

Recent developments in railway dynamics using multibody dynamics approaches including fluid-structure interaction

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Vehicle dynamics in general, and railway dynamics in particular, find in multibody approaches irreplaceable methodologies to deal with the analysis needs of complex nonlinear phenomena with, sometimes, long durations. The ability of multibody dynamics to describe in an integrated form not only the general dynamics of complex mechanical systems but also the non-smooth aspects concerning with contact or interactions with other media, generally described using other computational methods, allows for its application to railway dynamics aspects that have traditionally been addressed with alternative numerical approaches. This is typically the case in which fluid-structure interactions play a role, such as the case of the aerodynamic effects, approached via finite elements or particle methods to describe the fluid and flexible multibody dynamics to describe the vehicle components. In this seminar recent developments in railway dynamics application to crashworthiness, rail-wheel contact and pantograph-catenary interaction and fluid loading will be presented. In the process, different methodological aspects will be reviewed in face of these application needs.

The importance of the kinematic joints flexibility in the dynamics of the system and the modelling of imperfect joint versus ideal kinematic joints are discussed. Contact mechanics issues associated not only to wheel-rail contact but also to the pantograph-catenary interaction and to the biomechanics of impact of railway vehicle occupants will be addressed.

Finally, the use of flexible multibody dynamics in the modelling of railway applications versus the use of standard finite element methods will be debated in the framework of the foreseen applications.