Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Identification of spatially-localized initial conditions via sparse PCA[1] ANUBHAV DWIVEDI, MIHAILO JOVANOVIC[2], Univ of Minn - Minneapolis — Principal Component Analysis involves maximization of a quadratic form subject to a quadratic constraint on the initial flow perturbations and it is routinely used to identify the most energetic flow structures. For general flow configurations, principal components can be efficiently computed via power iteration of the forward and adjoint governing equations. However, the resulting flow structures typically have a large spatial support leading to a question of physical realizability. To obtain spatially-localized structures, we modify the quadratic constraint on the initial condition to include a convex combination with an additional regularization term which promotes sparsity in the physical domain. We formulate this constrained optimization problem as a nonlinear eigenvalue problem and employ an inverse power-iteration-based method to solve it. The resulting solution is guaranteed to converge to a nonlinear eigenvector which becomes increasingly localized as our emphasis on sparsity increases. We use several fluids examples to demonstrate that our method indeed identifies the most energetic initial perturbations that are spatially compact.

[1]This work was supported by Office of Naval Research through grant number N00014-15-1-2522
[2]Currently at University of Southern California

Anubhav Dwivedi
Univ of Minn - Minneapolis

Date submitted: 01 Aug 2017 Electronic form version 1.4