Abstract Submitted
for the DFD08 Meeting of
The American Physical Society

Reduced order models for control of fluids using the Eigensystem Realization Algorithm[1] ZHANHUA MA, SUNIL AHUJA, CLARENCE ROWLEY, Princeton University — We present a computational algorithm for model reduction of high-dimensional fluid simulations based on the Eigensystem Realization Algorithm (ERA), a method often used for system identification of vibrating systems. Our goal is to obtain models that capture the underlying flow physics and, at the same time, are useful for control design. For that purpose, we consider a system whose output is the velocity field in the entire computational domain. For such a large number outputs, ERA is intractable, so we use a technique called output projection, which involves reducing the number of outputs by projecting them onto the most energetic POD modes of the impulse response of the system. The presented algorithm involves a simple snapshot-based procedure commonly used for POD or balanced POD. The resulting models are equivalent to those obtained using balanced POD, but the algorithm involved requires only $O(n)$ inner products as compared to $O(n^2)$ for balanced POD, and does not need any adjoint simulations as required for balanced POD, thus resulting in large computational savings. We apply this technique to 2D flows past a flat plate at a low Reynolds number, and obtain reduced order models of the flow linearized about stable and unstable steady states.

[1]supported by the Air Force Office of Scientific Research

Clarence Rowley
Princeton University

Date submitted: 04 Aug 2008 Electronic form version 1.4