Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Only certain riblets experience the Kelvin-Helmholtz instability[1]

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The Kelvin-Helmholtz instability develops in turbulent flow above blade riblets and degrades their drag-reduction performance (Garcia-Mayoral & Jimenez 2011). Based on our direct numerical simulations of 21 cases comprising six riblet cross-sections and various viscous-scale sizes, the instability also develops over sharp triangular riblets, but not over blunt triangular or trapezoidal riblets. Specifically, two out of six riblet shapes in the present data set experience strong Kelvin-Helmholtz rollers. In this presentation, we offer an explanation for the occurrence of the instability over only certain riblets: we observe that only riblet shapes with high momentum absorption in the tip region seem to create a pronounced mixing-layer profile that drives the instability. Additionally, as previously known for blade riblets, only riblet grooves with a large viscous-scaled cross-sectional area provide the necessary effective wall-normal permeability at the riblet tips.

[1]Australian Research Council DP170102595, Pawsey, NCI

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Date submitted: 03 Aug 2020 Electronic form version 1.4