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Evaluation of Drag Reduction via Superhydrophobic Surfaces and Active Gas Replenishment in a Fully-developed Turbulent Flow JAMES W. GOSE, KEVIN GOLOVIN, STEVEN L. CECCIO, MARC PERLIN, ANISH TUTEJA, Univ of Michigan - Ann Arbor — The development of superhydrophobic surfaces (SHS) for skin-friction drag reduction in the laminar regime has shown great promise. A team led by the University of Michigan is examining the potential of similar SHS in high-speed naval applications. Specifically, we have developed a recirculating facility to investigate the reduction of drag along robustly engineered SHS in a fully-developed turbulent boundary layer flow. The facility can accommodate both small and large SHS samples in a test section 7 mm (depth) x 100 mm (span) x 1200 mm (length). Coupled with an 11.2 kilowatt pump and a 30:1 contraction, the facility is capable of producing an average flow velocity of 20 m/s, yielding a height based (7 mm) Reynolds number of 140,000. The SHS tested were designed for large-scale application. The present investigation shows skin-friction drag reduction for various sprayable and chemically developed SHS that were applied over a 100 mm (span) x 1100 mm (length) area. The drag measurement methods include pressure drop across the test specimen and PIV measured boundary layers. Additional SHS investigations include the implementation of active gas replenishment, providing an opportunity to replace gas-pockets that would otherwise be disrupted in traditional passive SHS due to high shear stress and turbulent pressure fluctuations. Gas is evenly distributed through a 90 mm (span) x 600 mm (length) sintered porous media with pore sizes of 10 to 100 microns. The impact of the active gas replenishment is being evaluated with and without SHS.

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