Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

A robotic device with a passive undulating ribbon fin: kinematics and propulsive performance[1] HANLIN LIU, OSCAR CURET, Florida Atlantic University — Many aquatic animals swim with high maneuverability using undulating ribbon fins. In this type of swimming, the organism propels by sending one or multiple traveling waves along an elongated fin. In previous work, robotic models with fully actuated fins where the parameters of the traveling waves are fully prescribed have been used to study the propulsive performance and fluid dynamics of this type of propulsion. However, less work has been done in ribbon fins with passively undulating waves. In this work, we use a robotic device to study the kinematics and propulsive performance of a passively undulating ribbon fin. The physical model is composed of fifteen rays interconnected with a membrane. Only two rays are actuated while the other rays are free to rotate through a common axis. The robotic fin was tested in a flume at different flow conditions. In a series of experiments we measured fin kinematics, propulsive forces and power consumption. As the leading two rays are actuated, a traveling wave with decaying amplitude passes through the passive rays. As the frequency of the actuated rays increases, the enclosed area of the undulating wave and the traveling wave frequency increase while the wavelength decreases. Our data also show that the propulsive force generated by the fin scaled with the enclosed area and the square of the relative velocity between incoming flow and traveling wave. These results suggest that both natural swimmers and underwater vehicles using ribbon-fin-based propulsion can potentially take advantage of passive undulating waves.

[1]National Science Foundation Grant No. 1420774

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Date submitted: 01 Aug 2015 Electronic form version 1.4