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Modeling of the Longitudinal Motion of a High Speed Supercavitating Vehicle DAVID ESCOBAR, Saint Anthony Falls Laboratory - University of Minnesota, GARY BALAS, University of Minnesota, ROGER ARNDT, Saint Anthony Falls Laboratory - University of Minnesota — High speed supercavitating vehicles offer challenges regarding modeling and control. A mathematical model of the longitudinal motion of a supercavitating test vehicle composed of a cylindrical body, a disk cavitator, and two fins is derived with the aid of experimental data acquired in a high speed water tunnel. The model considers the effect on the vehicle motion of a perturbed flow generated by an oscillating foil gust generator that emulates the effect of flying in the proximity of the sea surface. The vehicle equations of motion and experiments suggest that the fins provide the means for vehicle stability as well as control authority whereas the cavitator only provides control. It was also found that flow oscillations can be modeled as perturbations to the fin angle of attack since variations of the cavitator angle of attack due to the perturbed flow do not contribute to the moments about the vehicle center of gravity. Moreover, an initial view of planing forces generated through large variations of cavitator angle of attack are also presented here. The mathematical description of the vehicle dynamics enables the design of control laws and simulation of the vehicle motion subject to flow perturbations. This research is supported by a grant from the Office of Naval Research.

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