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KINETICS tool of ANSA for Multi Body Dynamics

Introduction

During product manufacturing processes it is important for engineers to have an overview of their design prototypes' motion behavior to understand how moving bodies interact with respect to each other. Addressing this, the KINETICS module has been incorporated in ANSA as a Multi-Body Dynamics (MBD) solution. Through its use, engineers can perform motion analysis to study and analyze the dynamics of mechanical systems that change their response with respect to time. Through the KINETICS module ANSA offers multiple capabilities that are accomplished by the functionality presented below.

Model definition

Multi-body models can be defined on any CAD data or on existing FE models. Users can either define their Multi-body models manually from scratch or choose to automatically convert an existing FE model setup (e.g. ABAQUS, LSDYNA) to a Multi-body model.

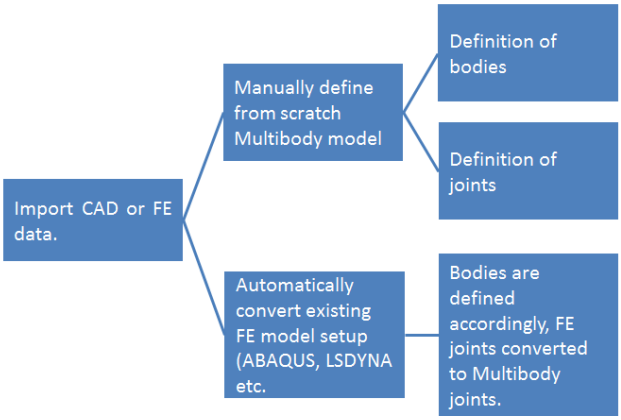

Image 1: A Seat-dummy FE model converted to a multibody model

Contact Modeling

The accuracy and robustness of contact modeling are very important in MBD simulations. The implementation of algorithms based on the non-smooth dynamics theory of unilateral contacts allows users to study contact incidents providing accurate solutions that the ordinary regularized methodologies cannot offer. Furthermore, the selection between different friction types maximizes the realism in the model behavior.

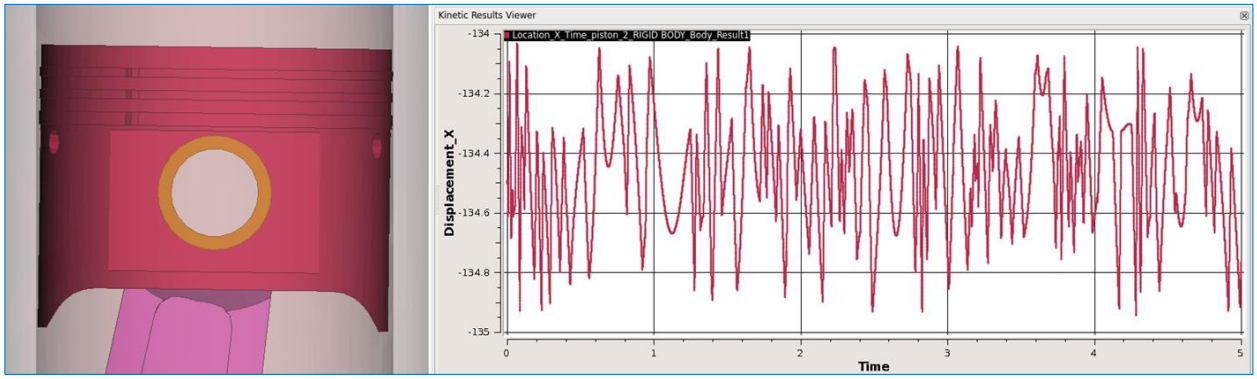

Image 2: Bouncing of a piston inside a cylinder

Configurator

In many cases, engineers need to manipulate mechanisms under the influence of joints, forces and contacts and save them in different positions. Also, very often, in a given mechanical system, the presence of many mechanisms results in multiple movements on the system. Such an example is a car's seat. The configuration toolkit within KINETICS offers the capability to build configurations per mechanism and run position based simulations by applying displacement increments steps on them or by specifying source and target points for their movement.

