



The Effect of Ambient Turbulence on Wingtip Vortices and the Air-Water Interface

R. Jason Hearst

Professor, Department of Energy and Process Engineering
Norwegian University of Science and Technology



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Room 2540 GGB

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Abstract:

We will discuss two areas where recent advances in experimental turbulence measurements have led to new insights. First, the impact of freestream turbulence on a wingtip vortex is investigated by

placing a finite wing downstream of an active turbulence grid. It will be demonstrated that the vortex itself remains largely the same, however, the transient motion of the vortex increases with the scale of the incoming turbulence. Moving to air-water interfacial flows, we investigate the interaction between surface waves and sub-surface turbulence, with a particular focus on enstrophy enhancement and wave scattering. Our results demonstrate that sub-surface turbulence can increase the rate of environmentally significant gas exchange (e.g., O_2 , CO_2) across the air-water interface by up to 45%. The talk will also showcase recent advances in flow measurements, including the use of quantifiable laser-induced fluorescence to map O_2 concentration in water while simultaneously capturing the velocity field and surface topology. Additionally, we introduce a novel co-flowing air-water facility equipped with active turbulence grids in each phase, allowing for independent control of turbulence in the air and water.

Bio:

Jason Hearst is a Professor at the Norwegian University of Science and Technology (NTNU) in Trondheim, Norway. He was awarded his PhD in 2015 from the University of Toronto Institute for Aerospace Studies (Canada), and then worked as a post-doctoral researcher at the University of Southampton (UK). He moved to NTNU in 2017 as a tenure-track Associate Professor, and received tenure and was promoted to Professor in 2023 (NB: titles differ between the US and Norway). He is presently on sabbatical at the University of Toronto until June 2025. His primary research activities are centred around the generation of bespoke turbulent flows using active turbulence generating grids and investigating how turbulence influences other canonical and environmental fluids problems. Most recently, his group has focussed on momentum and gas transfer processes at the gas-liquid (air-water) interface and how they are influenced by turbulence. Prof. Hearst's team is primarily funded via the European Research Council (Starting Grant, GLITR), Marie Skłodowska-Curie Actions (Post-doctoral fellow, Dr. Yi Hui Tee, InMyWaves) and the Research Council of Norway (FRIPRO, WallMix; Knowledge Building Project, reSail).

University of Michigan Mechanical Engineering | 2336 G.G. Brown Building 2350 Hayward Street | Ann Arbor, MI 48109-2125 US

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