Aircraft Leading Edge Strakes on Conventional NACA Wings

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Research Justification

The prevention of stall on aircraft wings has been a great challenge over the history of airplanes. As the aircraft become more and more complex, it becomes harder to fit high lift devices and leading-edge devices onto high camber, supercritical airfoil aircraft wings. Typically, in the fighter jet class of aircraft the obstacle of stall is delayed by the implementation of leading-edge root extensions, better known as strakes. These strakes create a tip vortice along the sharp leading edge that transitions over the surface of the wing preventing separation on both the upper and lower surface of the wing allowing the fighter jet to experience higher angles of attack. Thus, leads to the potential issue that arises when this type of system is implemented on a NACA airfoil with camber and a much thicker cross section. Anthony's Fall 2019 and Spring 2020 research project is to test if the geometry of the leading-edge root extension can be altered so it produces a similar effect to the ones found on todays fighter jets. Through the use of Computation Fluid Dynamics (CFD) via the Department of Defenses new program HPCMP Create Genesis.

Project Issues

- Creation of Mesh on wing with strake geometry was rather challenging to make structured.

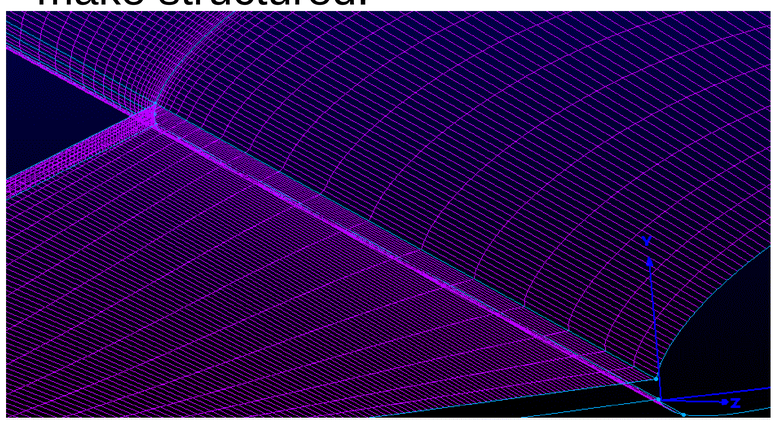

Figure 1: Mesh Problem Area

- RAM Usage was a large issue due to DOD Create Genesis

Results

- Normal NACA 4412 base airfoils stall at approx. 12-15 Deg AoA without High Lift Devices
- Addition of Leading-Edge Extension shows re-attachment due to vortice formation on the leading edge at 20 Deg AoA.
- Results Conclude that Leading-Edge Extension (Strake) addition proves to be effective based on CFD Results

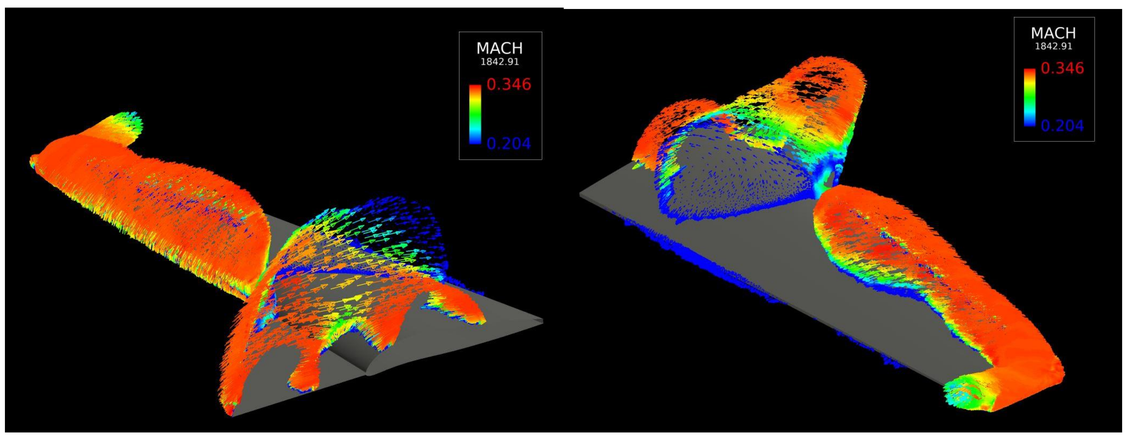

Figure 2: Vortice Formation at 20 Deg AoA

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