

Abstract Submitted
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Rapid experimental optimization of efficiency of rolling and pitching foils.¹ DAVID BEAL, PROMODE BANDYOPADHYAY, Naval Undersea Warfare Center, Newport, RI — The search for highest efficiency for a given thrust is considered for rolling and pitching hydrofoils when no apriori knowledge of the characteristics is available. This is an alternative to knowledge of the unsteady flow field over the performance domain. The variables are frequency of foil roll and pitch, angles of roll, pitch, pitch bias and phase difference between roll and pitch, and the incoming flow speed. A downhill simplex method is used to search the variables to optimize efficiency. Roll and pitch torque and foil position sensors give efficiency. A simulated annealing term with a gradually reducing ‘temperature’ helps avoid becoming stuck in a selection where the repeatability level of the data results in inaccurate minimum. The method converged in 50 cycles in 4 minutes for all random starting values each search being for two cycles. The optimized parameters agree with our methodical measurements. The rapidity of the optimization suggests that high efficiency in swimming and flying animals might be a common occurrence.

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