

Abstract Submitted
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Control of a Supercavity-Piercing Fin¹ JUSTIN SYRSTAD, MARTIN WOSNIK, GARY BALAS, ROGER E.A. ARNDT, University of Minnesota, SUPERCAVITATION TEAM — Supercavitation provides a means of significantly reducing the drag of an underwater vehicle, thus enabling a dramatic increase in maximum speed. The control of supercavitating vehicles poses unique challenges. Only small regions at the nose (cavitator) and on the afterbody (fins) are in contact with water. Unlike for a fully wetted vehicle, there is an absence of lift on the body. Viable vehicle control options are limited to actuation of the cavitator and fins, and possibly thrust vectoring. Fin control is highly nonlinear due to the interaction of the fin with the cavity wall. Also, the cavity-fin interaction exhibits strong hysteresis effects. Tests were conducted in the high-speed water tunnel at St. Anthony Falls Laboratory with a semi-axisymmetric, ventilated cavity and a single wedged-shaped, 45 degree swept, cavity-piercing fin. Using a variety of fin control experiments, cavity stability and hysteresis effects were studied and compared to theoretical results. Fin torque was measured for different angles of attack with varying cavitation numbers. A closed-loop control experiment with fin responses to upstream/cavity disturbances is being carried out. Simulink models are being used to control the experimental setup and the measured parameters (fin position and torque) are compared to theoretical results.

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