Abstract Submitted
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Air-Induced Drag Reduction at High Reynolds Numbers: Velocity and Void Fraction Profiles[1] BRIAN ELBING, SIMO MÄKIHARJU, ANDREW WIGGINS, DAVID DOWLING, MARC PERLIN, STEVEN CECCIO, University of Michigan — The injection of air into a turbulent boundary layer forming over a flat plate can reduce the skin friction. With sufficient volumetric fluxes an air layer can separate the solid surface from the flowing liquid, which can produce drag reduction in excess of 80%. Several large scale experiments have been conducted at the US Navy's Large Cavitation Channel on a 12.9 m long flat plate model investigating bubble drag reduction (BDR), air layer drag reduction (ALDR) and the transition between BDR and ALDR. The most recent experiment acquired phase velocities and void fraction profiles at three downstream locations (3.6, 5.9 and 10.6 m downstream from the model leading edge) for a single flow speed (∼6.4 m/s). The profiles were acquired with a combination of electrode point probes, time-of-flight sensors, Pitot tubes and an LDV system. Additional diagnostics included skin-friction sensors and flow-field image visualization. During this experiment the inlet flow was perturbed with vortex generators immediately upstream of the injection location to assess the robustness of the air layer. From these, and prior measurements, computational models can be refined to help assess the viability of ALDR for full-scale ship applications.

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