On the Singular Value Decomposition of Measured Data  

BRENDEN EPPS, Thayer School of Engineering, Dartmouth College — Singular value decomposition (SVD) is a well-known mathematical tool that can be used to decompose an ensemble of velocity field data into spatiotemporal modes that may reveal coherent flow structures. The proper orthogonal decomposition (POD) is a special case of the SVD, used when the data are uncorrelated in time (as in a turbulent flow). Although the SVD and POD have been widely used in fluid mechanics, Epps and Techet (2010, ExpFluids 48:355367) were among the first to consider how experimental error affects the results of the SVD. This talk revisits that paper and provides mathematically-rigorous bounds on the errors in the computed singular values and spatio-temporal mode shapes. Given experimental data with unknown error, a procedure is presented to (i) determine the root mean square measurement error and (ii) determine error bars for the singular values and vectors.

Brenden Epps  
Thayer School of Engineering, Dartmouth College