Mechanical Engineering Thesis Defense

Modernization of a Vortex-Lattice Method with Aircraft Design Applications

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Abstract

The Vortex-lattice method has been utilized throughout history to both design and analyze the aerodynamic performance characteristics of flight vehicles. There are numerous different programs utilizing this method, each of which has its own set of assumptions and performance limitations. This thesis highlights VORLAX, one such solver, and details its historic and modernized performance benchmarks through a series of code improvements and optimizations. With VORLAX, rapid synthesis and verification of aircraft performance data related to wing pressure distributions, stability and control, and federal regulation compliance can be quickly and accurately obtained. As such, VORLAX represents a class of efficient yet forgotten computational techniques that are financially sensible and allow their uses to generate numerous baseline design considerations in a fraction of the time necessary in more complex, full-fledged engineering tools. In the age of modern computers, one hypothesis is that VORLAX and similar "lean" computational fluid dynamics (CFD) solvers have preferential performance characteristics relative to expensive, convoluted CFD suites, such as ANSYS Fluent. By utilizing these types of programs, tasks such as pre- and post-processing become trivially simple with basic scripting languages such as Visual Basic for Applications or Python. Thus, lean engineering programs and methodologies deserve their place in modern engineering, despite their wrongfully decreasing prevalence.

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