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# LOCAL MECHANICAL BEHAVIOUR OF CAST COMPONENTS

Simulations and DIC on multiple scale levels

*Jakob Olofsson, Ph.D.*

*Senior lecturer*

*Materials and Manufacturing – Casting*

# MATERIALS AND MANUFACTURING

## CASTING



Anders Jarfors  
Prof., Head of Dpt.



Ingvar L Svensson  
Prof.



Attila Diószegi  
Prof.



Arne Dahle  
Prof.



Salem Seifeddine  
Prof.



Taishi Matsushita  
Assoc. Prof.



Nils-Erik Andersson  
Assist. Prof.



Jakob Olofsson  
Assist. Prof.



Magnus Wessén  
Assoc. Prof.



Ehsan  
Ghassemali  
PostDoc



Hemant Borkar  
PostDoc

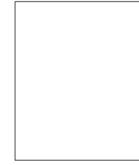


Josef Svidro  
PostDoc



Lucian Diaconu  
PostDoc

## SURFACE TECHNOLOGY



Caterina Zanella  
Assoc. Prof.



Ilja Belov  
Assoc. Prof.



Peter  
Leisner  
Adj. Prof.

## Laboratory staff



Toni Bogdanoff  
Lab Manager



Lars Johansson  
Technician



Esbjörn Ollas  
Technician



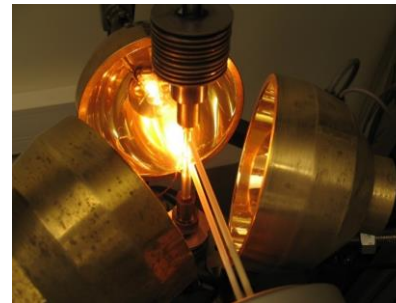
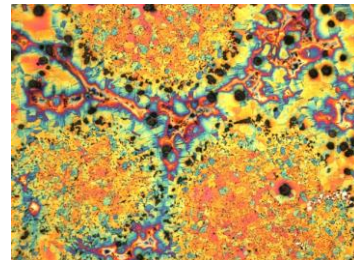
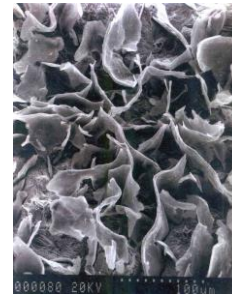
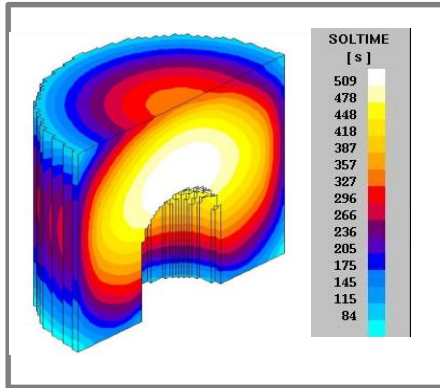
Jörgen Bloom  
Technician



Peter Gunnarsson  
Technician

**+ 15-20 PhD students**

# EXPERIMENTS & EQUIPMENT



# COMPCAST

## High performing COMPOnents by CASTing

*– Development of Products, Process and Materials*

*A research profile on Jönköping University financed by the Swedish Knowledge Foundation and industrial partners*



