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Energy Analysis of Turbulent Flow Using Bi-Orthogonal Wavelets JOSHI VIVEK, DIETMAR REMPFER, IIT — Turbulent flow exhibits many different length and time scales. Hence in order to have a deeper insight into turbulence it is important to study energy transfer at discrete scales and between scales. Wavelets offer some potential for the analysis of energy transfer in turbulent flow. This is mainly due to their locality and scalability property. Wavelet representations have a natural built-in adaptivity through their ability to express and separate structures in a flow at different scales. Combined with the concept of the energy cascade, this feature makes wavelets a powerful tool for analysis compared to conventional discretizations. Wavelets are traditionally associated with orthonormal bases. A closer look reveals that orthogonality is often convenient but not essential. So in order to have more flexibility we have used the concept of bi-orthogonality for resolving different energy terms in the turbulent kinetic energy equation. This approach appears sometimes better suited, and offers interesting new combinations of concepts. The present work involves a wavelet decomposition of the terms in the turbulent kinetic energy transport equation of a fully developed channel flow, and a study of the behavior of the important terms. A detailed study of the energy transfer term is performed. An attempt is made to identify some well-known structures in turbulent channel flow at different scales of decomposition. The dynamics of these coherent structures is studied based on their contribution to energy transfer in the flow at discrete scales and over a period of time.

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