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Aspects of turbulent boundary-layer separation

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Abstract

Features of two-dimensional and three-dimensional separating turbulent boundary layer flows are discussed. For the two-dimensional cases, the behavior and structure of strong adverse-pressure-gradient separating flows over streamlined surfaces and backward-facing step separations are reviewed. There are a number of differences from attached flows: normal stress effects in the Reynolds-averaged momentum and turbulence kinetic energy equations are strong; the backflow is dominated by large-scale unsteady motions that produce the mean velocity profile, low Reynolds shearing stresses, and the turbulence energy diffusion toward the wall, which is balanced by dissipation; the non-equilibrium turbulent structure requires stress transport equation(s) to model these flows. Recent developments in laser-Doppler anemometry permit new, more detailed measurements of mean three-dimensional turbulent flow. The turbulent structure is strongly anisotropic and simple isotropic algebraic turbulence models do not describe the shearing stresses. Non-equilibrium lags of the turbulent structure relative to the mean flow structure also require stress transport equation(s) for modeling. Features of

mean flow structure also require stress transport equation(s) for modeling. Features of the flow structure around a 6 : 1 prolate spheroid at angle of attack and around a wing/body junction are discussed. In the first case, an open separation with no flow reversal is examined. For the wing/body junction, an unsteady horseshoe vortex structure with flow reversal is present in front of the leading edge of the wing.

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small vector of angular velocity, even taking into account the public nature of these legal relations.
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