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**Stabilization of the fluidic pinball with gradient-based Machine Learning Control**[1] GUY Y. CORNEJO MACEDA, Paris-Saclay University, CNRS, LIMSI, France, YIQING LI, HIT, China, FRANCOIS LUSSEYRAN, Paris-Saclay University, CNRS, LIMSI, France, MAREK MORZYNSKI, Poznan University of Technology, Poland, BERND R. NOACK, HIT, China and TU Berlin, Germany — We propose a fast and automated gradient-enriched machine learning control (MLC) from steady open-loop control to multi-input multi-output feedback laws. The framework alternates between explorative and exploitive gradient-based iterations, generalizing MLC and the explorative gradient method (EGM). We stabilize the flow past a cluster of three cylinders, known as the fluidic pinball. The control laws for the independent cylinder rotations have been optimized over successively richer search spaces: symmetric and general asymmetric steady actuation and feedback control. As expected, the control performance improves with each generalization of the search space. Surprisingly, a non-trivial asymmetric steady forcing outperforms symmetric steady forcing. Intriguingly, the optimal feedback controller is a combination of asymmetric steady forcing and phasor control. We hypothesize that asymmetric forcing is typical also for other pitchfork bifurcation attractors. We expect that gradient-based MLC will be employed in many future multi-input multi-output control experiments.

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