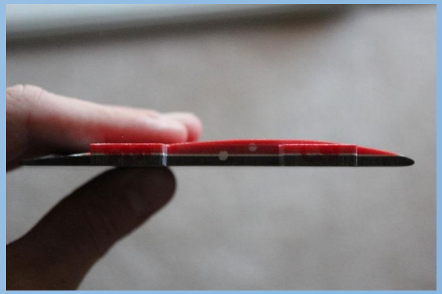
Project S.H.R.E.D.

(Surfing Hydrodynamic Research with Engineering Design)

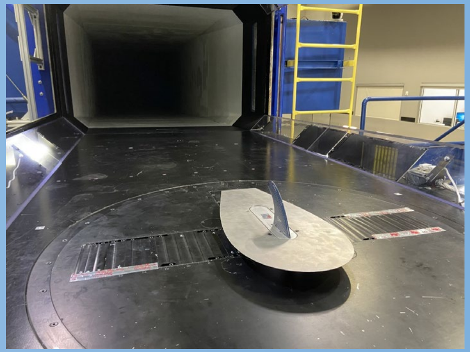


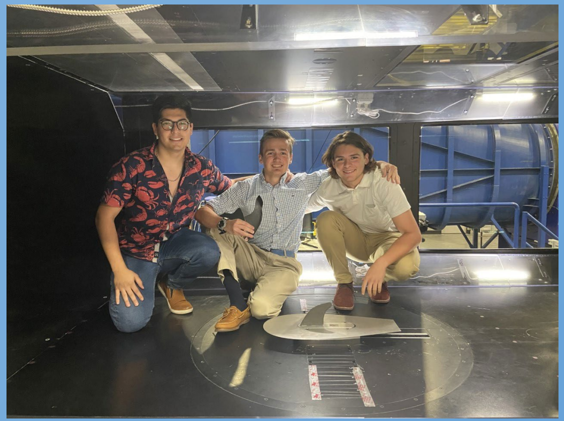
The surfboard fin remains largely untouched since it's addition on the bottom of surfboards became commonplace in the 60's. Project S.H.R.E.D. looks to redesign the surfboard fin to allow for better efficiency and performance in the central Florida beaches.

Fundamentally speaking the only difference in two fluids such as water and air is the density. This leads us to compare surfboard fins to wings and develop performance enhancing designs inspired by the aeronautical industry.

Two main points of interest are reducing the parasitic and/or skin friction drag present in finite pressure surfaces as well as validating the theory behind dynamic similarity through quantitative analysis and qualitative feedback from local surfers.

By understanding the physics behind lifting pressure devices and applying classroom knowledge used in the aerospace industry, Project S.H.R.E.D. was able to design, model and gather data on a fin that perform more efficiently than market competitors over a span of applicable angles of yaw.

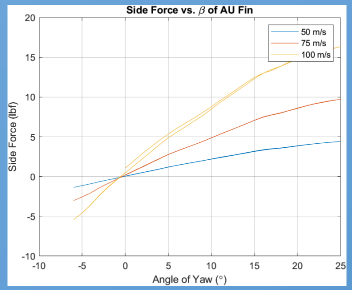


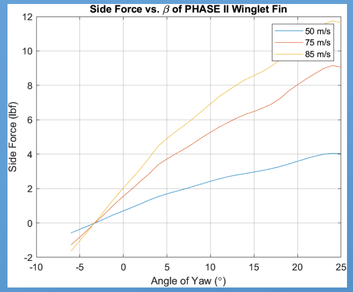


With the assistance of Embry-Riddle Aeronautical University's College of Engineering and IGNITE program, in collaboration with Dr. J. Gordon Leishman and Dr. Zheng Zhang, Principal Investigator and Team Lead Patricio Garzon, Co-Lead Andrew Ankeny, Testing Team Lead D. Drew Paolicelli and supporting members V. Castano, J. Nasgovitz, and C. Cabrera were able to test Project S.H.R.E.D's designed surfboard fins against market competitors in similar conditions produced by the Miceplex Low-Speed Wind Tunnel at Embry-Riddle Aeronautical University.

The optimal conditions used to collect data were Sea Level Standard pressure, temperature and density set by the ISA and a windspeed set at 75 m/s. These conditions corresponded to a saltwater speed of about 11 mph, which was deemed by local surfers as a reasonable comparison speed. The angles of yaw inputted into the model ranged from -6 to 25 degrees. Data collected by a state-of-the-art force balance was plotted using MATLAB to emphasize the change in side and drag force produced varying with yaw. An efficiency comparison of side force per drag plotted versus the yaw angle leads the viewer to infer that the Project S.H.R.E.D. Phase II Winglet Fin design was more efficient over a span of angle of attacks when compared to market competitors.

Shown below are the results collected for a market competitor. The optimal conditions for testing surfboard fins were found during this test. Previously a speed of 100 m/s was hypothesized to be optimal for comparison, however upon analyzing the data collected we see supersonic flow was reached on the top surface of the airfoil, causing shocks which invalidated the data collected for that speed. Initially a sweep back and forth through the angles was conducted but upon finding the optimal speed, the final angle set was selected.





Plotting the efficiency in the form of side force produced per unit drag varying with the angle of yaw allows us to compare different fins. While the AU fin performs the best across a small range of angles, the drop off in efficiency across other angles still commonly used in surfing prove to be a limiting factor in the design's performance. The most well-rounded fin across the entire range of angles was found to be the Phase II Winglet Fin which utilizes winglets to reduce wingtip vortices and in turn, induced drag.