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Nonisotropic turbulence: A turbulent boundary layer KUNLUN LIU, RICHARD PLETCHER, Dept. of Mechanical Engineering, Iowa State University, TURBULENT BOUNDARY LAYERS COLLABORATION, TURBULENCE THEORY COLLABORATION — The probability density function (PDF) and the two-point correlations of a flat-plate turbulent boundary layer subjected to the zero pressure gradient have been calculated by the direct numerical simulation. It is known that the strong shear force near the wall will deform the vortices and develop some stretched coherent structures like streaks and hairpins, which eventually cause the nonisotropy of wall shear flows. The PDF and the two-point correlations of isotropic flows have been studied for a long time. However, our knowledge about the influence of shear force on the PDF and two-point correlations is still very limited. This study is intended to investigate such influence by using a numerical simulation. Results are presented for a case having a Mach number of $M = 0.1$ and a Reynolds number 2000, based on displacement thickness. The results indicate that the PDF of the streamwise velocity is Lognormal, the PDF of normal velocity is approximately Cauchy, and the PDF of the spanwise velocity is nearly Gaussian. The mean and variance of those PDFs vary according to the distance from the wall. And the two-point correlations are homogenous in the spanwise direction, have a slightly variation in the streamwise direction, but change a lot in the normal direction. R_{ww} or R_{vv} can be represented as elliptic balls. And the well-chosen normalized system can enable R_{ww} and R_{vv} to be self-similar.

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