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Drag Control through Wrinkling on Curved Surfaces[1] DENIS TERWAGNE, Department of Civil and Environmental Engineering, Massachusetts Institute of Technology, Cambridge, MA USA, PEDRO REIS, Department of Civil and Environmental Engineering and Department of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, MA USA — We present the results of an experimental investigation on the wrinkling of positively curved surfaces and explore their use towards drag reduction applications. In our precision model experiments we make use of rapid prototyping techniques to cast samples with custom geometry and material properties out of silicone-based rubbers. Our structures consist of a thin stiff shell that is chemically bonded to a thicker soft substrate. The substrate contains a spherical cavity that can be depressurized, under controlled volume conditions, to compress the ensemble structure. Under this compressive loading, the initially smooth outer-shell develops complex wrinkling patterns. We systematically characterize and quantify the morphology of the various patterns and study the phase diagram of the system. We consider both geometric and material quantities in the parameter space. Moreover, since the wrinkling patterns can be actuated dynamically using a pressure signal, we systematically characterize the aerodynamic behavior of our structures in the context of fluid drag reduction. An added advantage of our novel mechanism is that it allows for both dynamic switching and tuning of the surface morphology, thereby opening paths for drag control.

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