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**Optimization of Unsteady Fluid-Body Interactions via Machine Learning** JOHN ROBERTS, MIT, LIONEL MORET, JUN ZHANG, NYU, RUSS TEDRAKE, MIT — Optimization of the interactions between a moving body and its surrounding fluid can be extremely complicated; even optimization on simple models can be tremendously computationally expensive. In this work we demonstrate that using a state-of-art machine learning algorithm we are able to efficiently optimize a flapping strokeform for energy efficiency entirely on a laboratory experimental system (i.e., without the use of any simulation). The learning is performed in real-time on a vertically heaving wing that is free to rotate about its center in the horizontal plane as a model of forward flapping flight (Re$\sim$30,000). The learning algorithm must contend with the stochasticity and long-term correlations inherent in its being run online and on an experimental system. Despite these difficulties, we demonstrate its success at learning using several wing forms, where it is able to optimize a strokeform in approximately 1,000 flaps (less than twenty minutes).

John Roberts
MIT

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