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Limit cycle dynamics in swimming systems CYNDEE FINKEL, KARL VON ELLENRIEDER, Florida Atlantic University — An experimental apparatus was constructed to model basic features expected in the flow about a freely swimming fish. A D-shaped cylinder is used to represent the body and an oscillating foil, the tail. The swimming system is suspended in a constant freestream flow. A closed loop PI controller is used to maintain a set point, stream-wise location. The system is released from multiple downstream and upstream locations and permitted to swim to the set point. The Strouhal number measured when the swimming system achieves a constant forward swimming speed is compared to values observed in nature. The results suggest that self-regulation passively selects the Strouhal number and that no other external sensory input is necessary for this to happen. This self-regulation is a result of a limit cycle process that stems from nonlinear periodic oscillations. Phase plane analyses are used to examine the synchronous conditions due to the coupling of the foil and wake vortices. It is shown that the phase locking indices depend on the Strouhal number and approach a frequency locking ratio of about 0.5. The results suggest that Strouhal number selection in steady forward natural swimming is the result of a limit cycle process and not actively controlled by an organism.

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