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Near-wall 3D velocity measurements above biomimetic shark skin denticles using Digital In-line Holographic Microscopy MOSTAFA TOLOUI, DAVID BRAJKOVIC, JIARONG HONG, University of Minnesota — Digital In-line Holography is employed to image 3D flow structures in the vicinity of a transparent rough surface consisting of closely packed biomimetic shark skin denticles as roughness elements. The 3D printed surface replicates the morphological features of real shark skin, and the denticles have a geometrical scale of 2 mm, i.e. 10 times of the real ones. In order to minimize optical aberrations near the fluid-roughness interface and enable flow measurements around denticles, the optical refractive index of the fluid medium is maintained the same as that of the denticle model in an index-matched flow facility using NaI solution as the working fluid. The experiment is conducted in a 1.2 m long test section with 50 mm $\times$ 50 mm cross section. The sampling volume is located in the downstream region of a shark skin replica of 12" stretch where the turbulent flow is fully-developed and the transitional effect from smooth to the rough surface becomes negligible. Several instantaneous realizations of the 3D velocity field are obtained and are used to illustrate turbulent coherent structures induced by shark-skin denticles. This information will provide insights on the hydrodynamic function of shark's unique surface ornamentation.

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