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SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Future Space Transportation Systems Verification and In-Flight Experimentation (6)

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MULTI-DISCIPLINARY ANALYSIS ADAPTATION: IMPROVING THE MODERN SIZING APPROACH BY ADOPTING BEST-PRACTICE ELEMENTS FROM THE 1965 USAF SPACE PLANNER GUIDE

Abstract

Goal: The final goal of this research is to compare and contrast the design results of a modern synthesis system and a legacy handbook system (USAF Space Planners Guide) to identify and adapt the best and still relevant parts of the legacy tool into the modular modern design synthesis system. This paper identifies applicable legacy elements by comparing the two conceptual design synthesis methodologies in sizing studies of two selected cases, namely: the X-20 Dyna Soar (orbital) and a DLR SpaceLiner-type hypersonic vehicle (sub-orbital, point-to-point) .

Methodology: Developed by the Systems Command Department of the USAF in 1965, the Space Planners Guide is a synthesis and planning handbook for the development and analysis of future space missions and vehicles. The Guide is a prime example of effective system integration and planning capability and uses intricate handbook methods characterized by nomographs derived from both industrial and scientific research data. A big drawback is that it is restricted by the hard-coded methods (many based on industrial capability of the 1970s) into its development and thus updating the guide is not an option. This systems-level integration tool was discarded soon after the end of the Space Race. Eventually, portions of it were adopted into a high-fidelity toolset for trajectory analysis; the top-level systems-integration mentality did not carry over.
For comparison, the selected modern design synthesis system was developed at the Aerospace Vehicle Design Laboratory (AVD) at the University of Texas at Arlington (UTA). This system is designed around a multi-disciplinary design synthesis approach that is modeled in an effort to move away from the classic configuration-oriented synthesis systems towards a generic design capability. In this regard, the AVD sizing approach and tool is modular in its implementation and thus disciplinary-flexible while still capable of a high-level of integration. The synthesis system assembles necessary disciplinary methods into a coherent system framework framed around a convergence logic based on total system weight and volume, and determines the size of the vehicle required to perform a given mission.

Results and applications: The top-level systems-integration understanding as applied by the Space Planners Guide was lost in the wake of high-fidelity disciplinary tools. Therefore, it is important for this generation's design engineers to learn from the best examples from history so that he can apply today's advanced computing toward solving the design challenges of true synthesis with an integrated,

multi-disciplinary system.