**VOLVO**

**SKF**

**COMP**  
castings and  
moulding innovation **tech**

**Research area Casting**

MaM – Casting  
MaM – Surface Technology  
Product Development

 **KONSGBERG** AUTOMOTIVE

**CIC**

**swerea** | **SWECAST**

**CompCAST**  
KKS-research profile

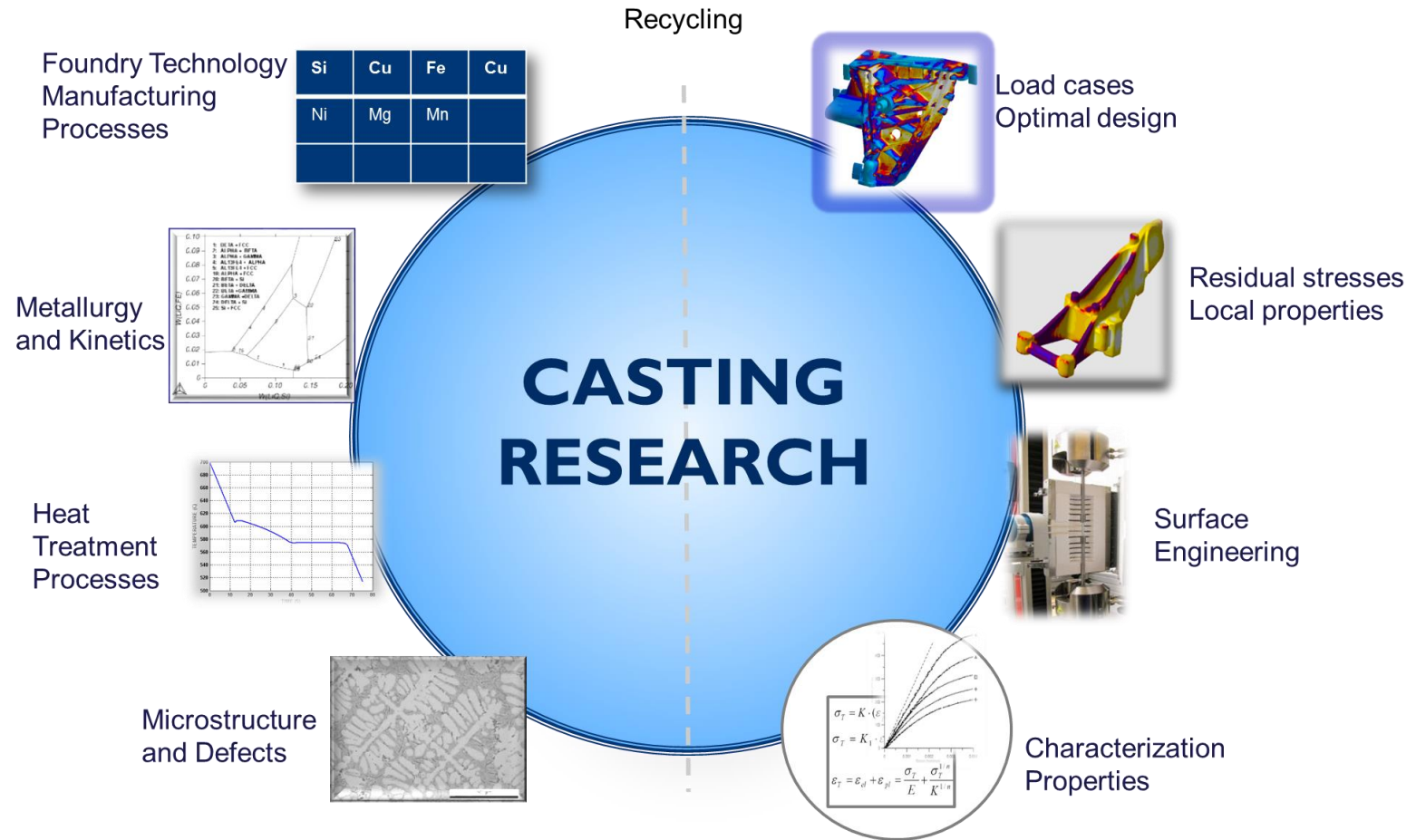
