Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Stability may not compromise Maneuverability in Aquatic Periodic Locomotion[1] EVA KANSO, FANGXU JING, University of Southern California — Most aquatic vertebrates swim by lateral flapping of their bodies and caudal fins. While much effort has been devoted to understanding the flapping kinematics and its influence on the swimming efficiency, little is known about the stability (or lack of) of periodic swimming. It is believed that stability limits maneuverability and body designs/flapping motions that are adapted for stable swimming are not suitable for high maneuverability and vice versa. Here, we consider an idealized model of a planar elliptic body undergoing prescribed periodic heaving and pitching in a perfect fluid. We show that periodic locomotion depends on several parameters including the aspect ratio of the body and the amplitude and phase of the prescribed flapping. We then study the stability of periodic locomotion using Floquet theory. We find that interesting trends of switching between stable and unstable motions emerge and evolve as we continuously vary the parameter values. This suggests that, when it comes to live organisms, maneuverability and stability need not be thought of as disjoint properties, rather the organism may manipulate its motion in favor of one or the other depending on the task at hand.

[1]This work is partially supported by the National Science Foundation through the CAREER award CMMI 06-44925 and the grant CCF 08-11480

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Date submitted: 01 Aug 2014 Electronic form version 1.4