

INFLUENCE OF VEHICLE AND ENVIRONMENTAL PERTURBATIONS ON THE QUALITY OF THE PANTOGRAPH- CATENARY CONTACT

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ABSTRACT

Important limitations for modern high speed trains to reach higher velocities are due to the pantograph-catenary system, which is used to collect the electrical energy for the railway locomotives. The most sensitive aspect of the pantograph-catenary system consists in the study of the contact between the contact wire of the catenary and the registration strips of the pantograph. The quality of this contact is highly influenced by the disturbances induced by the vehicle, when running on the track, and by the environmental conditions. The work presented here proposes to study the influence of vehicle and environmental perturbations on the quality of the pantograph-catenary contact. For this purpose, the catenary is represented by a detailed finite element model while the pantograph is described by a detailed multibody model. A methodology is developed in order to allow a general geometric description of the railway track, which includes the representation of the rails spatial geometry and of the track irregularities, measured experimentally. The environmental perturbations considered in this work are the aerodynamics forces resulting from side winds. These wind forces are applied on the catenary by distributing them on the finite element mesh. Since the multibody formulation does not include explicitly the geometric information of the bodies, the wind field forces are applied to each body of the pantograph as nonlinear external forces, which are experimentally collected in a wind tunnel. The methodologies are demonstrated by their application to different operation scenarios for high speed trains on straight tracks. The simulation results are compared with others obtained without perturbations in order to evaluate the influence of the different disturbances on the pantograph-catenary interaction. It is shown that the detailed analysis of the results, allows detecting loss of contact conditions, exaggerated contact forces, out-of-position contact and to estimate the limit running velocity of high-speed trains based on the quality of the pantograph-catenary contact as related to environmental and track conditions.