Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Finding unstable periodic orbits with polynomial optimization, with application to a nine-mode model of shear flow.
MAYUR LAKSHMI, GIOVANNI FANTUZZI, Imperial College London, JESUS FERNANDEZ-CABALLERO, University of Warwick, YONGYUN HWANG, SERGEI CHERNYSHENKO, Imperial College London — It was recently suggested (Tobasco et al. Phys. Lett. A, **382**, 382–386, (2018)) that trajectories of ODE systems which optimize the infinite-time average of an observable can be localized using sublevel sets of a function that arise when bounding such averages using so-called auxiliary functions. This talk will demonstrate that this idea allows for the computation of extremal unstable periodic orbits (UPOs) for polynomial ODE systems. We first show that polynomial optimization is guaranteed to produce near-optimal auxiliary functions, which are required to localize the extremal UPO accurately. We then show that points inside the relevant sublevel sets can be computed efficiently through direct nonlinear optimization. Such points provide good initial conditions for UPO computations. We illustrate the potential of this new technique of finding UPOs by presenting the results of applying it to a nine-dimensional model of a sinusoidally forced shear flow.

Mayur Lakshmi
Imperial College London

Date submitted: 30 Jul 2019

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