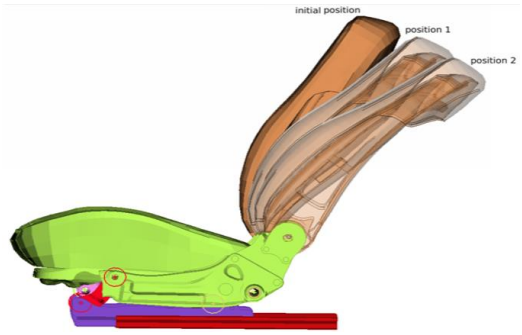

Image 3: In a car seat system one configuration is built for every individual mechanism movement e.g. one to represent the backrest inclination, one for the seat's height adjustment etc.

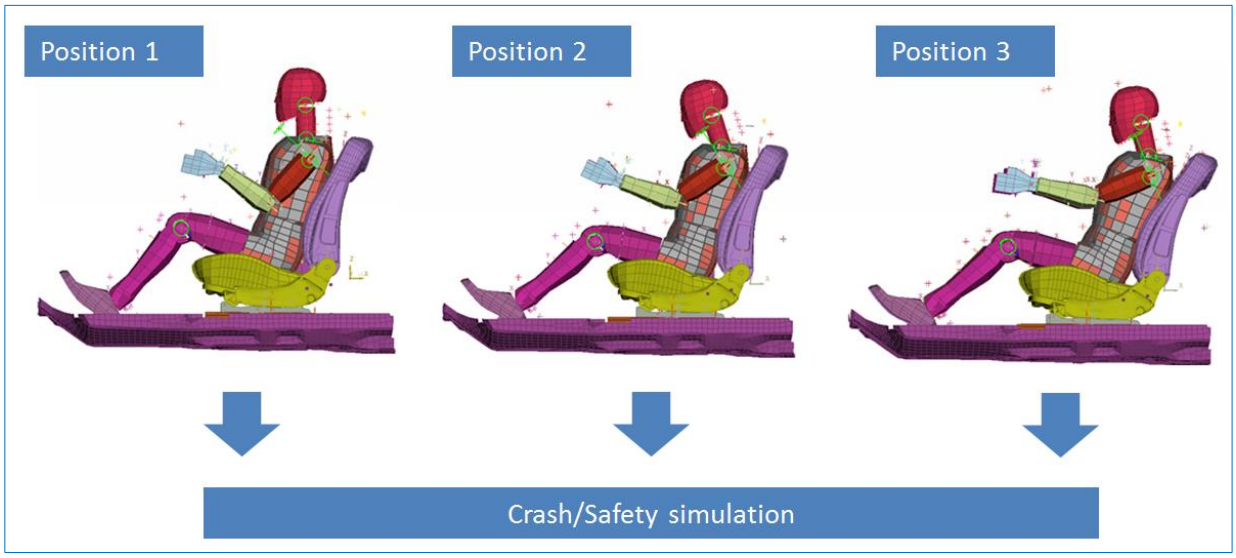

Image 4: Multi positioned sub-model defining several load-cases ready to run for Crash/Safety analysis.

Kinematics-dynamics analysis

Whether users need to study the motion of a system, without taking into account any forces (kinematic model), or study why bodies move in a particular way, taking into account the forces that produce the motion (dynamic model),the available KINETICS simulation types can provide quick and accurate results even for the most complex and large-scale models.

