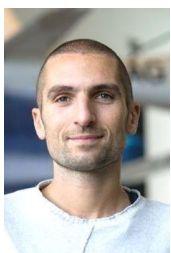
Daniele Ragni graduated in Thermo-Mechanical Engineering at the Polytechnic University of Marche (2007). Obtained the Ph.D. in 2012 (Faculty of Aerospace Engineering TU Delft) and joined the section of Wind Energy in the AWEP Department in the same year. Associate professor in Aeroacoustics, he worked in the projects NWO-STWs Thames (2016), IPER-MAN (2017), Marie Curie ETN SMART-ANSWER (partner, 2016) and European Project ARTEM (partner, 2016). The research interests cover the development of experimental aeroacoustics (PIV) and

its applications to rotors in low/high-speed. His background in wind energy and propulsion is engaging him in the extension of PIV-based pressure reconstruction in wind turbine and aircraft propeller blades for academic and industrial aerodynamics research.

He collaborates with many academic institutes and research centers worldwide in the field of experimental fluid mechanics, aeronautics and aerospace.

Dr. Stefan Oerlemans (Siemens Gamesa Wind Power)

Stefan Oerlemans has worked in aircraft and wind turbine aeroacoustics R&D for 25 years. He holds a MSc degree in Engineering Physics and a PhD degree on "The detection of aeroacoustic sound sources on aircraft and wind turbines". From 1998 to 2012 he worked at the Netherlands Aerospace Centre, where he investigated aerodynamic noise from aircraft, wind turbines and helicopters using advanced experimental and theoretical techniques. Since 2012 he works at Siemens Gamesa, a large wind turbine manufacturer, where he developed world-class wind turbine noise technology. His current positions are Head of Noise Department and Key Expert Aeroacoustics.

Prof. Alessandro Di Marco (Roma Tre University)

Prof. Alessandro Di Marco is an Associate Professor at the Roma Tre University for the MSc in Aeronautical Engineering and the BA and MSc in Ocean and Marine Engineering. His main research activities feature low-Reynolds number airfoils and propellers, shallow cavities, wall pressure fluctuations beneath turbulent boundary layers in subsonic and supersonic conditions, jet flow and interaction with a flat plate, turbulent combustion. He has been involved, as test responsible and supervisor, in several wind tunnel experimental test campaigns, investigating the aerodynamics and aeroacoustics of laminar wings, UAVs, high-lift devices, turboprop aircrafts, installed pusher propellers and the space launcher VEGA-C.

Ing. Alessandro Aquili (Pininfarina)

Is Head of Wind Tunnel in Pininfarina since 2020. After graduation in Aerospace Engineering at Politecnico di Milano in 2002, Alessandro started working at Fondmetal Technologies initially as aerodynamicist and then as Wind Tunnel manager. In 2016 he moved to Ducati Corse where he worked on Moto GP and SBK aerodynamic development. As Pininfarina Head of Wind Tunnel Alessandro main task is to satisfy customers requirements for improving aerodynamic and aeroacoustic testing capabilities. Pininfarina WT team recently worked on the reduction of wind tunnel background noise and on development of Coherence based Beam Forming Technique that helps to identify the localization of aerodynamic noise sources.

Prof. Francesco Avallone (PoliTo)

Francesco Avallone is Full Professor at the Politecnico di Torino. He received both his MSc and PhD degrees from the University of Naples Federico II. In 2015, he joined Delft University of Technology when he started working on aeroacoustics. Since 2022 he is working at PoliTo. His research interests are airfoil self-noise, acoustic liners, fan noise, jet installation noise and propeller noise. For his research he uses both experimental and computational techniques. He is PI of the ERC StG project LINING and he has worked on several EU and national projects.

Prof. Damiano Casalino (TU Delft)

PhD in fluid-dynamics (Turin Polytechnic) and acoustics (Ecole Centrale de Lyon), my research interests in aeroacoustics cover propeller noise prediction through semi-analytical and numerical methods, scale-resolving CFD fan-noise prediction, frequency-domain CAA for duct acoustics and installation effects, sound propagation in sheared flows, acoustic-analogy integral methods, stochastic noise generation, advanced experimental techniques for space launcher noise, helicopter trajectory optimization, vortex-airfoil interaction noise, liner optimization, long-range acoustic propagation. I am currently senior R&D fluid science director at Dassault Systemes/SIMULIA and chair of Aeroacoustics in the Aerospace faculty of Delft University of Technology. My current research focus is on eVTOL and wind-turbine aeroacoustics.

COMPANY

Siemens Gamesa

Siemens Gamesa is a leading global provider of wind power products and service solutions. The company has around 28,000 employees and produces both onshore and offshore wind turbines. Siemens Gamesa has installed 130 GW of wind power since 1979, and maintains 83.5 GW under service. The Noise Department is part of SGRE's Technology organization, and provides advanced noise tools and technology to support the business. The Noise Department has the central responsibility for evaluating product noise performance and for developing new low-noise technologies. The work scope includes all aspects of noise, including rotor noise, mechanical noise, and farm noise.

Pininfarina

Founded in 1930, Pininfarina has evolved from an artisan concern to an international service Group. A group employing 500 people, offices in Italy, Germany, China and the United States, listed on the Stock Exchange. In 1972 Pininfarina became a leader in aerodynamic and aeroacoustic research when inaugurated the Wind Tunnel in Grugliasco, near Turin. It was Italy's first wind tunnel to be built for testing full-scale cars, at the time one of only seven in the world. Nowadays aerodynamics and aeroacoustic play a crucial role not only in the automobile, but in all

sectors in which Pininfarina is fully committed. The Wind Tunnel has already proved to be a powerful tool for testing and developing products across different fields. Examples include aircrafts, high-speed trains, yachts, buildings, wind engineering, industrial design and sporting goods.