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Laminar skin friction drag reduction through the "roller bearing effect" over butterfly-inspired transverse cavities SASHANK GAUTAM, AMY LANG, LEONARDO SANTOS, University of Alabama — The Monarch butterfly wings are covered in minuscule scales (100 m) which align together in a pattern that resembles roof shingles. These scales are angled upwards such that transverse cavities form for a flow passing perpendicular to the rows of scales. As the air flow passes over the cavities, a single vortex is entrapped and forms at a very low Re (less than 10) inside each cavity. This embedded vortex acts as a fluidic bearing to the outer boundary layer and results in reduced skin friction drag. As the cavity geometry is varied to better mimic the butterfly scales, the shape of the vortex and the dividing streamline also changes, which in turn would affect the skin friction drag. This study aims to determine the cavity geometry that results in the optimum drag reduction. It is hypothesized that the slanted models inspired from observed butterfly scale geometries, with AR 2:1 with 45cavity inclination angle and AR 3:1 with 22inclination angle will result in higher drag reduction. This is because the slanted cavity vortex will be in less contact with cavity walls compared to rectangular cavity and thus be able to maintain a higher partial slip velocity as it interacts with the boundary layer. All experiments are conducted in a vertical tow-tank facility using DPIV.

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