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Evolutionary Optimization of Non-Continuous and Non-Sinusoidal Gaits of a Self-Propelled Swimmer[1] FATMA AYANCIK, EMRE AKOZ, KEITH MOORED, Lehigh University — Animals propel themselves through the oceans with a wide variety of swimming gaits. However, it is typically assumed that biological propulsion is achieved by using continuous, sinusoidal motions. Yet, animals have been observed using non-continuous or intermittent swimming gaits and at many times non-sinusoidal motions. Through the use of an evolutionary algorithm, optimal swimming gaits that can be both nonsinusoidal and intermittent are determined. Both the non-dimensional cost of transport and swimming speed are optimized for a virtual body combined with a two-dimensional self-propelled pitching and heaving foil within a boundary element method numerical framework. Nonsinusoidal motions are varied from a triangle-wave to a square-wave motion and the intermittency of the gait is varied by changing the duty cycle of the active phase to the coasting phase during swimming. Both pure pitching, and combined heaving and pitching motions are examined. The Pareto front of optimal solutions is investigated for trends in the optimally efficient swimming gait as the swimming speed is increased. The variation in the wake structures produced by optimally efficient swimmers is probed.

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