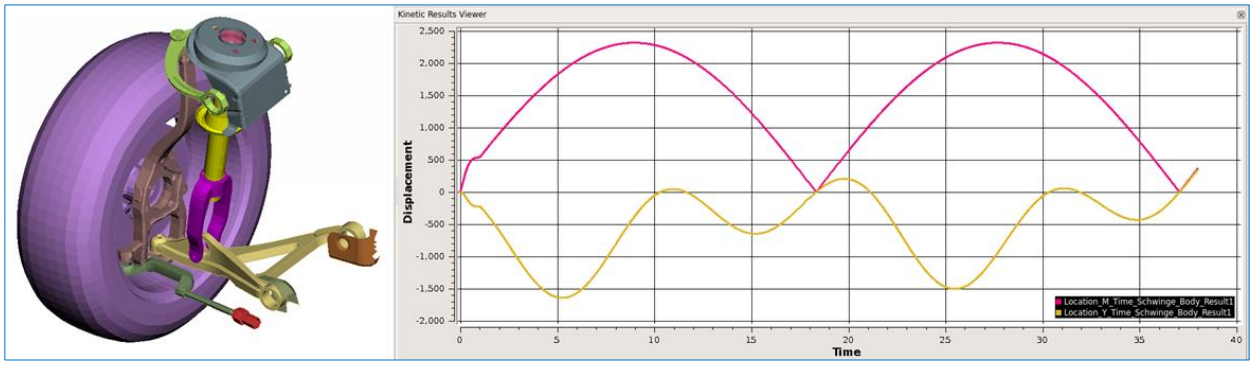

Image 5: Dynamic analysis of a double wishbone suspension.

Co-Simulation with ANSA tools

KINETICS can be used to support multiple types of analysis (Durability, Crash and others) that may involve motions. This support can be used for positioning purposes, when the mechanical system should be moved to different positions for each of which an analysis has to be run, or for Co-Simulation purposes where the results of a MBD simulation must be extracted and be imposed as initial conditions for another type of analysis.

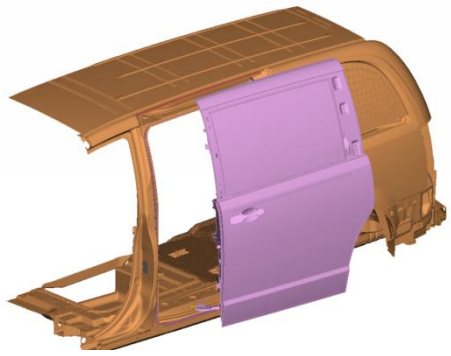

Image 6: Ready to run multi-body model of a sliding door. Simulation results are extracted and imposed as initial conditions for a durability load-case.

Tire modeling

The implemented tire modeling features further extend the capabilities of KINETICS and enable users to add tires in their models. The available tire models (Pacejka, FTire) provide a solid background for studying the interaction between tires and road surfaces. The calculation of tire results data, such as forces and torques that are exerted on the tires as well as other tire characteristic results, provides a good overview of how the tire behaves under loads, steering inputs, or other external factors. The large number of adjustable tire parameters leads towards a more realistic modeling with the aim to optimize the model's performance.

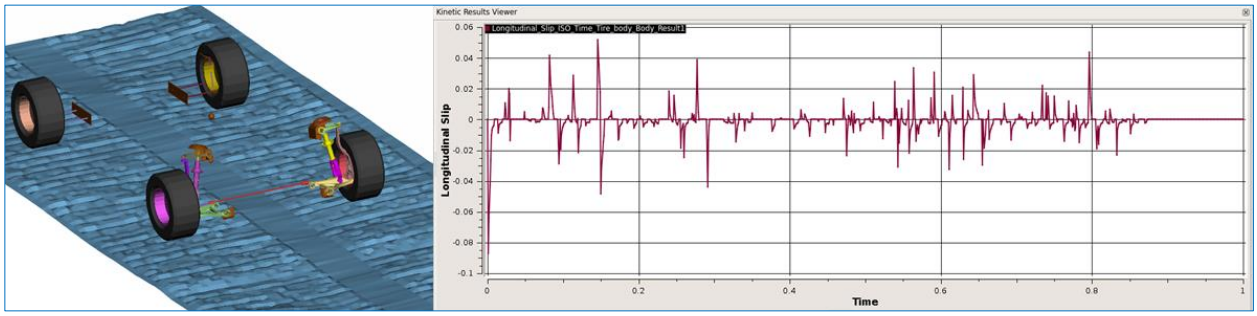

Image 7: Dummy car model driven on a Belgian block road.

Conclusions

The addition of the KINETICS module offers impressive MBD capabilities and augments ANSA range of applications. Whether its usage is for positioning purposes of mechanisms, for kinematic analyses, or for contact modeling, the implementation of new user-friendly features transforms MBD simulations to an easy task for even novice users. Furthermore, the evaluation and analysis of the results within ANSA, and the wide range of applications of the KINETICS module, make it suitable for numerous industries, such as Aerospace, Automotive, Defense, Manufacturing and Bioengineering.

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