

THE USE OF BAYESIAN OPTIMISATION TECHNIQUES FOR THE PANTOGRAPH-CATENARY DYNAMIC INTERACTION STOCHASTIC PROBLEM

Santiago Verdú, Manuel Tur, Javier Fuenmayor

Universitat Politècnica de València, Spain
sangreve@upv.es, manuel.tur@mcm.upv.es, ffuenmay@mcm.upv.es

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Abstract: Nowadays, simulation of pantograph-catenary dynamic interaction [1] have become an essential tool for the design of the overhead contact line. This problem entails some challenges from the computational point of view, mainly related to the strong nonlinearities associated to both dropper slackening and pantograph contact loss. With the aid of numerical simulations, it is possible to obtain optimal catenary geometry configurations to reduce, for example, wear on the cabling and therefore, to decrease maintenance costs. Up to date, these kind of optimisations [2] have been performed by means of Genetic Algorithms for very specific operating conditions, such as, for a single train speed or for an ideal initial configuration of the catenary. Nevertheless, in a more realistic scenario, these conditions are much more variable since the locomotive travels at a certain speed range and, due to installation errors, there is uncertainty in determining the geometric configuration of a catenary. Thus, this work is aimed to find optimal catenary configurations, in terms of maintenance, for wider and more realistic operating conditions. To this end, the uncertainty associated with the catenary installation errors is taken into account in the catenary finite element model. This stochastic approach makes more expensive the objective function evaluation in terms of computational cost. For that reason, the use of Bayesian Optimisation techniques seems very suitable for the problem at hand and their application is explored in this work.

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References

- [1] S. Bruni, J. Ambrosio, A. Carnicero, Y. H. Cho, L. Finner, M. Ikeda, S. Y. Kwon, J. P. Massat, S. Stichel, M. Tur, et al. "The results of the pantograph-catenary interaction benchmark", *Vehicle System Dynamics*, vol. 53-3, pp. 412-435, 2015.
- [2] S. Gregori, M. Tur, E. Nadal, and F.J. Fuenmayor, "An approach to geometric optimisation of railway catenaries". *Vehicle System Dynamics*, published online, DOI: 10.1080/00423114.2017.1407434, pp.1-25, 2017.