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Examination of Large-Scale Structures in Turbulent Microchannel Flow HAO LI, MICHAEL OLSEN, Iowa State University — Microscopic particle image velocimetry was performed on turbulent flow in microchannels of various diameters and aspect ratios to evaluate the characteristics of large-scale turbulent structures. Spatial correlations of velocity fluctuations were measured along the channel centerlines and at four other locations, and characteristic turbulent length scales were defined. For square microchannels, excellent agreement was observed between the measured length scales and results for macroscale duct flow. Along the centerline of the square microchannels the normalized longitudinal length scale, $2Lx_{uu}/W$, ranged from 0.30-0.37, the lateral length scale, $2Ly_{uu}/W$, ranged from 0.16-0.18, and the ratio between the two length scales, Lx_{uu}/Ly_{uu} ranged from 1.88-2.00, results which agree well with macroscale results. Results for non- square microchannels indicate that as aspect ratio increases, the ratio Lx_{uu}/Ly_{uu} also increases, ranging from 2.29 for an aspect ratio of 2.09 up to 3.75 for an aspect ratio of 5.68. For the square microchannels the turbulent structures are smaller near the side walls than near the center of the microchannel with $2Lx_{uu}/W$ ranging from 0.30-0.38 along the centerline, but dropping to 0.04-0.06 at $y/(W/D) = 0.94$. Similar results were observed for the rectangular microchannels. For the rectangular microchannels $2Lx_{uu}/W$ ranged from 0.32 to 0.42, compared to 0.30-0.38 for the square microchannels.

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