Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

A Simple Analytical Model for Batoid Wake topology and Propulsive Forces[1] PABLO VALDIVIA Y ALVARADO, KARTHIK SRIVATSA, Singapore MIT Alliance for Research and Technology — Batoids swim by forcing waves along their large pectoral fins. These waves determine the topology of the shed wakes and the resulting propulsive forces. An understanding of the relation between fin kinematics and wake topology is essential to control vehicles that use batoid-like fin propulsion. Simulations of the fluid-structure interactions during fin motions provide information of the changes in wake topology and the propulsive forces that result with variations in fin kinematics. However, simulations require computing power usually not available in mobile robots and cannot be used for real time control. An alternative is to develop simple qualitative models whose errors can be compensated by closed loop feedback controllers. Here we describe an analytical model that can be used to predict wake geometry and resulting propulsive forces in batoid-like fins. The model incorporates important fin kinematic parameters such as wave number, amplitude envelope, and flapping frequency. Dye flow visualization and particle image velocimetry along with force measurements confirm the model applicability to batoid-like fin propulsion.

[1]This work was funded in whole or in part by the Singapore National Research Foundation (NRF) through the Singapore-MIT Alliance for Research and Technology (SMART)

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Date submitted: 02 Aug 2013 Electronic form version 1.4