Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Computing Finite-Time Lyapunov Exponents with Optimally Time Dependent Reduction[1] HESSAM BABAEE, MOHAMMAD FARAZMAND, THEMIS SAPSIS, MIT, GEORGE HALLER, ETH — We present a method to compute Finite-Time Lyapunov Exponents (FTLE) of a dynamical system using Optimally Time-Dependent (OTD) reduction recently introduced by H. Babaee and T.P. Sapsis (*A minimization principle for the description of modes associated with finite-time instabilities*, Proceedings of the Royal Society of London A: Mathematical, Physical and Engineering Sciences, Vol. 472, 2016). The OTD modes are a set of finite-dimensional, time-dependent, orthonormal basis $\{\mathbf{u_i}(\mathbf{x},\mathbf{t})\}|_{\mathbf{i=1}}^{\mathbf{N}}$ that capture the directions associated with transient instabilities. The evolution equation of the OTD modes is derived from a minimization principle that optimally approximates the most unstable directions over finite times. To compute the FTLE, we evolve a single OTD mode along with the nonlinear dynamics. We approximate the FTLE from the reduced system obtained from projecting the instantaneous linearized dynamics onto the OTD mode. This results in a significant reduction in the computational cost compared to conventional methods for computing FTLE. We demonstrate the efficiency of our method for double Gyre and ABC flows.

[1]ARO project 66710-EG-YIP

Hessam Babaee
MIT

Date submitted: 03 Aug 2016 Electronic form version 1.4