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CARMECA - A tool for pre-design, and optimization of liquid-propellant engines during preliminary phases

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CARMECA allows the parametric definition of a liquid engine model through coupling of EXCEL-CATIA-ABAQUS software. Functional data files coming from another internal tool are imported into CARMECA calculation modules, to be used as inputs to the dimensioning of various engine parts. The dimensioning guidelines are incorporated into CARMECA by VBA macros, containing analytical structural analysis laws, lessons from past experiences, and supplemented by design choices. All modelling actions are driven by macros triggered by the CARMECA interfaces. The parametric description of the engine geometry is constructed as a CATIA V5 model. This model consists in a main assembly with subsets corresponding to different engine components. Meshes and mechanical analyses are defined in a generic model constructed with ABAQUS. Orders entered in CARMECA are transmitted to CATIA and to ABAQUS for updating generic models. These transfers are made using intermediate files, and exploiting the associativity option between CATIA and ABAQUS. The aim of CARMECA is to anticipate and support the evolution of existing engines. The paper will present in detail the various steps required for a study: import functional data of thermodynamic cycle, definition of engine components, definition of the engine assembly, modelling, meshes and finally, analysis to lead for the estimates: mass ($\pm 20\%$), modes, static and dynamic responses of future engine. In conclusion, this presentation will display the results leading to validation of CARMECA tool on some current European liquid rocket engines.

Biography

Sebastien BEGOC received his degree in engineering at IPSA (French Polytechnic Institute). He started his early career at ARIANESPACE (European commercial launch services), followed by an expert function in numerical modelling and simulation at ONERA (French aerospace lab). Then, he became the Project Manager for Space Activities at LIGERON (project risks). Afterward, he became an Engineer Dependability and Risk Controller at the Launcher Directorate (DLA) of the French space agency CNES. Currently he is a mechanical propulsion engineer at the Propulsive and Engine Systems Department of CNES in charge of: maintenance of qualification for the mechanical aspects of engines operating, R&T in engine mechanics, development and maintenance of simulation tools in engine mechanics.

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