Interests and complementary of two structural modeling tools for the analysis of multibody systems: Maplesim and bond graph with 20-sim

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Abstract

In the industry which designs complex mechanical (or mechatronic) systems such as cars and helicopters, to avoid certain undesired complex dynamic phenomenon, local and punctual curative solutions are often used. These kinds of solutions are often used because subsystems are modeled with modeling assumptions that are too strong both for their environment and structure. Additionally, they are built as an assembly of mathematical functional models and are not homogenous in terms of modeling tools. Moreover, these solutions are generally used at a specific moment without any generic approach and often for a specific version of apparel.

In this context, new structural modeling tools have emerged to tackle these difficulties. The main objectives of these tools are to bring a more global and modular modeling approach. A more global comprehension of physical phenomenon should permit to lead to more sustainable solutions. A modular approach based on the oriented-object and acausal features will allow for a better knowledge capitalization. These structural modeling tools contain essential features that permit an efficient modeling of complex mechanical systems: modularity, multiphysics and acausality. In [1], the frame of the complex system in the aeronautic field is specified and a general presentation of some structural modeling tools have been presented.

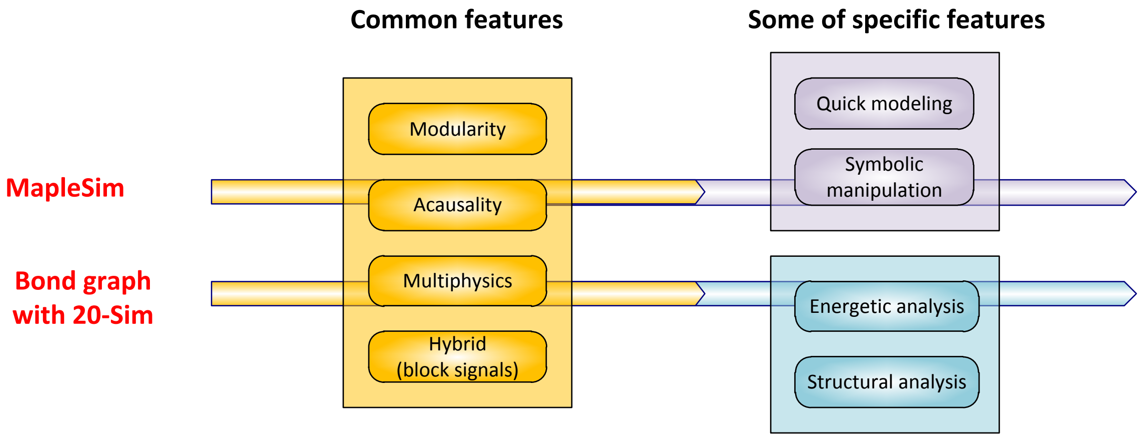

Figure 1 : Comparison and complementarity between MapleSIM and BG with 20-SIM.

Two structural modeling tools : the bond graph (an energetic modeling tool) with 20-sim software (a simulation package for dynamic systems using iconic diagrams, block diagrams, bond graphs and equations of motion) and MapleSim are applied to a helicopter's subsystem : the main gear box MGB-Fuselage joint. The bond graph approach enables to represent mechatronics systems in a graphical form describing the exchange of power between basic elements like inertia, compliance, dissipation, conservative power transformation, gyrator actions and sources. Methodology and theory to model rigid multibody systems in a systematic manner has been introduced by Bos [2]. The main techniques are quiet exhaustively reviewed in [3]. In more recent work [4] and [1], multibody systems modeled with 20-sim are modeled and simulated. As far as MapleSim is concerned, this kind of modeling and simulation platform corresponds to a new trend in structural modeling tools coupling the benefit of Modelica models and symbolic manipulation [5].

