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VIRTUAL ENGINEERING FOR DESIGN AND MANUFACTURING OF SPACE PLATFORMS

Abstract

Space equipment (vehicles, rockets, satellites etc. . .) design and manufacturing poses great challenges to engineers, due to a unique combination of few aspects: a very complex (and sometimes big) product, product quality must be perfect, continued introduction of new materials and production technologies and finally a very small volume of production. The combination of these aspects mandates the usage of dedicated engineering software (SW) tools, which will enable product designers and manufacturing engineers to easily collaborate. Digital Manufacturing (DM) SW tools can increase the chance of a successful space mission, by virtually simulating the space product capability and its manufacturing process, and providing a communication platform for product designers, manufacturing engineers and shop floor technicians. Virtual three dimensions (3D) Human simulation, with realistic human model, and virtual reality capabilities, enables to virtually simulate complex assembly tasks, checking its feasibility, and even check ergonomics of various astronaut necessities within the space vehicle, and support their training. DM tools will also support the match of product and shop floor tools (jigs, fixtures) in this typical 'one of type' manufacturing activity. Product quality aspects, are supported by taking quality information defined by the Product Designer, e.g. Product Manufacturing Information (PMI), and leverage it in downstream processes - production and quality checking using Coordinates Measurement Machines (CMMs). Increased usage of composite material introduces new complexities and is supported by advanced process planning and simulation tools. Rapid prototyping had significantly advanced recently, with available commercial hybrid manufacturing machines, which enable both additive and subtractive manufacturing, such that the engineer can easily create a physical mockup, using advanced Computer Aided Machining (CAM) capabilities. An integrated SW for testing and simulation environment not only makes it possible to enhance the accuracy of simulation models and increase the insight in a spacecraft's physical behavior - leading to a higher reliability of the system under development. It also supports a better preparation of the test campaign and helps to de-risk the qualification test program through Virtual Testing. It provides the engineer with premier tools for highly non-linear analysis on a micro and a macro level, structural and mechanism analysis, the analysis of complex dynamic system behavior, the simulation of acoustic, vibration, thermal and shock loads, the composites and inflatable structures and high-end qualification testing.