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Time-Series Analysis of Intermittent Velocity Fluctuations in Turbulent Boundary Layers[1] MOHSEN ZAYERNOURI, Michigan State University, Department of Computational Mathematics, Science, and Engineering , MEHDI SAMIEE, Michigan State University, Department of Mechanical Engineering , MARK M. MEERSCHAERT, Michigan State University, Department of Statistics and Probability , JOSEPH KLEWICKI, University of New Hampshire, Department of Mechanical Engineering — Classical turbulence theory is modified under the inhomogeneities produced by the presence of a wall. In this regard, we propose a new time series model for the streamwise velocity fluctuations in the inertial sublayer of turbulent boundary layers. The new model employs tempered fractional calculus and seamlessly extends the classical 5/3 spectral model of Kolmogorov in the inertial subrange to the whole spectrum from large to small scales. Moreover, the proposed time-series model allows the quantification of data uncertainties in the underlying stochastic cascade of turbulent kinetic energy. The model is tested using well-resolved streamwise velocity measurements up to friction Reynolds numbers of about 20,000. The physics of the energy cascade are briefly described within the context of the determined model parameters.

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