# Multibody Model of a Motorbike with a Flexible Swingarm

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Object-oriented modelling, favoring a real modular and multi-domain approach, has been recognized as a fundamental tool for the mechatronic design, requiring an integrated approach to mechanical, electronic and control design[1]. In this respect, even if multibody dynamics is frequently just one of the physical domains involved, the simulation of flexible multibody systems plays an important role.

On the other hand, in real applications, the task of modelling distributed flexibility cannot be addressed without the help of finite elements (FE) codes, in order to describe complex geometries and material properties. Moreover, for the sake of efficiency of numerical simulation, the huge number of nodal coordinates introduced by FE modelling, must be reduced to a much smaller number of modal coordinates, for example through the classical Craig-Bampton method[2].

Considering the specific case of the multibody modelling of a racing motorbike, where the rigid model of the rear swingarm has been replaced with a flexible one, a general approach to flexible multibody systems modelling in Modelica is presented in this paper. In particular, the steps required to generate the model of a flexible body starting from a FEM analysis, performed with commercial packages, are detailed. Simulations results are shown with reference to a sudden braking and to a series of impacts with curbs. In this last case, an unstable behaviour occurred when considering the flexible component, which is currently under investigation.

The developed approach to flexible multibody moelling will allow to easily include the description of bodies' flexibility in mechatronic systems, expanding the range of the dynamic analysis. In particular, the said unstable behaviour is currently under investigation, as well as another unstable behaviour (shimmy) occurring in racing bikes.
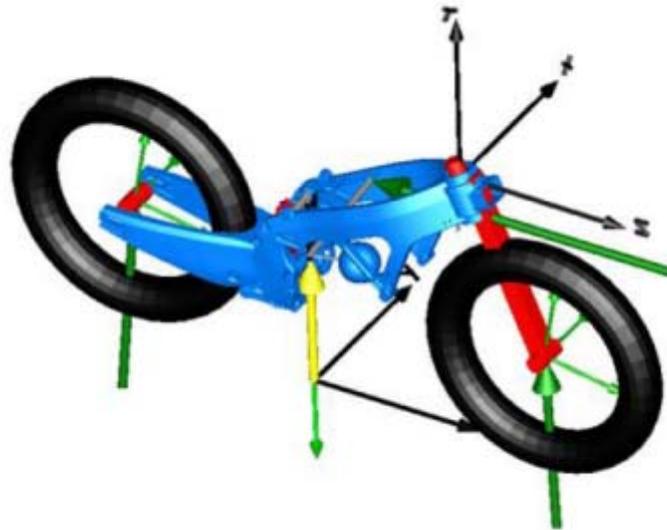
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https://modelica.org/events/modelica2014/proceedings/html/index.html

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[2] R. R. Craig, M. C. C. Bampton, Coupling of substructures for dynamic analyses, AIAA Journal 6 (7) (1968) 1313–1319.