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Turbulence Structure in Rough and Smooth Wall Boundary Layers[1] RALPH VOLINO, MICHAEL SCHULTZ, KAREN FLACK, United States Naval Academy — The outer region structure of turbulent boundary layers on smooth and rough walls was studied experimentally. Turbulence spectra were computed from LDV data. Velocity fields were computed from PIV data. Instantaneous swirl strength fields were computed from the velocity fields. The heads of hairpin vortices grouped as packets were visible in the streamwise wall normal plane, and the legs of these vortices were visible along the length of low speed streaks in streamwise spanwise planes at y/δ=0.1 and 0.4. These structures, observed previously in smooth wall boundary layers, were qualitatively similar in the rough and smooth wall cases. Two point correlations of the velocity and swirl strength were quantitatively similar for the smooth and rough walls. The turbulence spectra and probability density functions of the turbulence and swirl strength also showed quantitative similarity between the rough and smooth wall cases when the results were normalized using the friction velocity and the boundary layer thickness. This similarity in turbulence structure is in agreement with the similarity in turbulence statistics reported previously.

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