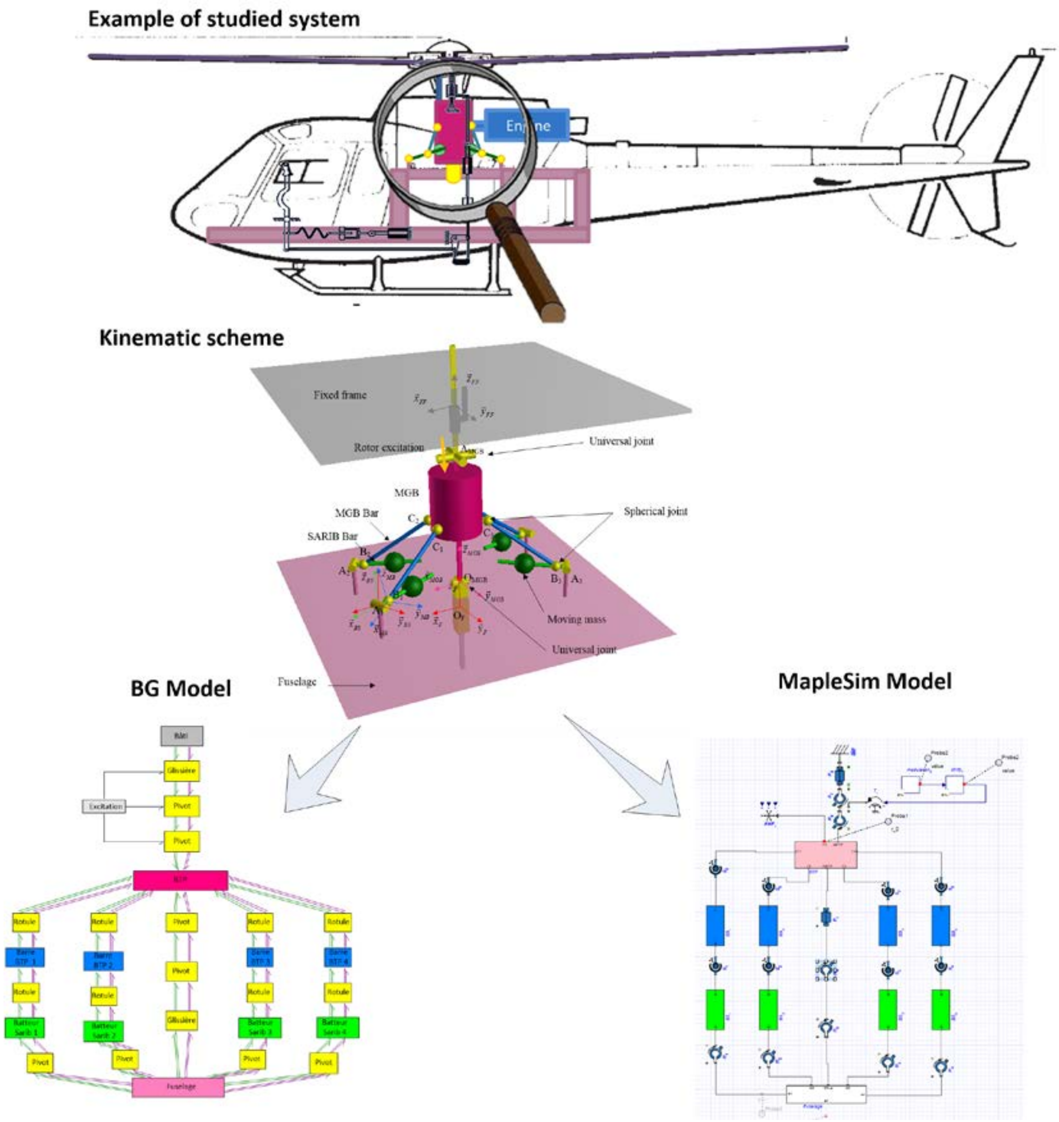

Figure 2 : Example of structural models developed with MapleSIM and BG with 20-SIM.

The main objective of this paper is to illustrate the advantages of structural modeling tools for the modeling of complex multibody systems and to analyze the complementarities between two structural modeling tools: Maplesim and Bond graph with 20-sim. First, the benefits of the structural tools in comparison with classic tools will be presented. Secondly, the main steps of the modeling of complex multibody systems and the results of simulations conducted with both Maplesim and Bond graphs with 20-sim of the models will be presented. Thirdly, this paper will discuss about the main difference between these two structural modeling tools and in what ways these tools are complementary.

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