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Reversing flow causes passive shark scale actuation in a separating turbulent boundary layer[1] AMY LANG, The University of Alabama, BRADFORD GEMMELL, PHIL MOTTA, LAURA HABEGGER, KEVIN DU CLOS, University of South Florida, SEAN DEVEY, CALEB STANLEY, LEO SANTOS, The University of Alabama — Control of flow separation by shortfin mako skin in experiments has been demonstrated, but the mechanism is still poorly understood yet must be to some extent Re independent. The hypothesized mechanisms inherent in the shark skin for controlling flow separation are: (1) the scales, which are capable of being bristled only by reversing flow, inhibit flow reversal events from further development into larger-scale separation and (2) the cavities formed when scales bristle induces mixing of high momentum flow towards the wall thus energizing the flow close to the surface. Two studies were carried out to measure passive scale actuation caused by reversing flow. A small flow channel induced an unsteady, wake flow over the scales prompting reversing flow events and scale actuation. To resolve the flow and scale movements simultaneously we used specialized optics at high magnification (1 mm field of view) at 50,000 fps. In another study, 3D printed models of shark scales, or microflaps (bristling capability up to 50 degrees), were set into a flat plate. Using a tripped, turbulent boundary layer grown over the long flat plate and a localized adverse pressure gradient, a separation bubble was generated within which the microflaps were placed. Passive flow actuation of both shark scales and microflaps by reversing flow was observed.

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