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Composite Expansions for Active and Inactive Motions in the Streamwise Reynolds Stress of Turbulent Boundary Layers ROBERT MCKEE, Southwest Research Institute, RONALD PANTON, University of Texas Austin — Proper scaling of streamwise Reynolds stress in turbulent boundary layers has been controversial for more than a decade as its Reynolds Number dependence can not be removed by normal scaling. One issue that explains the behavior of the streamwise Reynolds stress is that it is affected by both active and inactive motions per Townsend's hypothesis. The goal of this research is to develop a composite expansion for the streamwise Reynolds stress that considers active and inactive motions, explains various Reynolds Number dependencies, and agrees with available data. Data from four sources are evaluated. A new asymptotic representation for the Reynolds shear stress, <uv>+, that meets the requirements for a proper composite expansion is developed. The streamwise Reynolds stress, <uu>+, can be separated into active and inactive parts with Reynolds shear stress as the active part. An outer correlation equation with the correct asymptotic limits for the inactive streamwise Reynolds stress is developed and shown to fit the outer <uIuI># data. A separate correlation equation for <uIuI># is developed and fit to data. These two equations form a composite expansion for the inactive streamwise Reynolds stress. This composite expansion can be combined with the ¡uv¿+ expansion to produce predictions for <uu>+. Thus a composite expansion for predicting streamwise Reynolds stress in turbulent boundary layers is developed and shown to agree with available data and to explain the Reynolds Number dependence streamwise Reynolds stress.

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