Simulation of the dynamic interaction between pantograph and overhead line using a coupled FEM - Multibody procedure

A. Bautista[*], P. Pintado[*]

[*]Department of Mechanical Engineering, E.T.S.I. Industriales, Universidad de Castilla – La Mancha, Avda. Camilo José Cela s/n, 13071 Ciudad Real, Spain,
angela.bautista.moreno@hotmail.com, publio.pintado@uclm.es

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Most studies on the interaction between pantograph and catenary refer to the conventional flexible catenary composed of messenger wire and droppers, whereas the literature related to the interaction with rigid overhead conductor lines is limited. This paper presents an algorithm capable of simulating this interaction.

The rigid overhead line is modelled as a finite element structure. On the other hand, the pantograph linkages are modelled as a multibody system. Both models need to be integrated independently but taking into account the fact that the excitation force is the same (but different direction) in both models. This poses a problem that has been solved by estimating the force in the next time step and iterating (without advancing to the next time step) to make the estimation compatible with the dynamic equilibrium of both models.

The contact force is determined using the contact stiffness and the pseudo—interference between pantograph and overhead line. When the pantograph loses contact with the overhead line, the estimated contact force is naturally zero, and remains null until the calculated displacements predict interference again. The iteration referred to in the last paragraph requires just one step if loss of contact is confirmed.

This work shows that the proposed algorithm is fast and accurate. The procedure has been used to simulate interaction in different scenarios in order to optimize the design of the infrastructure as well as the configuration of the pantograph. The piece of software produced can consider interaction of one or two pantographs with one or two overhead lines in transition sections.

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