Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

Multi-directional thrusting using oppositely traveling waves in knifefish swimming OSCAR CURET, MALCOLM MACIVER, NEELESH PATANKAR, Department of Mechanical Engg., Northwestern University — *Apteronotus albifrons*, also known as the black ghost knifefish, generate a weak electric field for omnidirectional sensing. This is matched by an extraordinary multi-directional swimming ability that is achieved by undulating a ribbon-like anal fin. Forward or backward motion is generated by a traveling wave on the ribbon fin. We have discovered that, for hovering and vertical swimming, the knifefish use two oppositely traveling waves on the ribbon fin. To understand the hydrodynamic mechanism of hovering and heave we performed fully resolved simulations of self-propulsion of the knifefish. We used kinematic inputs based on experimental observations. We found that the counter propagating waves generate two opposite streamwise jets along the bottom edge of the ribbon fin. These two jets meet approximately at the mid-section along the fin length and are deflected downward. The resultant downward momentum imparted to the fluid creates an upward force on the fish body which can be used for hovering or vertical swimming. There is a vortex ring pair of opposite directions at the middle of the fin that is associated with this fluid flow. Further insight into how the knifefish control heave and hovering was obtained from the measurements of force generated by a robotic ribbon fin for different wave parameters.

Neelesh Patankar
Department of Mechanical Engg., Northwestern University

Date submitted: 07 Aug 2009 Electronic form version 1.4