

Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

**Comparison Between DNS Data and Resolvent Model Prediction
of Opposition Control with a Phase Shift Between Sensor and Actuator¹**

SIMON TOEDTLI, California Institute of Technology, MITUL LUHAR, University of Southern California, BEVERLEY MCKEON, California Institute of Technology — In a recent study, Luhar et al (J Fluid Mech, 2014) analyzed the opposition control scheme (Choi et al, J Fluid Mech, 1994) within the resolvent analysis framework (McKeon & Sharma, J Fluid Mech, 2010) and demonstrated that their low-order model is able to qualitatively reproduce results from previous direct numerical simulation (DNS) studies. The model further predicts that introducing a phase shift between the sensor measurement and the actuator response strongly affects the attainable drag reduction and has the potential to improve the control effectiveness. The present study validates these predictions by means of a parametric DNS study and demonstrates that the response of the full nonlinear system to opposition control with various phase shifts between sensor and actuator very closely follows the low-order model. The good agreement between model prediction and DNS demonstrates for the first time the predictive capabilities of the resolvent analysis framework and suggests that it is a suitable low-order model to systematically design and optimize flow control schemes.

¹This work is made possible by the Air Force Office of Scientific Research through AFOSR grant number FA 9550-16-1-0361.

Simon Todtli
Caltech

Date submitted: 27 Jul 2017

Electronic form version 1.4