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Analysis of Varying-Phase Opposition Control with Spatial Scale Restriction[1] SIMON TOEDTLI, BEVERLEY MCKEON, Caltech — This study considers a generalized version of the opposition control scheme (Choi et al, J Fluid Mech, 1994) from a Fourier domain perspective. Recent work (Toedtli et al, PRF, 2019) has shown that the effectiveness of the controller strongly depends on the relative phase between sensor measurement and actuator response, but an understanding of the underlying physics proves difficult so long as the controller simultaneously acts on a large number of spatial scales. We therefore consider here controllers with spatial scale restrictions and show that such controllers are capable of substantially altering the flow structure and drag. We first focus on the adverse scenario, where control leads to a pronounced drag increase, and use a combination of numerical simulation and modal analysis to shed light on the mechanisms underlying the change in drag. Insights obtained from the drag-increasing scenarios may help guiding the search for scale-restricted controller parameters that lead to drag reduction, which would be an important step towards a practical implementation of the control scheme.

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