Aerospace Engineering Thesis Defense

A Study and Design of Multi-Element High Lift Systems for Commercial Transport Aircraft

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Abstract

The design and development process of high-lift systems for commercial transport aircraft has been historically heavily dependent on extensive experimental testing. Whether this testing be in wind tunnels or during aircraft testing, the number and extent of high-lift system variations that can be tested are limited. With technology advancements, analyzing the complex flow around high lift systems using detailed computational fluid dynamics (CFD) has become more common; but, CFD has limitations due to the computational costs for such analysis. An empirical approach can be taken to analyze such systems, but the insight gained from such methods is often limited to a main contributing factor. While these methods often produce reasonable solutions, they fail in showing, and many times overshadow, the important minor effects within complex systems.

This thesis aims to present insight on the need and design of multi-element high-lift systems by using a tool developed which utilizes a legacy vortex lattice potential flow code and methods described in classical aerodynamic literature. With this tool, numerous variations of high lift devices were studied to understand why commercial transport aircraft require a high-lift system. Furthermore, variations of complete high-lift systems were also studied to understand why certain design decisions were made on existing commercial transport aircraft. Ultimately, enough insight was obtained to proceed to design a functioning high-lift system for a commercial transport aircraft capable of meeting all established requirements and exhibit favorable flow separation conditions.

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