**University Partners**

**Ljunghall**  
Est. 1877

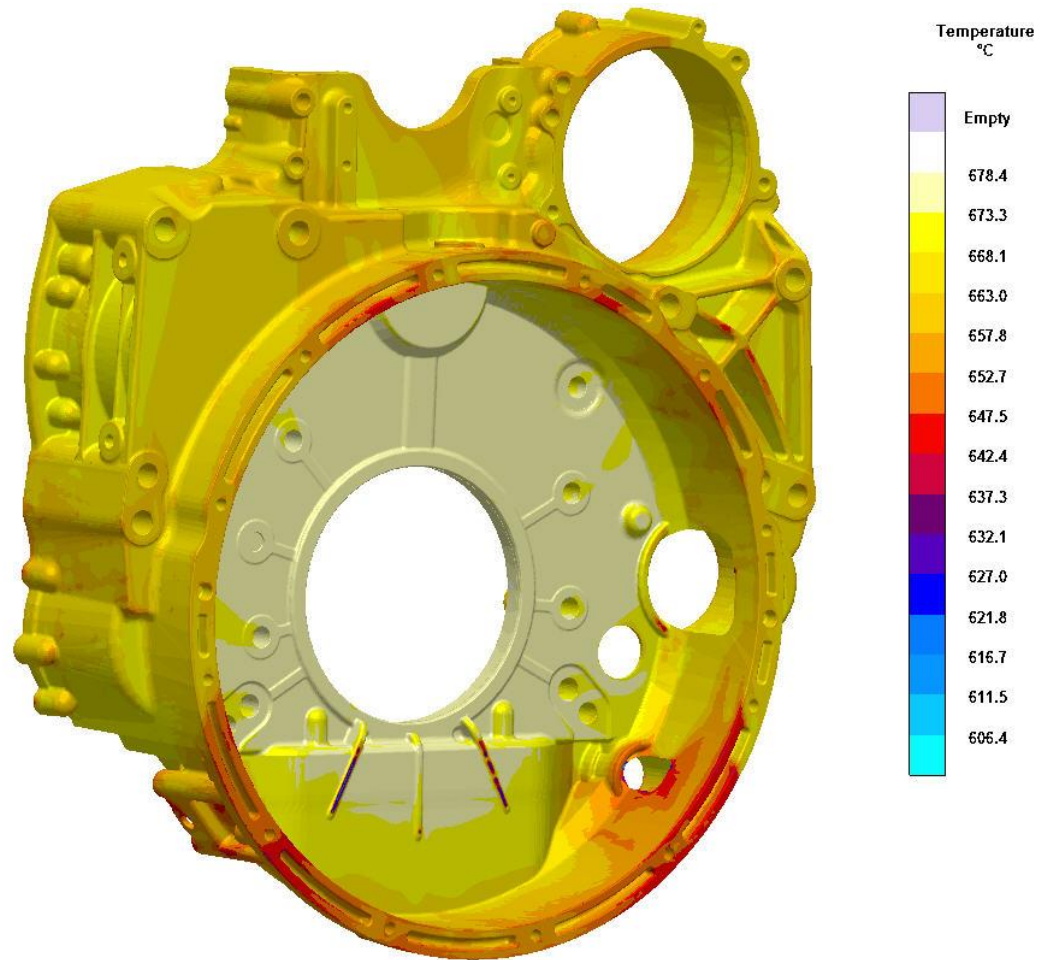
**Arvika Gjuteri**

 **Husqvarna**

