

Abstract Submitted  
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**Statistical growths of turbulent structures in a pipe flow.**<sup>1</sup> JUN-SUN AHN, HYUNG JIN SUNG, KAIST — The streamwise and spanwise (or azimuthal) growths of turbulent coherent structures in a turbulent pipe flow ( $Re_\tau = 3008$ ) are explored. Two-point correlation and 1-D pre-multiplied energy spectra of the streamwise velocity fluctuations are obtained to analyze the statistical growths of the streamwise and spanwise structures. The streamwise and spanwise length scales linearly grow along the wall-normal distance and the relationship between both length scales is shown to be linear, which support the attached eddy hypothesis. Furthermore, the statistical scalings of the coherent structures are demonstrated and compared to 2-D pre-multiplied energy spectra of the streamwise velocity fluctuations. Finally, the relationship between the streamwise and spanwise structures is analyzed by using the POD based on the translational invariance method (Duggeby et al. 2009). Several representative energetic modes are observed. The combinations of the energetic modes are used to examine the behaviors of the large- and very-large-scale motions.

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Junsun Ahn  
KAIST

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