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Control by Deep Reinforcement Learning of a separated flow

THIBAUT GUEGAN, Institut Pprime (CNRS, Universite de Poitiers, ISAE-ENSMA), France, MICHELE ALESSANDRO BUCCI, INRIA Saclay, France, ONOFRIO SEMERARO, CNRS - Universite Paris Saclay, LAURENT CORDIER, Institut Pprime (CNRS, Universite de Poitiers, ISAE-ENSMA), France, LIONEL MATHELIN, CNRS - Universite Paris Saclay, INSTITUT PPRIME TEAM, INRIA SACLAY TEAM, CNRS - UNIVERSITE PARIS SACLAY TEAM — In the closed-loop control framework, a dynamical model is often used to predict the effect of a given control action on the system. Specifically, model-based control approaches rely on a physical model based on first-principle equations is used. However, in the general case, a useful model is not always available. Besides systems whose governing equations are poorly known, there are situations where solving the governing equations is too slow with respect to the dynamics at play. While reduced-order models may help, they can lose accuracy when control is applied, resulting in poor performance. A different line of control strategy relies on a data-driven approach. No model is assumed to be known and the control command is based on measurements only. In this contribution, we consider a reinforcement learning strategy for the closed-loop nonlinear control of separated flows. Deep neural networks are used to approximate both the control objective and the control policy. We consider the flow over a 2D open cavity in the realistic settings where one relies only on a few pressure sensors at the wall. The performance of the control strategy is demonstrated on the dampening of the Kelvin-Helmholtz vortices of the shear layer.

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