

Abstract Submitted
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A relation between velocity-vorticity correlations and skin friction in wall-bounded turbulent flows¹ MIN YOON, JUNSUN AHN, JINYUL HWANG, HYUNG JIN SUNG², KAIST — The relationship between the skin friction and the velocity-vorticity correlations in wall-bounded turbulent flows is derived from the mean vorticity equation. A formula for the skin friction coefficient (C_f) is proposed and evaluated with regards to three canonical wall-bounded flows: turbulent boundary layer, turbulent channel flow, and turbulent pipe flow. The skin friction coefficient can be derived from the mean spanwise vorticity at the wall. Double integration with respect to the wall-normal direction (from 0 to y) is needed to derive C_f from the second derivative of the mean spanwise vorticity in the mean spanwise vorticity equation. One more integration is needed to find the contribution of each component to C_f from the wall to the boundary layer edge (from 0 to δ). The present formula encompasses four terms: advective vorticity transport, vortex stretching, viscous, and inhomogeneous terms. Drag-reduced channel flow with the slip condition is used to test the reliability of the formula. The advective vorticity transport and vortex stretching terms are found to dominate the contributions to the frictional drag.

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