Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Hydrodynamic interactions in metachronal paddling: effects of varying stroke kinematics MILAD SAMAEE, VISHWA KASOJU, HONG KUAN LAI, ARVIND SANTHANAKRISHNAN, Oklahoma State University —
Crustaceans such as shrimp and krill use a drag-based technique for propulsion, in which multiple pairs of limbs are paddled rhythmically from the tail to the head. Each limb is phase-shifted in time relative to its neighbor. Most studies of this type of metachronal swimming have focused on the jet formed in the animal's wake. However, synergistic hydrodynamic interactions between adjacent limbs in metachrony have received minimal attention. We used a dynamically scaled robotic model to experimentally investigate how variations in stroke kinematics impact inter-paddle hydrodynamic interactions and thrust generation. Physical models of limbs were fitted to the robot and paddled with two different motion profiles (MPs)—1) MP1: metachronal power stroke (PS) and metachronal recovery stroke (RS); and 2) MP2: metachronal PS and synchronous RS. Stroke frequency and amplitude were maintained constant across both MPs. Our results show that MP2 produced faster jets in the thrust-generating direction as compared to MP1. The necessity for a pause in MP2 after completion of PS by the paddles leading the motion, prior to executing the synchronous RS, aided in further downstream flow propagation. The effect of using asymmetric stroke kinematics on thrust generated will be discussed.

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Date submitted: 01 Aug 2017 Electronic form version 1.4