# Quantitative 3D analysis of microstructure and micromechanics in cast irons based on synchrotron experiments

TOOLS FOR ENHANCED DATA-ANALYSIS

## THE INDUSTRIAL CHALLENGE

Trucks and engines from Scania CV AB have several cast iron parts exposed to high loads. Static as well as cyclic loads may lead to cracks in the different microstructural constituents. Numerical modelling of the microstructural and micromechanical behaviour at different loads would enhance material development efforts, as well as the ability to design and cast components.

## WHY USING A LARGE SCALE FACILITY

Synchrotron experiments at a large-scale facility are necessary to achieve sufficiently high spatial resolution to study the local micromechanical responses to different loads, in this case an increasing static load.

## NEED TO IMPROVE THE ANALYTICAL TOOL

To be able to gain maximum use of the data from large scale facilities, automated evaluation will be very helpful. The purpose of the proposed project is to establish and use an Analysis Frame Work within which existing data, obtained at ESRF, can be analysed using a combination of quantitative 3D image analysis, Digital Volume Correlation (DVC) and Finite Element Model Updating (FEMU). Through this framework, the micro-mechanical properties of commercially relevant cast irons will be identified and quantified.

## THE RESULTS AND EXPECTED IMPACT

A modular approach was used allowing parallel development of the underlying tools and methods. Python code was used to handle the communication of data between the analysis steps and for the evaluation of the goal functions. Open source tools have been used for all the analysis steps apart from the DVC analysis which is based on proprietary software.

The continued use of the framework will contribute to an increased understanding of the relation between a material's microstructure and its mechanical performance. This will improve the design process including life length estimations.

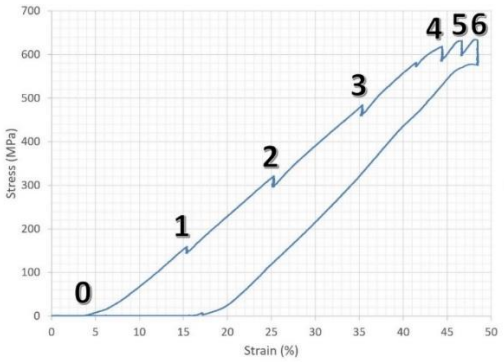
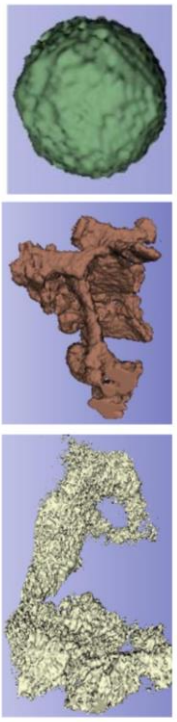



**Figure 1.** Stress-Strain-curve for one sample



Nodular graphite

Vermicular graphite

Carbide

**Figure 2.** Voxel data from the experiments were treated in order to separate the phases present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