

Uncertainty management in the development process of mechanical systems

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ABSTRACT

Every mechanical system inherently contains uncertainties that affect the relationship between the input and output of the system. According to the knowledge of the effect and probability, uncertainties in a system can be divided into three categories: stochastic uncertainty, incertitude, and ignorance. The traditional way of accounting for all three types of uncertainties has been the addition of experience-based safety factors on the critical dimensioning of a product. The increasing level of requirements on products has pushed modern product development to aim for sustainability by minimizing the effect of incertitude and ignorance by data-based uncertainty quantification. A second factor that has led for developments on uncertainty management is the widened use of virtual model-based product development to speed up product development.

As a first stage of new research this work aims to review recently developed methods and methodologies for uncertainty quantification in the development process of a mechanical product. Based on initial findings, the reviewed methodologies include systems engineering approaches that concern the uncertainties during the whole life cycle while the methods concentrate on quantification of certain uncertainties in specific use cases. The reviewed methods and methodologies are categorized based on their applicability on the product development process. The goal of the work is to give a brief overview on developments of uncertainty management and the application of the theories in real-world use cases.

The results of the study are utilized in further stages of the new research that aims to develop metrics for evaluating the effect of uncertainties on usability of a system model in an industrial application.

Keywords: method, methodology, quantification.