# Direct Numerical Simulations of Drag Reduction in Turbulent Channel Flow over Bio-inspired Herringbone Riblet Texture

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## Abstract

The use of drag reducing surface textures is a promising passive method to reduce fuel consumption. Probably most well-known is the utilisation of shark-skin inspired ridges or riblets parallel to the mean flow. They can reduce drag up to 10%. Recently another bio-inspired texture based on bird flight feather riblets has been proposed. It differs from the standard riblets in two ways. First, the riblets are arranged in a converging/diverging or herringbone pattern. Second, the riblet height or groove depth changes gradually. Drag reductions as high as 20% have been claimed [1]. The objective of the present work is to study the drag reducing properties and mechanisms of this texture. To that purpose Direct Numerical Simulations (DNSs) of turbulent plane channel flow have been performed. Structured roughness has been applied to both walls and several geometric parameters have been varied. Marginal drag reductions on the order of 2.5% and significant drag increases well beyond 100% were found. The latter is attributed to a strong secondary flow that mixes momentum through the whole channel. In future optimization studies we might look for conditions at which secondary motions affect the near-wall cycle of turbulence only.

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## References

[1] H. Chen, F. Rao, X. Shang, D. Zhang, and I. Hagiwara. Flow over bio-inspired 3D herringbone wall riblets. *Experiments in Fluids*, 55(3):1–7, 2014.