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Scaling law of ribbon fin propulsion[1] MOHAMMAD IRFAN UDDIN, GONZALO A GARCIA, OSCAR M. CURET, Florida Atlantic University — Some aquatic organisms swim by one or multiple elongated fins. In bony fish, this fin consists of an elastic membrane with hundreds of bony rays that allow them to stretch and manipulate the fin and to perform extraordinary swimming maneuvers. One of the most common kinematics of this elongated fin is transferring undulations in the form of traveling waves one end to the other, generating thrust in the opposite direction, though fishes adopt hybrid techniques for other maneuvering like rapid-reverse, station-keeping etc. Even though analytical formulation for this propulsion mode exists for few decades, very limited experimental work has focused to understand the law of scaling in undulating fin propulsion. The present work study how thrust produced by undulating fin can be scaled with respect to key variables. We used a bio-inspired robotic vessel that propels with an undulating ribbon fin, programmed to create sinusoidal motion. The vessel was tested for both static and free-swimming condition. First, we measured the dynamics of the vessel under free swimming condition, over a range of fin kinematics. Next, the drag force of the vessel was measured at a range of Reynold numbers. Finally, we measured the propulsive force and propulsive performance in a recirculating flume for different incoming flow speed (up to Re = 6 x10^4). We found that the propulsive force scales to the square of the relative velocity between the fin wave velocity and flow velocity. We will present the swimming performance and its implication to fish swimming.

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