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Effects of bio-inspired microscale roughness on macroscale flow structures HUMBERTO BOCANEGRA EVANS, Texas Tech University, ALI M. HAMED, University of Illinois at Urbana-Champaign, SERDAR GORUMLU, ALI DOOSTTALAB, BURAK AKSAK, Texas Tech University, LEONARDO P. CHAMORRO, University of Illinois at Urbana-Champaign, LUCIANO CASTILLO, Texas Tech University — The interaction between rough surfaces and flows is a complex physical situation that produces rich flow phenomena. While random roughness typically increases drag, properly engineered roughness patterns may produce positive results, e.g. dimples in a golf ball. Here we present a set of PIV measurements in an index matched facility of the effect of a bio-inspired surface that consists of an array of mushroom-shaped micro-pillars. The experiments are carried out—under fully wetted conditions—in a flow with adverse pressure gradient, triggering flow separation. The introduction of the micro-pillars dramatically decreases the size of the recirculation bubble; the area with backflow is reduced by approximately 60%. This suggests a positive impact on the form drag generated by the fluid. Furthermore, a negligible effect is seen on the turbulence production terms. The micro-pillars affect the flow by generating low and high pressure perturbations at the interface between the bulk and roughness layer, in a fashion comparable to that of synthetic jets. The passive approach, however, facilitates the implementation of this coating. As the mechanism does not rely on surface hydrophobicity, it is well suited for underwater applications and its functionality should not degrade over time.

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