MULTIBODY MODELING AND SIMULATION OF THE DYNAMICS OF RAILROAD VEHICLES AND TRACKS

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ABSTRACT

Computational analysis of the dynamics of railroad vehicles is becoming an essential tool for this industry. Vehicle designers, rolling stock manufactures and railroad administrations benefit from the special modeling tools provided by the different railroad multibody softwares that are present in the market. Railroad dynamics is nowadays a sub-field of multibody dynamics that is characterized by the use of special algorithms for the treatment of the track geometry and the wheel-rail interaction. This presentation shows the theoretical foundations of these algorithms. Railroad vehicles have been traditionally designed using linearized equations that uncouple the longitudinal, lateral and vertical dynamics. Linear models can be used to find a first approximation of the response of the vehicle to the track geometric irregularities, the lateral stability or the curving behavior. Linear models are based on the kinematics of the conical wheels, linear creep wheel-rail forces and the vehicle is considered as a collection of rigid bodies connected by springs and dashpots. On the other hand, multibody models of the railroad vehicles and track take into account the complex wheel-rail contact geometry and their normal and tangential interaction forces. The railroad vehicle bodies are assumed to be connected by kinematic joints and the can be considered as deformable. These modeling capabilities provide a more detailed insight into the vehicle dynamics at the expense of much longer computational analysis. However, special techniques like the use of trajectory coordinates or contact lookup tables alleviate this problem without significant reduction in accuracy. This presentation shows the modelling keys for the real-time simulation of railway vehicles using multibody dynamics that can be used in on–board applications.