Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

A minimal model for riblet geometry optimization MITUL LUHAR, ANDREW CHAVARIN, University of Southern California — Recent work shows that the forcing-response gain for resolvent modes resembling the energetic near-wall cycle is a useful predictor of overall drag reduction performance over riblets. Riblet sizes and shapes identified as being optimal in previous high-fidelity simulations and experiments are found to minimize gain for this resolvent mode. Building on this observation, we develop a geometry optimization framework for streamwise constant riblets. The shape and size of the riblets is parametrized using Bezier curves. A gradient-based search algorithm is employed to identify curve parameters that minimize amplification of the near-wall mode. Unsurprisingly, this procedure identifies scalloped and blade-like geometries as being optimal. Moreover, when scaled in inner units, the optimal sizes for these geometries are found to be insensitive to Reynolds number. Preliminary optimization results that take manufacturability constraints into account are presented briefly. Physical mechanisms responsible for performance deterioration are discussed in the context of the resolvent-based predictions.

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Date submitted: 01 Aug 2019 Electronic form version 1.4