

## **Compumag 2023 Keynote Speech**

**Title:** Assessment of Uncertainties & Tolerances in Electrical Machines

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**Abstract:**

A variety of manufacturing tolerances exists in electrical machines that influence their behavior. The accurate assessment of the tolerances and uncertainties is important to increase the manufacturing quality of the machine while keeping the required manufacturing effort at an affordable level.

Electrical machines possess hundreds of tolerances with different effects on the machine. To study these effects, high demands are placed on the simulation accuracy while a large number of simulations is required to analyze the tolerances. The underlying simulation methodology can be extended from conventional FE simulations to complex transient drive simulations, while also model order reduction techniques can be applied.

Therefore, a three-step sensitivity analysis is presented that identifies significant manufacturing tolerances. The analysis comprises a stepwise reduction of simulated tolerances depending on their importance to quantify their influence while increasing simulation accuracy.

With this comprehensive analysis the most important tolerances and their exact influence on the machine are known. For the manufacturing-oriented machine design, results can be utilized to reduce important tolerances but also to extend irrelevant tolerances so that the machine quality is improved while decreasing the manufacturing effort. In an End-of-Line test the simulation data can also be applied to train a machine learning process to improve the detection of manufacturing defects.