Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

A modal decomposition for discovery of nonlinear triadic interactions from flow data OLIVER SCHMIDT, University of California San Diego — We seek a decomposition of a flow field into spatial modes that reveal the footprint of triadic interactions. This goal is accomplished by extending bispectral signal analysis to multidimensional datasets with at least one inhomogeneous spatial direction. As we are interested in finding the dominant large-scale coherent structures associated with quadratic nonlinearities, we require the modal decomposition to optimally represent the data in terms of its phase coherence, as characterized by the third-order cumulant. In the frequency domain, this higher-order statistic is readily computed from a product of Fourier transforms at different frequencies. An algorithm for the computation of the proposed bispectral mode analysis is presented and applied to three data sets obtained from direct numerical simulation of cylinder flow at Re=300, large-eddy simulation of transitional jet flow, and particle image velocimetry measurements of a massively separated flat plate at a high angle of attack. The results are visualized in terms of frequency-frequency plots similar to the bispectrum that indicate the presence of the quadratic phase coupling, and spatial modes that can reveal the nature of the nonlinear interaction.

Oliver Schmidt
University of California San Diego

Date submitted: 01 Aug 2019 Electronic form version 1.4