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Feedback control of vortex shedding: An explanation of the gain window[1] SIMON ILLINGWORTH, University of Cambridge, HIROSHI NAITO, KOJI FUKAGATA, Keio University, KEIO UNIVERSITY TEAM — This presentation explains the gain window phenomenon seen in early experimental and computational studies on active, closed-loop control of vortex shedding, whereby shedding is completely suppressed only if the feedback gain lies within some narrow window of stabilizing gains. Using two-dimensional direct numerical simulations and reduced-order modeling techniques, a low-order, linear model of the cylinder wake is formed at a Reynolds number of 60. This model is used to reproduce and to explain the gain window seen in previous studies. It is shown that the gain window is not caused by the destabilization of a higher mode, but rather is determined entirely by the behaviour of the open-loop unstable mode under the action of the closed-loop controller. The time taken for actuated fluid to convect to the sensor location plays an important part in explaining this gain window. A similar analysis at a higher Reynolds number of 80 reveals that the wake remains unstable for all choices of the feedback gain. The study illustrates the limitations of closed-loop suppression of vortex shedding when a very simple control strategy is used.

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Simon Illingworth
University of Cambridge

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