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Feedback control of the cylinder wake using balanced reduced order models[1] SIMON ILLINGWORTH, HIROSHI NAITO, KOJI FUKAGATA, Keio University — Feedback control is most successful when an accurate model of the system-to-be-controlled is available. For fluids, this can be achieved using a reduced order model which is balanced (meaning the input-output behaviour is properly captured). With this in mind, we consider feedback control of the cylinder wake in low Reynolds number simulations. Actuation is via blowing and suction on the cylinder's surface, and a single velocity sensor in the wake is used. Balanced reduced order models are formed using the Eigensystem Realization Algorithm (ERA) at a number of Reynolds numbers. The reduced order models, validated by comparing their impulse responses to the full system, are then used in two ways. First, the "gain window" phenomenon seen in previous feedback control studies is reproduced (and therefore explained) by the models. We see that this gain window shrinks with increasing Reynolds number, the consequence being that feedback control with a simple proportional gain is not possible at higher Reynolds numbers. Second, $\mathcal{H}_\infty$ loop-shaping techniques are used to design "dynamic" controllers that are effective at higher Reynolds numbers, achieving complete suppression of vortex shedding at Reynolds numbers in excess of 100.

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