Hessisches Kompetenzzentrum
für Hochleistungsrechnen

Evaluation of the Thermo-Mechanical Behavior of Ventilated Truck Brake Discs



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Clusters
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Introduction

Brake discs are put to high thermomechanical stresses during operation. These loads might induce the so called heat cracks. These heat cracks have not yet been fully simulated in an extended Finite Element Analysis. Therefore, the main goal of this project is to understand the stress situation in the brake disc that leads to heat cracks by using simulation techniques.

Methods

Today, no valid simulation tool to forecast the crack propagation in ventilated brake discs exists. So far, only single cracks have been simulated [1] and the validity of the simulation has not been fully proven yet. Therefore, the focus of this project is to provide an accurate simulation of stresses and thermomechanical loadings on the one hand and crack growth on the other hand. If validity is achieved, the tool will be able to predict if a brake disc will crack before producing a sample and testing it on an expensive dynamometer test.

Results

The coupled thermomechanical simulation of a complex structure like a brake disc in conjunction with an advanced material model already requires a lot of computing power. In addition with the crack propagation simulation, the demands of computing power are raised far-off the requirements of the basic model. To simulate one single braking event, our model

currently consumes over 60 GB of RAM. The result file for one braking has a size over 100 GB. Using the HPC with a total number of 24 cores running simultaneously, we are currently able simulate roughly 100 consecutive brakings in less than 20 hours.

Reference

[1] Wu, S. C., Zhang, S. Q., & Xu, Z. W.: Thermal crack growth-based fatigue life prediction due to braking for a high-speed railway brake disc. international Journal of Fatigue, 87, 359-369 (2016). https://doi.org/10.1016/j.ijfatigue.2016.02.024

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