# Shark-Skin Inspired Micro-Riblets: A Biomimetic Approach to Airfoil Drag Reduction

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Overcoming aerodynamic drag is crucial for reducing aviation’s fuel consumption and CO2 emissions. This study examines a biomimetic approach to skin-friction drag reduction through shark-skin inspired micro-riblets, which are microscopic grooves that minimize the frictional impact of flow turbulence by constricting and raising vortices formed within the boundary layer. Using 3D printing, varying optimal and suboptimal micro-riblet sizes were manufactured on NACA 2412 airfoils, with drag changes being examined in a wind tunnel across varying Reynolds numbers (Re), a nondimensional parameter which predicts flow turbulence. It was hypothesized that micro-riblets would reduce drag at all Reynolds numbers tested, but with increasing effectiveness as the Reynolds number increased. Post-experimentation, the smooth model was found to have the lowest drag coefficient due to the micro-riblets causing surface roughness and lacking sufficient boundary layer turbulence to become effective. However, power law regressions (R^2> 0.95) of each model’s drag coefficient vs Reynolds number extrapolated that optimal size micro-riblets (average nondimensional spacing of 18) would begin to decrease drag at Re = 1.193E6, with a best and worst case envelope within one standard deviation of error propagated from the load-cell calibration predicting crossover at 8.970E5 < Re < 5.042E6. While micro-riblets appear detrimental at low Reynolds numbers, applications in aviation are predicted to see large scale skin-friction drag reduction. Micro-riblets applied on the wings of a Cessna 172 Skyhawk or similar small-scale aircraft could theoretically reduce drag by approximately 3%, and further studies could prove effectiveness in other applications involving turbulent fluid flow.

**Awards Won:**