MoCoSyMec: model and design of mechatronic systems *(MOdélisation et COnception de SYstèmes MECatroniques).*

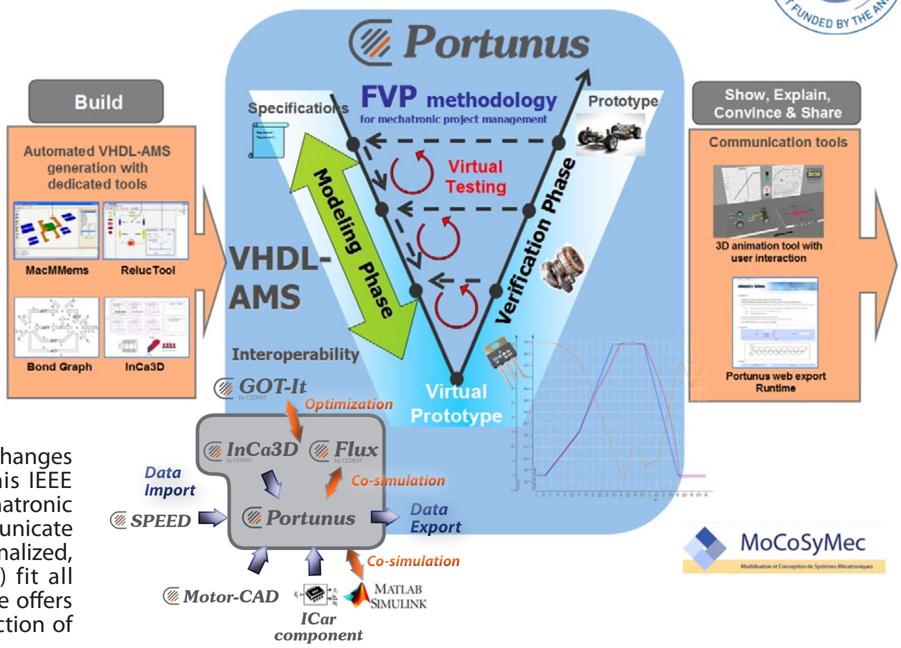
P. Guitard - CEDRAT.

Over the past four years, CEDRAT has been coordinator of an R&D project named **MoCoSyMec** run by the French National Research Agency (ANR). It deals with software tools used for simulating and designing mechatronic systems: in particular it is looking to secure a new generation of modelling tools in order to rethink design flow at system level. Based on consistent methodology, these software environments will improve the reliability of the design cycle. In other words, the main goal of the project was to fill a need for designers in many industrial fields including energy, electrical engineering, ground transportation, aerospace, building, home automation, and many others besides.

Our multi-domain system simulator Portunus was firstly selected to host the developments performed during the MoCoSyMec project and then the strategic choice of the implementation of the VHDL-AMS standard was taken since this language is perfect for information exchanges between teams, sub-contractors, suppliers, etc... This IEEE standard is really able to ensure the success of a mechatronic project, where inter-disciplinary teams have to communicate using the same language, since its main features (normalized, multidisciplinary, multi-abstractions, mixed signal) fit all requirements for system-level modelling. This language offers the possibility of building complex system and abstraction of the language makes structural decomposition possible.

To make VHDL-AMS advantages accessible to a wider audience, in the MoCoSyMec framework several gateways have been developed in order to provide automatically VHDL-AMS code from dedicated tools (RelucTool, MacMMems, InCa3D) and from languages such as Bond-Graph to Portunus simulator. In the same way, a VHDL-AMS tool has been set up to easily manage different configurations of a precise step in a project: it facilitates architectural exploration for the optimum technology.

As well as the VHDL-AMS language and technologies used, an integration of FVP (Functional Virtual Prototyping), design methodology allows manufacturers to reduce marketing cost of new products. Indeed, our approach is based on V-cycle methodology (see figure) and consequently it provides a scheme to



manage an industrial project from specification to virtual prototype. In parallel to this methodology work, the Portunus simulator has been made interoperable with a range of business tools (Flux, Simulink) in order to deepen mechatronic models and/or improve system performance with an optimization tool (Got-It, Isight). Moreover, considerable efforts have also been devoted to communication tools to share technical results between teams of a project and also to convince customers of the benefits of a new product. This collaborative project featuring CEDRAT, InESS, Schneider Electric, Alstom, Femto-ST companies and G2ELab and Ampère laboratories has provided a significant development of Portunus software which is today the tool for mechatronic design and the reference software of VHDL-AMS standard.

PREFACE project: lightning effects on composite aircrafts.

Enrico Vialardi - CEDRAT.

During the past 4 years, CEDRAT has been involved with 16 other partners in an R&D project called PREFACE, co-funded by the French Government and devoted to the study of Lightning Indirect Effects (LIE) on more electric and composite aircrafts. Carbon-Fiber-Reinforced Polymer (CFRP) is being increasingly used in the aeronautic industry to save money, but it means paying closer attention to electromagnetic phenomena (like lightning) that were less significant in the past with metallic fuselages only.

Several modelling and simulation methodologies have been analysed by the partners: for example Finite Differences in Time Domain (ONERA, DGA) and some simplified circuital approaches (Safran Group, EADS-IW, Supélec, Eurocopter), etc.

CEDRAT – in close collaboration with G2Elab – has contributed to the success of PREFACE via its Flux and InCa3D tools, which have proved to be very efficient and accurate in studying the CFRP mock-up (see figure 1) proposed as a test-case by the aeronautic industry. In fact, Flux 3D uses its "shell elements" formulation coupled to the circuit to reduce the number of unknowns and is able to deal with these low conductive materials

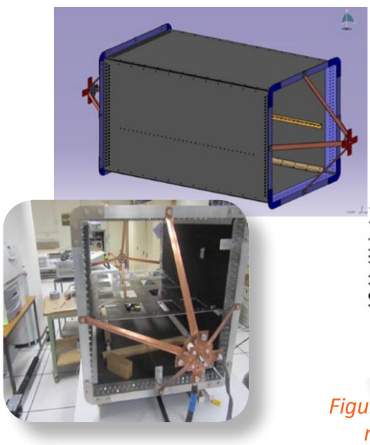


Figure 1: The Carbon-fiber mock-up studied in the framework of PREFACE.

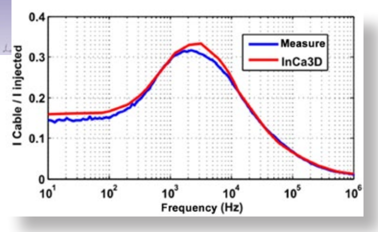


Figure 2: One of the comparisons between measurements and InCa3D results.

(σ = 500 S/m) in its AC Steady State magnetic application. In the same way, for InCa3D it is natural to model irregular stretched structures at low frequencies because the PEEC technique used avoids cumbersome meshing of the surrounding air. A comparison between measurement and simulation results is shown in figure 2.