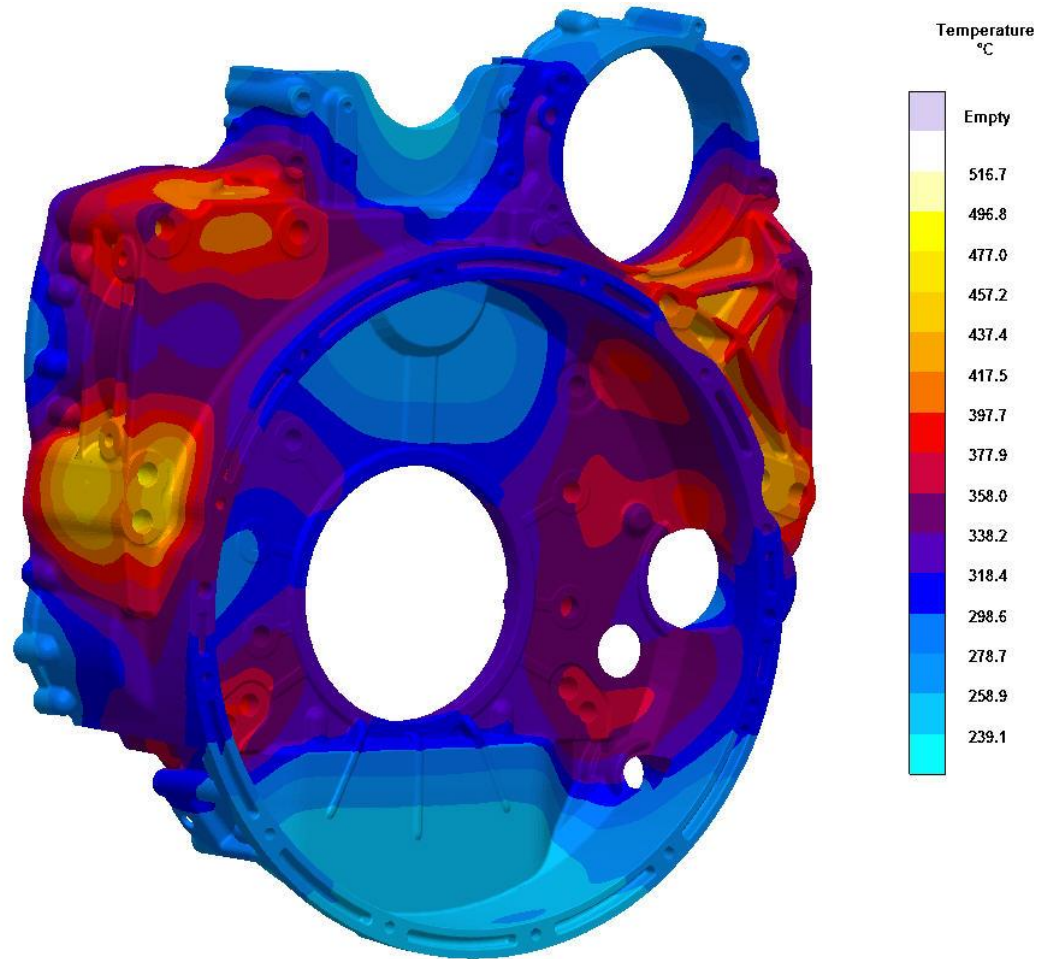
# THE CASTING CIRCLE



# MOULD FILLING

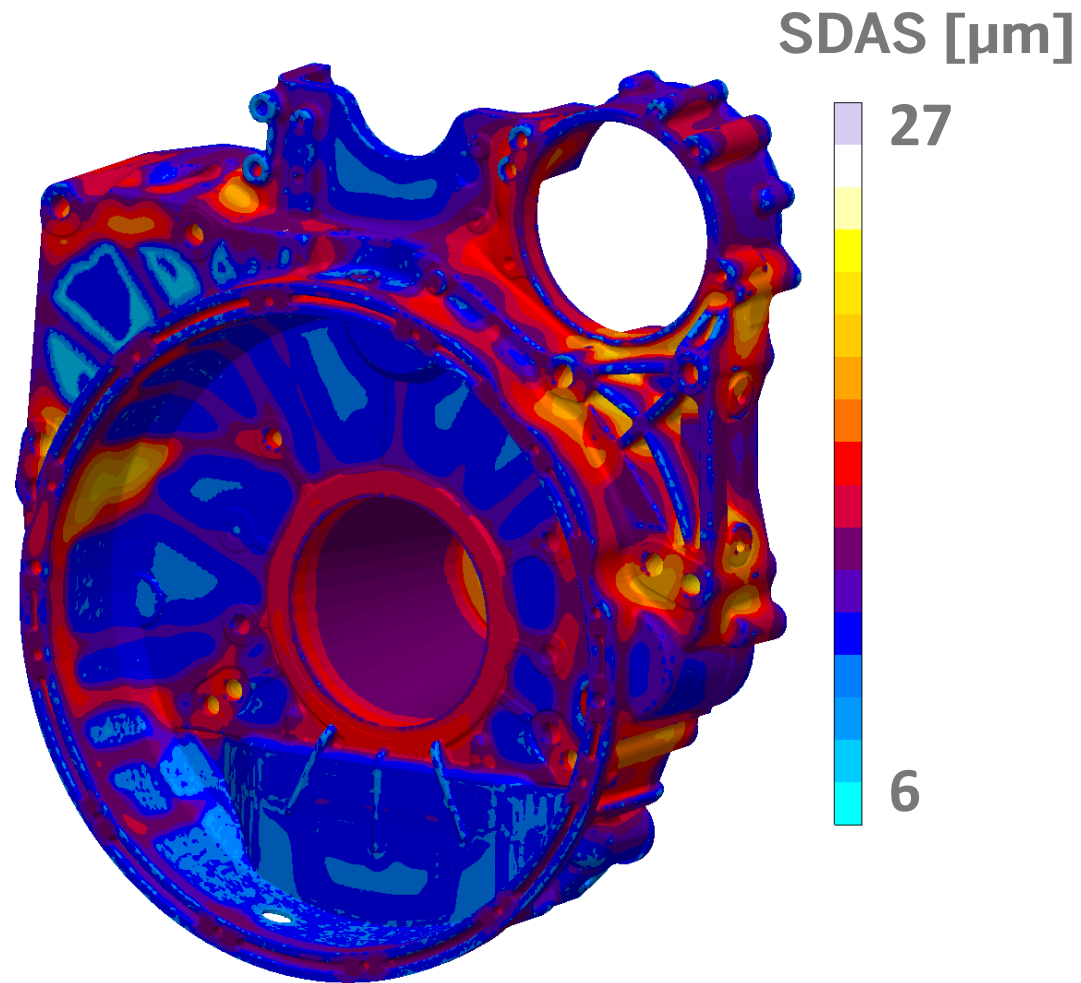


