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Inter-scale energy transfer by multiscale vorticity stretching and strain self-amplification in turbulence[1] PERRY JOHNSON, Stanford University — Three-dimensional turbulent flows are characterized by net transfer of energy from large to small scales. This inter-scale energy transfer is commonly described as a cascade driven by vorticity stretching, but in a phenomenological or imprecise way. Somewhat less commonly, the role of strain self-amplification is emphasized. This talk demonstrates an exact expression for inter-scale energy transfer in terms of multiscale vorticity stretching and strain self-amplification. This relationship elucidates the relative role of these two mechanisms in driving the cascade in the inertial range, while also accounting for the relative importance of scale-local and scale-nonlocal processes. Direct numerical simulations show that strain self-amplification contributes more to the energy cascade than vorticity stretching, but not overwhelmingly so. The leaky cascade view of inter-scale energy transfer is supported by the results. An additional mechanism of inter-scale energy transfer is revealed, with a possible connection to two-dimensional turbulence.

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