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Butterfly scales and their local surface drag dependence on flow orientation AMY LANG, ROBERT JONES, University of Alabama — An experimental study was carried out to measure surface drag over embedded cavity models based on the geometry of butterfly wing scales. Monarch (*Danaus plexippus*) scales, each measuring about 0.1 mm in length, were observed using microscopy to evaluate the microgeometry. Two separate, fabricated models scaled up (300:1) the geometry for dynamically similar testing in a Couette flow oil tank facility. The drag induced over the patterned surfaces was measured using a force gauge. Flow transverse to the rows of scales resulted in a significant drag decrease ($> 30\%$), with dependence on Re. This drag reduction is attributed to the formation of embedded vortices forming between the rows of scales resulting in a "roller bearing" effect. Flow parallel to the rows, as expected, resulted in larger drag increases, especially at lower Re. Both effects may prove beneficial to the butterfly, during flapping and gliding flight, and will be discussed based on the observed orientation of the scales on real specimens.

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