# SOLIDIFICATION

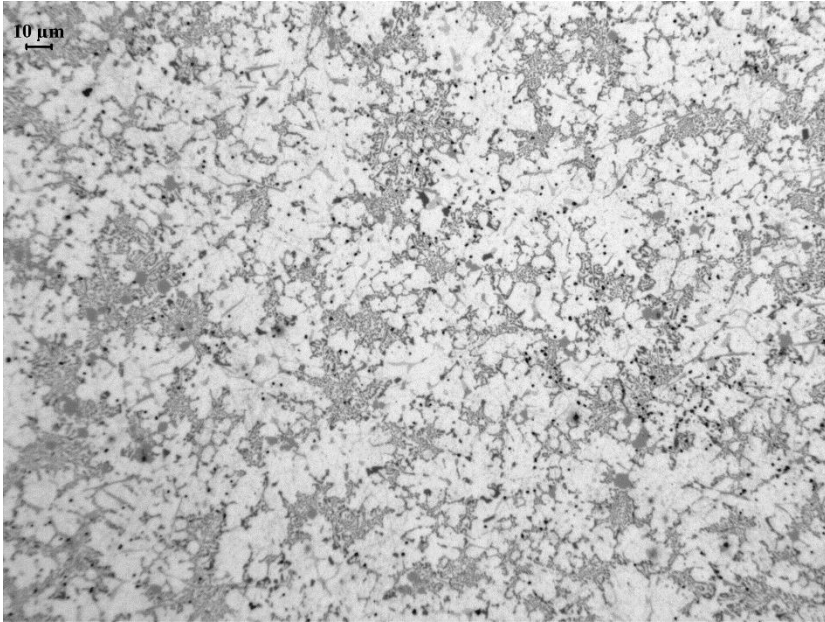




# MICROSTRUCTURE

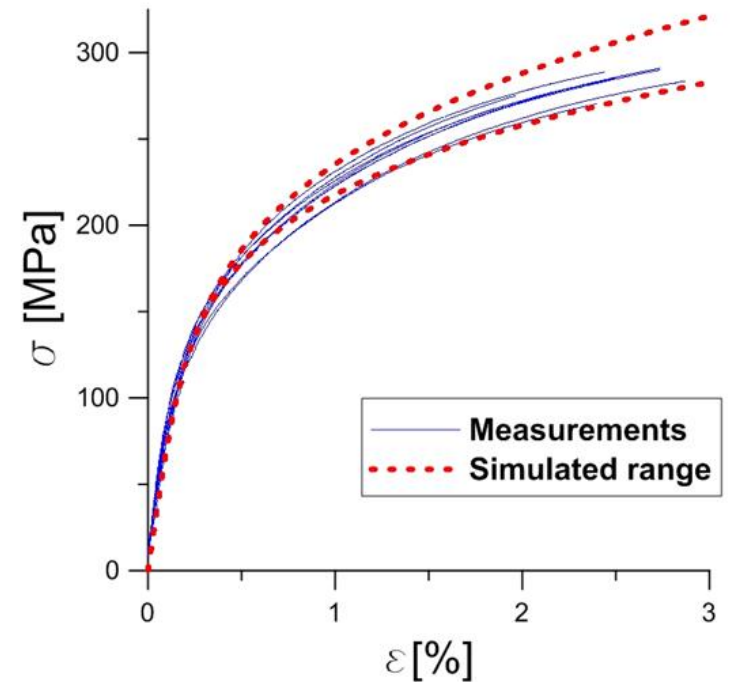
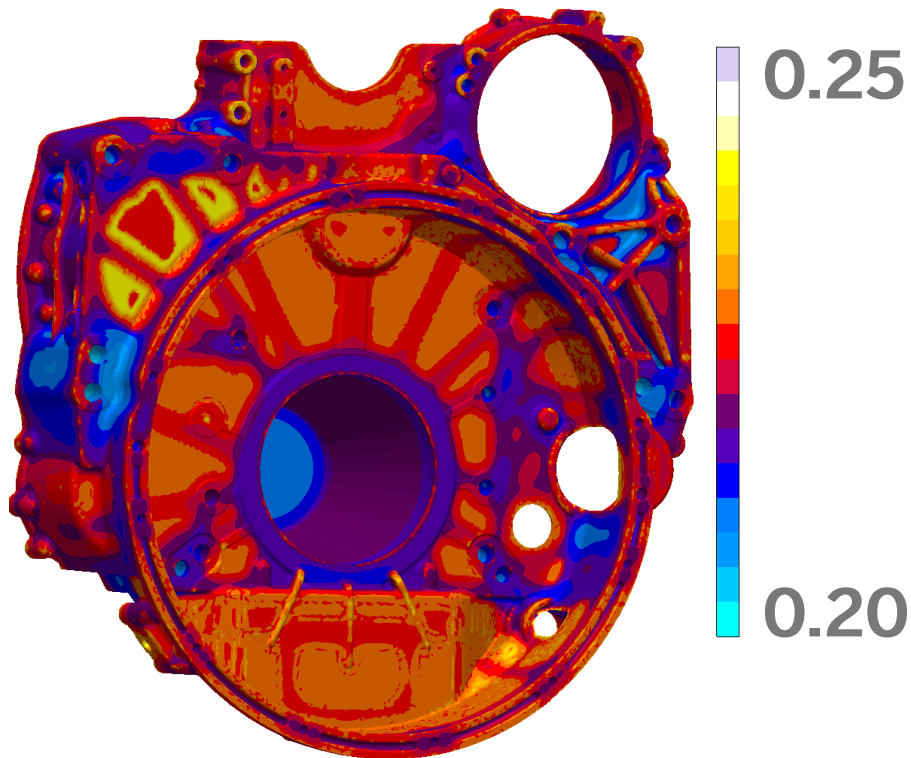


