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Space Systems Engineering - Methods, Processes and Tools (1) (4A)

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IDREAM: A MULTIDISCIPLINARY METHODOLOGY AND INTEGRATED TOOLSET FOR FLIGHT VEHICLE ENGINEERING

Abstract

Rapid prototyping of flight vehicle engineering needs the use of two key elements: the data from the different building blocks, and the required engineering tools to design vital subsystems of the flight vehicle. Politecnico di Torino in the framework of the I-DREAM, a GSTP contract carried out under supervision of the European Space Agency (ESA), has developed a unique multidisciplinary methodology and integrated toolset able to support the rapid prototyping of a wide range of aerospace vehicles. iDREAM allows complementing the conceptual design activities with economic viability and technological sustainability assessments. In details, the iDREAM Methodology consists of four main modules which can be used in a stand-alone mode as well as in an integrated activity flow, exploiting the implemented automatic connections. The first module consists in a well-structured MySQL database developed to support all the other modules, thanks to a unified connection guaranteed by an ad-hoc developed Database Management Library managing the operations of data input and data output from/to database throughout the tool modules. The second module consists in a vehicle design routine and a mission design routine, supporting the design of a new vehicle and mission concept as well as assessing the main performance of an already existing configuration. The vehicle design routine is called ASTRID-H and it is the latest version of an in-house conceptual design tool integrating capabilities ranging from high-speed aircraft to lunar-landers design. The vehicle design routine automatically interfaces with ASTOS, a commercial software environment used for mission analysis optimization. Automatic interactions between the two routines

inside the module have been ad-hoc developed and tested to guarantee a good accuracy of the results. The third module consists in the economic viability module. Once the design is defined, it is possible to run a subsystem-level cost estimation. Using the subsystems' masses estimated in the design routine, the parametric cost model provides useful insights on the potential development, manufacturing, and operating costs, as well as the cost and price per flight. Eventually, the developed methodology gives the possibility to generate a technology roadmap (forth module). Supported by a database connection, the tool performs an estimation of the technology readiness and risk assessment of each technology, along with an indication of the activities, missions, and future works necessary. This paper describes the methodology, integrated toolset and main results achieved in flight vehicle engineering of Microlaunchers.