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Effects of varying inter-limb spacing to limb length ratio in metachronal swimming HONG KUAN LAI, RACHAEL MERKEL, ARVIND SANTHANAKRISHNAN, Oklahoma State University — Crustaceans such as shrimp, krill and crayfish swim by rhythmic paddling of four to five pairs of closely spaced limbs. Each pair is phase-shifted in time relative to the neighboring pair, resulting in a metachronal wave that travels in the direction of animal motion. The broad goal of this study is to investigate how the mechanical design of the swimming limbs affect scalability of metachronal swimming in terms of limb-based Reynolds number (Re). A scaled robotic model of metachronal paddling was developed, consisting of four pairs of hinged acrylic plates actuated using stepper motors that were immersed in a rectangular tank containing water-glycerin fluid medium. 2D PIV measurements show that the propulsive jets transition from being primarily horizontal (thrust-producing direction) at Re of order 10 to angled vertically at Re of order 100. The ratio of inter-limb spacing to limb length among metachronal swimming organisms ranges between 0.2 to 0.65 (Murphy et al., Mar. Biol. 158, 2011). 2D PIV will be used to examine the jets generated between adjacent limbs for varying inter-limb spacing to limb length ratios. The effect of increasing this ratio to beyond the biologically observed range will be discussed.

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