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A NOVEL SOFTWARE APPLICATION FOR THE DESIGN AND OPTIMIZATION OF STUDENT LAUNCH VEHICLES

Abstract

Space Concordia Rocketry Division has long used a variety of analytic software tools, both free and commercial, throughout its launch vehicle design process. These software applications individually model particular simulation mechanics and other aspects of the complete launch system. Considered together, these applications inform the overall rocket system design. In order to centralize this process and introduce whole-of-system optimizations, Space Concordia is developing a modular software application using modern software development and integration practices.

The application, written in the Python programming language, will combine multiple elements, such as a six degrees-of-freedom solver, aerodynamics and stability data from the United States Air Force Digital Data Compendium, a propulsion simulation system using the NASA Chemical Equilibrium with Applications software, and various other individual simulation and modeling tools. The software application will provide a common data interface across these elements, any of which may be composed into custom, end-to-end computation pipelines. The introduction of a standardized data interface for these elements will ensure extensibility, and access to the Python software ecosystem will simplify the future introduction of a wide range of accessible computational and data science libraries. The application will provide the user with comprehensive, tailored data visualization alongside other ease-of-use features.

Simulation pipelines produced by the software application will be validated against results from existing simulation software such as RASAero and Astos, as well as experimental data collected on previous Space Concordia sounding rocket flights and from existing open data initiatives including the NASA Standard Check-Cases for Six-Degree-of-Freedom Flight Vehicle Simulations. Software development and updates will be conducted on GitHub according to agile practices such as test-driven development and continuous integration. The introduction of powerful simulation and modeling assistance tools will contribute towards Space Concordia Rocketry Division's superior sounding rocket design capability.