Abstract Submitted
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A mechanism for efficient swimming[1] HOSSEIN HAJ-HARIRI, MEHDI SAADAT, AARON BRANDES, VISHAAL SARAIYA, HILARY BART-SMITH, University of Virginia — We present experimental measurements of hydrodynamic performance as well as wake visualization for a freely swimming 3D foil with pure pitching motion. The foil is constrained to move in its axial direction. It is shown that the iso-lines for speed and input power (or economy) coincide in the dimensional frequency versus amplitude plane, up to a critical amplitude. The critical amplitude is independent from swimming speed. It is shown that all swimming gaits (combination of frequency and amplitude) share a single value for Strouhal number (for amplitudes below the critical amplitude), when plotted in non-dimensional frequency vs. amplitude plane. Additionally, it is shown that the swimming gaits with amplitudes equal to the critical amplitude are energetically superior to others. This finding provides a fundamental mechanism for an important observation made by Bainbridge (1958) namely, most fish (such as trout, dace, goldfish, cod and dolphins) maintain constant tail-beat amplitude during cruise, and their speed is correlated linearly with their tail-beat frequency. The results also support prior findings of Saadat and Haj-Hariri (2013). *Ref1:* Bainbridge, R. Journal of Experimental Biology 35, 109 (1958). *Ref2:* Saadat, M., Haj-Hariri, H., APS DFD66, 2013.

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