Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

**Optimizing Geometry Mediated Skin Friction Drag on Riblet-Textured Surfaces** SHABNAM RAAYAI, GARETH MCKINLEY, Massachusetts Inst of Tech-MIT — Micro-scale riblets have been shown to modify the skin friction drag on patterned surfaces. Shark skin is widely known as a natural example of this passive drag reduction mechanism and artificial riblet tapes have been previously used in the America's Cups tournament resulting in a 1987 victory. Previous experiments with riblet surfaces in turbulent boundary layer flow have shown 4-8% reduction in the skin friction drag. Our computations with sinusoidal riblet surfaces in high Reynolds number laminar boundary layer flow and experiments with V-grooves in laminar Taylor-Couette flow also show that the reduction in skin friction can be substantial and depends on the spacing and height of the riblets. In the boundary layer setting, this frictional reduction is also a function of the length of the plate in the flow direction, while in the Taylor Couette setting it depends on the gap size. In the current work, we use scaling arguments and conformal mapping to establish a simplified theory for laminar flow over V-groove riblets and explore the self-similarity of the velocity contours near the patterned surface. We combine these arguments with theoretical and numerical calculations using Matlab and OpenFOAM to show that the drag reduction achievable in laminar flow over riblet surfaces depends on a rescaled form of the Reynolds number combined with the aspect ratio of the texture (defined in terms of the ratio of the height to spacing of the riblets). We then use these results to explain the underlying physical mechanisms driving frictional drag reduction and offer recommendations for designing low drag surfaces.

Shabnam Raayai
Massachusetts Inst of Tech-MIT

Date submitted: 28 Jul 2016 Electronic form version 1.4