Analysis of non-stationary turbulent flows using Multivariate EMD and Matching Pursuits ARVIND MOHAN, LIONEL AGOSTINI, DATTA GAITONDE, The Ohio State University, MIGUEL VISBAL, U.S. Air Force Research Laboratory — Time-series analysis of highly transient non-stationary turbulent flow is challenging. Traditional Fourier based techniques are generally difficult to apply because of the highly aperiodic nature of the data. Another significant obstacle is assimilating multivariate data, such as multiple variables at a location or from different sources in a flow-field. Such an analysis has the potential to identify sensitive events common among these sources. In this work, we explore two techniques to address these challenges - Multivariate Empirical Mode Decomposition and Matching Pursuits, on deep dynamic stall of a plunging airfoil in a mixed laminar-transitional-turbulent regime. Although primarily used for neuroscience applications, we use them in fluid mechanics and highlight their significant potential to overcome limitations of more traditional techniques. Application of these methods highlight different stages in the development of stall. A first stage shows development of 2-D boundary layer oscillations at frequencies similar to those associated with trailing edge vortices. Subsequently, new instabilities arise due to imminent separation. The separation bubble itself is characterized by relatively higher frequency content, and further analysis indicates its 3-D collapse.

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