An Investigation of Wing-Body Junction Flows

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Abstract

- Junction flows, are a complex, coupled, and interacting flow field broadly seen across applications.
- There is some understanding of the individual components, there is very little predictive understanding of it: the focus of this research.
- Utilized a NACA 2415 wing section in tandem with various flow visualization techniques.
- Discovered that the horseshoe vortex is invariant, while the corner separation was highly dependent on the angle of attack and placement of the wing section in the flow.
- Future research should focus on corroborating these results.

Methods

- Prepared a NACA 2415 wing section of aspect ratio 4.32 and chord 117.413 mm.
- Wing was tested in College of Engineering’s Boundary Layer suction tunnel.
- Micro-tuft flow visualization was performed to select parameter space for more advanced testing, validated using XFLR.
- Advanced testing utilized talcum streaks flow visualization.
- Performed an angle of attack sweep at multiple tunnel stations downstream of the inlet.

Results

- Micro-tuft visualization showed a parameter space varying angle of attack, $\alpha$ from zero to 15 degrees [Fig. 2].
- Moderate angles of attack sometimes produced corner separation [Fig. 1].
- Extreme angles of attack created large-scale flow separation and vortices [Fig. 3].
- Horseshoe size and strength varies based on angles of attack [Figs. 1a-4b].

Conclusions

- Horseshoe vortex is always present with respect to the parameter space.
- Boundary layer thickness and angle of attack are tied to corner separation onset.
- Findings limited by lack of literature data verification, will be performed in future research [1-3-5].
- Further research will study Reynolds number effects and utilize state-of-the-art full field measurement techniques.

References


