

## MULTIBODY MODELLING OF PANTOGRAPHS FOR PANTOGRAPH-CATENARY INTERACTION

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### ABSTRACT

In the great majority of railway networks the electrical power is provided to the locomotives by the pantograph-catenary system. From the mechanical point of view, the single most important feature of this system consists in the quality of the contact between the highly flexible contact wire(s) of the catenary and the contact strips of the pantograph. This paper presents the development of a suitable methodology, within which validated models of pantographs are used to represent the correct dynamic behaviour of the pantograph and interaction in the pantograph-catenary system. The catenary system is described by a detailed finite element model while the pantograph is described by a detailed flexible multibody model. Each sub-system's dynamic behaviour is simulated by independent codes, i.e., a finite element code for the catenary and a multibody code for the pantograph. A co-simulation scheme is devised to coordinate a constant time step Newmark type of integration algorithm, implemented in the finite element code and the multi-step, multi-order Gear integration algorithm of the multibody code. Due to the vibration of the pantograph components, resulting from the operational and perturbed conditions, the use of flexible bodies in the pantograph multibody model is a requirement to better represent the position of the registration strips and the contact forces. The interaction between the systems is obtained by the contact between the finite element and multibody models, represented by a continuous contact force model. The discussion on the proposed methodologies and of their accuracy is supported by the application to a real operation scenario and the comparison of the results with experimental test data. The potential contribution of this work to the railway community is the development of a tool that enables decreasing of the number of incidents related to this system and the reduction of the maintenance and interoperability development costs.