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A new algebraic transition model based on stress length function

MENG-JUAN XIAO, ZHEN-SU SHE, SKLTCS, COE, Peking Univ. — Transition, as one of the two biggest challenges in turbulence research, is of critical importance for engineering application. For decades, the fundamental research seems to be unable to capture the quantitative details in real transition process. On the other hand, numerous empirical parameters in engineering transition models provide no unified description of the transition under varying physical conditions. Recently, we proposed a symmetry-based approach to canonical wall turbulence based on stress length function, which is here extended to describe the transition via a new algebraic transition model. With a multi-layer analytic form of the stress length function in both the streamwise and wall normal directions, the new model gives rise to accurate description of the mean field and friction coefficient, comparing with both the experimental and DNS results at different inlet conditions. Different types of transition process, such as the transition with varying incoming turbulence intensities or that with blow and suck disturbance, are described by only two or three model parameters, each of which has their own specific physical interpretation. Thus, the model enables one to extract physical information from both experimental and DNS data to reproduce the transition process, which may prelude to a new class of generalized transition model for engineering applications.

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