Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Performance and robustness comparison between reduced-plant-based and directly-reduced optimal control[1] KEVIN CHEN, CLARENCE ROWLEY, Princeton University — A common objective in flow control is the construction of a low-dimensional controller from a high-dimensional plant modeling the fluid dynamics. Traditionally, the controller is constructed from a reduced-order model of the original plant. Recent advances, however, have allowed the construction of the H_2 optimal controller directly from the full-dimensional plant; this controller could then be reduced to a lower dimension. This study explores these two methods of arriving at a low-dimensional optimal controller, using the Ginzburg-Landau equation as a testbed. The controller's performance is evaluated by the H_2 norm of the transfer function from state disturbances and sensor noise to costs on the state and input magnitude. The robustness is measured primarily by the coprime stability margin, for which analytic bounds are available via the ν-gap metric. The directly-reduced controller generally achieves greater performance and robustness than the reduced-plant-based controller, but takes longer to compute for large-dimensional plants. A decrease in performance and robustness is attributed to faster growth rates of an instability, greater non-normality or time lag, and lower model reduction order.

[1]This work was supported by the DOD NDESG.

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Date submitted: 04 Aug 2011 Electronic form version 1.4