TOOLS FOR ENHANCED DATA-ANALYSIS

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

THE INDUSTRIAL CHALLENGE

Scania CV AB and Xylem Water Solutions have several cast iron parts exposed to high loads. Static as well as cyclic loads may lead to cracks in the different microstructural constituents. Deeper understanding of how different microstructural constituents micromechanically respond to different loads would enhance material development efforts, as well as the ability to design and cast components.

WHY USING A LARGE SCALE FACILITY

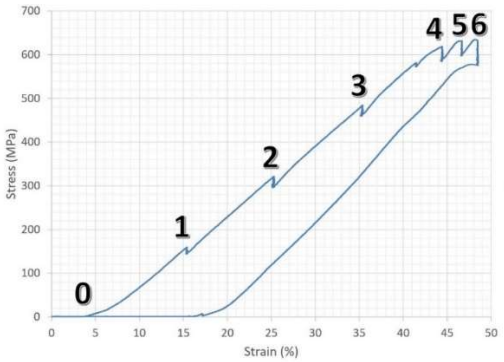
Synchrotron experiments at a large-scale facility are necessary to achieve sufficiently high spatial resolution to study the microstructure and the local micromechanical responses different loads, in this case an increasing static load.

NEED TO IMPROVE ANALYTICAL TOOL

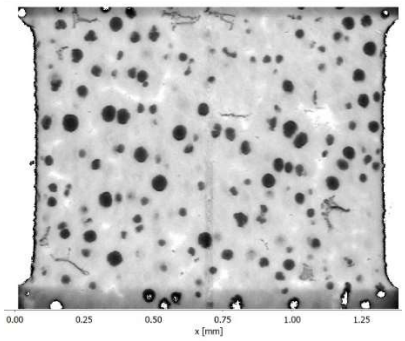
The aim of this project is to develop and refine methods to analyse synchrotron data and to verify the capability of the photon-based techniques for qualitative microstructural and micromechanical analysis of cast irons in 3D. Experiments previously performed at ESRF in Grenoble generated a large amount of data. Manual evaluation is very time consuming why more automated methods are needed to fully use the possibilities with photon-based techniques. The developed analysis route uses correlation techniques, classical image analysis and image segmentation together with machine learning.

THE RESULTS AND EXPECTED IMPACT

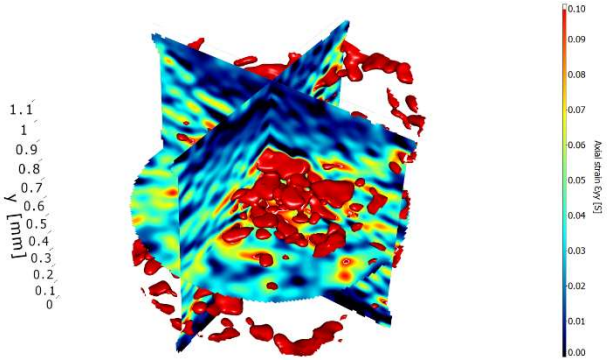
The evaluation methods and tools developed contributes considerably to the usefulness of synchrotron experiments for analysing cast iron microstructures and their respond to mechanical loads. The material consists of iron phase, graphite particles, porosities and carbides. Each constituent as well as the local strain could be visualised using correlation techniques as shown in the figure to the right.



Stress-Strain-curve for one sample



Tomography section at 620 MPa



DVC data showing the 3D distribution of axial strain at 620 MPa

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