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Documentation of roller-bearing effect on butterfly inspired grooves[1] SASHANK GAUTAM, AMY LANG, The University of Alabama — Butterfly wings are covered with scales in a roof shingle pattern which align together to form grooves. The increase or decrease of laminar friction drag depends on the flow orientation to the scales. Flow in the longitudinal direction to the grooves encounters increased surface area which increases the friction drag. However, in the transverse direction, for low Re laminar flow, a single vortex is formed inside each groove and is predicted to remain stable due to the very low Re of the flow in each cavity. These embedded vortices act as roller bearings to the flow above, such that the fluid from the outer boundary layer does not mix with fluid inside the cavities. This leads to a reduction of skin friction drag when compared to a smooth surface. When the cavity flow Re is increased beyond a critical point, the vortex becomes unstable and the low-momentum fluid in the grooves mixes with the outer boundary layer flow, increasing the drag. The objective of this experiment is to determine the critical Re where the embedded vortex transitions from a stable to an unstable state using DPIV. Subsequently, for steady vortex conditions, a comparison of skin friction drag between the grooved and flat plate can show that the butterfly scaled surface can result in sub-laminar friction drag.

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Sashank Gautam
The University of Alabama

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