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Qualitative Approaches to Understanding Coherent Structures in Turbulence IHSAN T. SHAFI, Department of Nuclear Engineering, Texas AM University, PAUL J. KRISTO, Department of Mechanical Engineering, Texas AM University, ABDULLAH G. WEISS, Department of Nuclear Engineering, Texas AM University, MARK L. KIMBER, Department of Mechanical Engineering, Department of Nuclear Engineering, Texas AM University — A review of several techniques is presented, with emphasis on recent developments in the mathematical treatment of the proper orthogonal decomposition (POD) as applied to experimental particle image velocimetry data. The experiment in question is the classical flow past a cylinder with three distinct shapes: round, square, and hexagonal at a Reynolds number of 16000. The purpose of the study is to analyze the identification of basic structures and estimation of energy content via filtering methods. Reynolds decomposition is the method of separating the flow field into its mean and fluctuating components. Galilean decomposition uses the bulk velocity to identify small-scale vortices within the flow field. LES decomposition is analogous to a low pass filter that reveals small length scales. POD is an advanced method that takes high dimensional nonlinear coherent structures and converts them into a finite dimensional linearized projection. Vorticity is used to describe the local spinning motion near an eddy and to recover a velocity field from a vorticity field. The accuracy of each method is compared and differences in structures produced by each geometry are discussed. Practical concerns include computational time, data compression, and spatial resolution are addressed.

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