Quantification of Data and Production Uncertainties for Tire Design Parameters

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Abstract

The design process for products such as tires constitutes a multi-objective optimization to enhance the products performance for a specific usage. However, the selected geometry and material parameters as well as the boundary conditions, which are the basis of the performance prediction resulting from a numerical simulation, can't be guaranteed to coincide with the real parameters of a finished product in use. Most set parameters are subject to variation in production and service, which can lead to significant variation in performance.

This contribution has the objective of describing how to model uncertainties of tire design parameters with regard to production variation as well as to non-precise data (Viertl (1996)), to enable uncertainty analysis for tire performances. Thus, the choice of the product design parameters will not be solely based on the predicted value, but also on the robustness of the performance. Uncertainties of design parameters, divided into the two types aleatoric and epistemic with respect to their causation, are quantified for several geometry and material parameters based on the situation of available data (Leichsenring et al. (2018)) as well as their sensitivity (Götz et al. (2018)). Using statistical analysis methods for provided data from production plants, different approaches for stochastic, probabilistic and polymorphic uncertainty modeling, combining both types of uncertainties, are selected, including random variables, fuzzy variables, probability-boxes and other fuzzy stochastic approaches (Möller et al. (2007)).

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