Bioinspired shark skin surfaces for improved hydrodynamic performance

U.S. NAVAL RESEARCH LABORATORY

AT A GLANCE

What is it?

Shark skin possesses microstructure scales called denticles, which interact with the surrounding flow to increase speed, decrease drag, and provide antifouling properties for sharks. The aim of this project is to create bioinspired surfaces to improve the hydrodynamic performance of unpiloted underwater vehicles (UUVs) and other robots.

How does it work?

Individual denticle structures are created using computer-aided design (CAD), and patterned denticle surfaces are 3D printed using state-of-the-art additive manufacturing technologies at NRL. In addition to computational tools, these surfaces with various denticle sizes, shapes, and material properties are then tested on hydrofoils in flow facilities to determine which patterns generate the best performance.

What will it accomplish?

Next-generation UUVs can potentially use denticle surface patterns in strategic locations to improve performance, reduce power costs, and enhance persistence in future missions.

R&D Sponsor(s)

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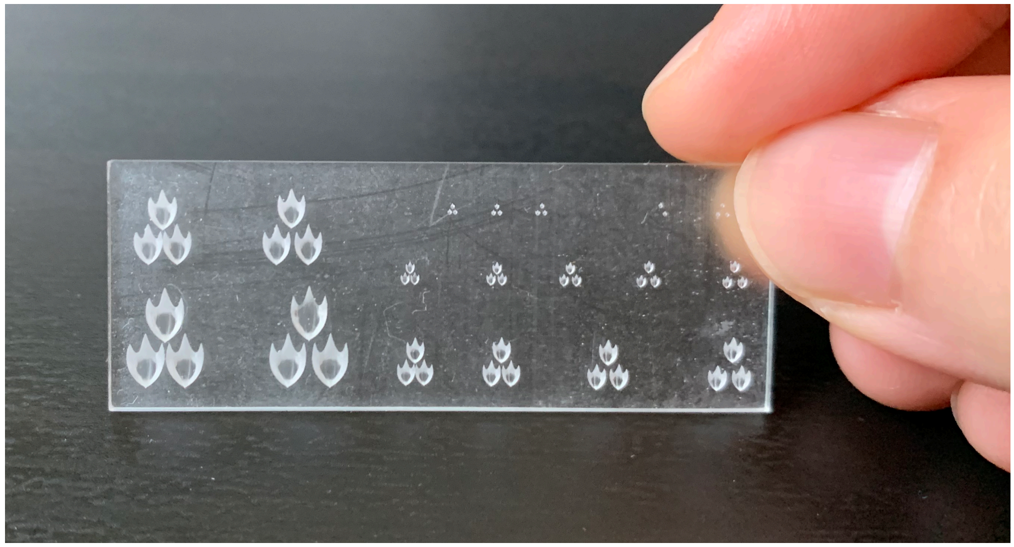
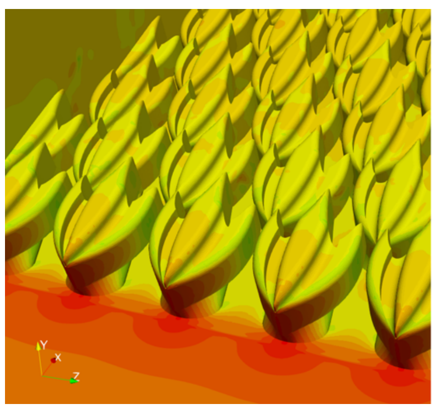
Point(s) of Contact

Nicole Xu
nicole.xu.ctr@nrl.navy.mil

Jason Geder
jason.geder@nrl.navy.mil



Bioinspired shark denticles, 3D printed in rigid plastic with various sizes and spacings to test the capabilities and limitations of additive manufacturing techniques.



Contour plots of surface pressure using in-house computational methods to model the flow over denticles.

The U.S. Naval Research Laboratory (NRL) has developed shark skin-inspired surfaces that can improve the hydrodynamic performance of foils in flow channels, with the potential for applications in unpiloted underwater vehicles (UUVs). By combining additive manufacturing techniques, experimental methods, and computational fluid dynamics (CFD), this project applies fundamental ideas from nature to engineering, with the aim to design next-generation UUVs, as well as to enhance swimming and aerial robots.

Cross-sectional view of a foil with a denticle panel surface inserted into the top surface for flow channel tests.