

Abstract Submitted
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On the evaluation of control performance in drag reducing flows¹

YOSUKE HASEGAWA, BETTINA FROHNAPFEL, Center of Smart Interfaces, TU Darmstadt, MAURIZIO QUADRIO, Department of Aerospace Engineering, Polytechnic Institute of Milan — Performance of drag reduction control for internal flows is customarily evaluated under two flow conditions, i.e., constant mass flow rate or constant pressure gradient. In the former, the drag reduction rate, i.e. the reduction of the pumping power, is used for evaluating control performance, while the increase rate of the mass flow rate indicates successful control in the latter. Considering real applications, however, the optimization problem of flow control is essentially formulated by the interplay between energy saving and achieved flow rate, that can be interpreted as money on one side, and time or convenience on the other side. Based on this idea, we derive two dimensionless parameters which quantify the costs of total energy consumption and convenience for transportation of fluid through a given duct. We reevaluate the control performances of existing strategies in the present framework and also show that this evaluation can easily be extended to external flows.

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Yosuke Hasegawa
Center of Smart Interfaces, TU Darmstadt

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