The Hydrodynamic Cart-Pole: Experiments in Machine Learning and Control of Fluid-Body Interactions JOHN W. ROBERTS, JACOB STEINHARDT, MIT - CSAIL, SAVERIO SPAGNOLIE, UCSD, RUSS TEDRAKE, MIT - CSAIL — Unsteady fluid-body interactions at intermediate Reynolds numbers exhibit a great deal of dynamical complexity, as well as a great deal of structure. Abundant evidence from nature demonstrates that this structure can be exploited to achieve high performance at dynamical tasks. In this talk we present experimental work on a simple fluid-body system, a hydrodynamic analogue to the well- studied "cart-pole" system. Examples include balancing an immersed wing robustly at a passively unstable equilibrium, as well as more fundamentally nonlinear tasks such as moving the system from a passively stable to a passively unstable but controller-stabilized equilibrium. Our approach demonstrates the effectiveness of machine learning control and linear optimal control techniques for providing high-performance controllers in this challenging domain. The generality and transferability of the techniques to other systems will also be discussed.

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