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Identifying optimal vortex spacing for swimming and flying animals[1] PETER A. DEWEY, KEITH W. MOORED, DANIEL B. QUINN, ALEXANDER J. SMITS, Princeton University — Swimming and flying animals generate thrust by creating an unsteady vortex wake through the oscillation of their appendages. To determine the vortex spacing that maximizes propulsive efficiency, a finite core vortex array model was developed to compute the unsteady velocity field generated by vortex streets representative of bio- inspired propulsion. The model systematically varies the streamwise and transverse spacing between vortex cores to determine the time averaged velocity field induced by a reverse von Karman vortex street and a uniform freestream velocity. Experimental particle image velocimetry was conducted in the wake of a rigid pitching panel to determine the size and strength of the vortex cores to input to the model. Viscosity is accounted for by assuming a Gaussian vorticity distribution around the vortex core. A linear spatial stability analysis was performed on the computed velocity profiles to determine which vortex configuration leads to efficient propulsion. Here it is assumed that efficient propulsion proceeds when the driving frequency of the vortex street matches the resonant frequency of velocity jet.

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