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On the existence of self-similar structures in turbulent pipe flow[1] LEO HELLSTRM, TYLER VAN BUREN, Princeton University, JOHN VACCARO, Hofstra University, ALEXANDER SMITS, Princeton University — Townsend's attached eddy hypothesis assumes the existence of a set of geometrically self-similar eddies in the logarithmic layer in wall-bounded turbulent flows that scale with their distance from the wall. Although there is statistical evidence to support the scaling of the attached eddies in the wall-normal and spanwise directions, there is little evidence to support the existence of fully three-dimensional self-similar coherent motions in the log-layer. Here we present experimental results of a study of coherent motions in pipe flow using two synchronized stereo PIV systems, to resolve three-component velocity data simultaneously in two pipe cross-sections with streamwise spacing spanning from 0 to $9.97R$, at $Re_\tau = 2390$. The data reveal a set of structures with self-similar behavior in all three dimensions. Interestingly, the resolved eddies show some geometrical variations among structures of different physical sizes where, for instance, the smaller structures have a more stable streamwise repetition mechanism compared to their larger counterparts.

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