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Geometry Mediated Drag Reduction in Taylor-Couette Flows

SHABNAM RAAYAI, GARETH MCKINLEY, Massachusetts Inst of Tech-MIT —

Micro-scale ribbed surfaces have been shown to be able to modify surface properties such as skin friction on both natural and fabricated surfaces. Previous experiments have shown that ribbed surfaces can reduce skin friction in turbulent flow by up to 4-8% in the presence of zero or mild pressure gradients [1]. Our previous computations have shown a substantial reduction in skin friction using micro-scaled ribs of sinusoidal form in high Reynolds number laminar boundary layer flow. The mechanism of this reduction is purely viscous, through a geometrically-controlled retardation of the flow in the grooves of the surface. The drag reduction achieved depends on the ratio of the amplitude to the wavelength of the surface features and can be presented as a function of the wavelength expressed in dimensionless wall units. Here we extend this work, both experimentally and numerically, to consider the effect of similar ribs on steady viscous flow between concentric cylinders (Taylor-Couette flow). For the experimental work, the inner rotating cylinder (rotor) is machined with stream-wise V-groove structures and experiments are performed with fluids of different viscosity to compare the measured frictional torques to the corresponding values on a smooth flat rotor as a measure of drag reduction. The numerical work is performed using the OpenFOAM®open source software to compare the results and understand the physical mechanisms underlying this drag reduction phenomenon.

[1] D. Bechert *et al.*, Experiments in Fluids **28** (2000)

Shabnam Raayai
Massachusetts Inst of Tech-MIT

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