Abstract Submitted
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Alignment of infinitesimal material lines and surfaces in wall turbulence[1] ZHIWEN CUI, WEIXI HUANG, CHUNXIAO XU, Tsinghua University, HELGE I. ANDERSSON, Norwegian University of Science and Technology, LIHAO ZHAO, Tsinghua University — An infinitesimal material line or surface are both referred to as an infinitesimal material element, which is defined as an object always consisting of the same group of fluid particles and passively following the fluid motion. We numerically investigate the Lagrangian evolution of infinitesimal material elements in a turbulent channel flow with a focus on the interaction between turbulent coherent structures and the material elements. Based on the ensemble-averaged coherent vortices and the alignment pattern of material elements, we classify three regions from the wall to the center of channel, i.e. shear-dominance region, structure-dominance region and isotropic region. We find that each region is characterized by its distinct alignment pattern and alignment mechanism. Our work highlights the importance of coherent structures on the alignment behavior of material elements in the structure-dominance region and proposes an alignment mechanism, which has the implications in the relevant studies including polymers or fiber induced drag reduction of wall-turbulence and orientation distribution of wood fibers in paper making process.

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