# MICROSTRUCTURE



# LOCAL BEHAVIOUR

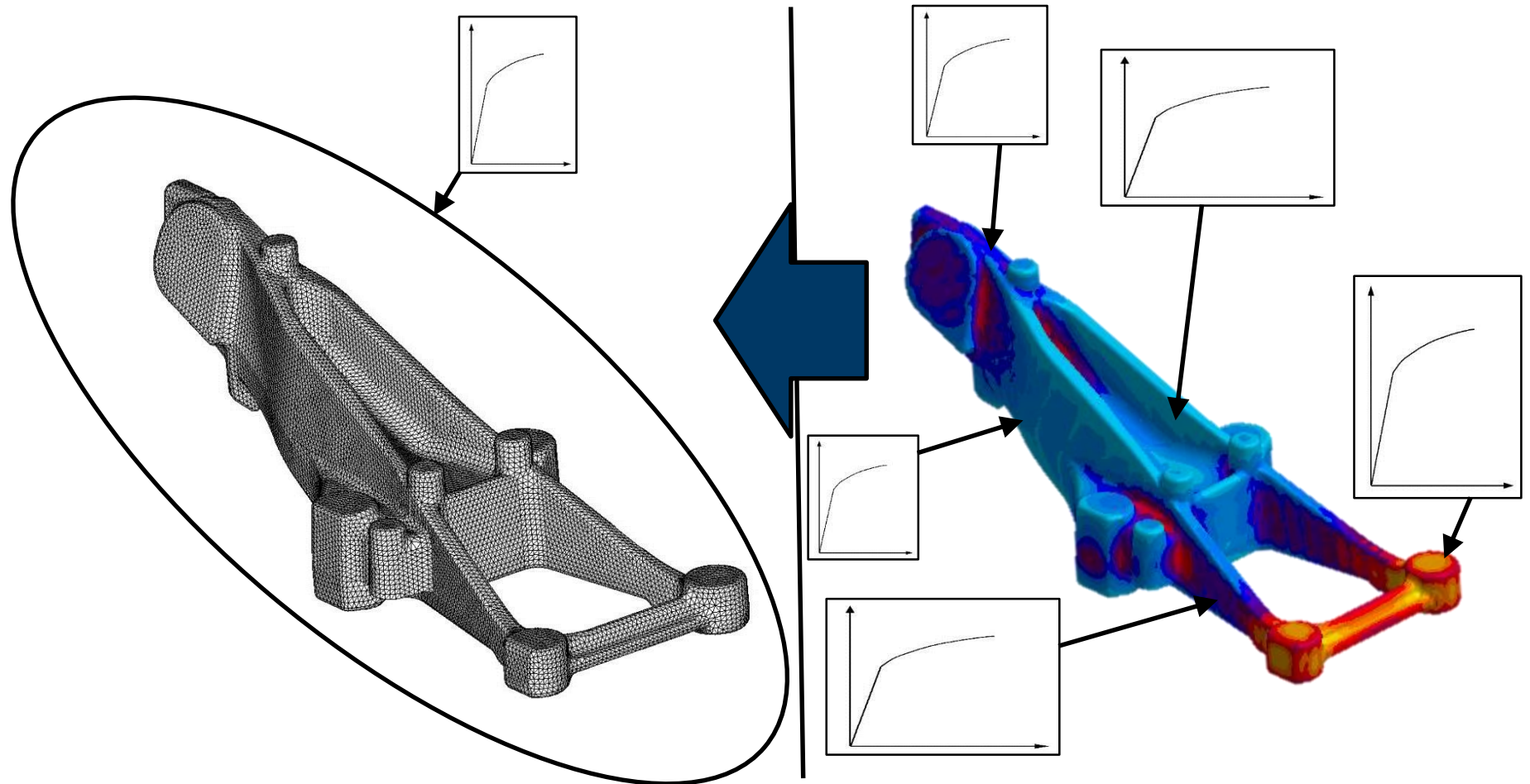
Plastic strain hardening



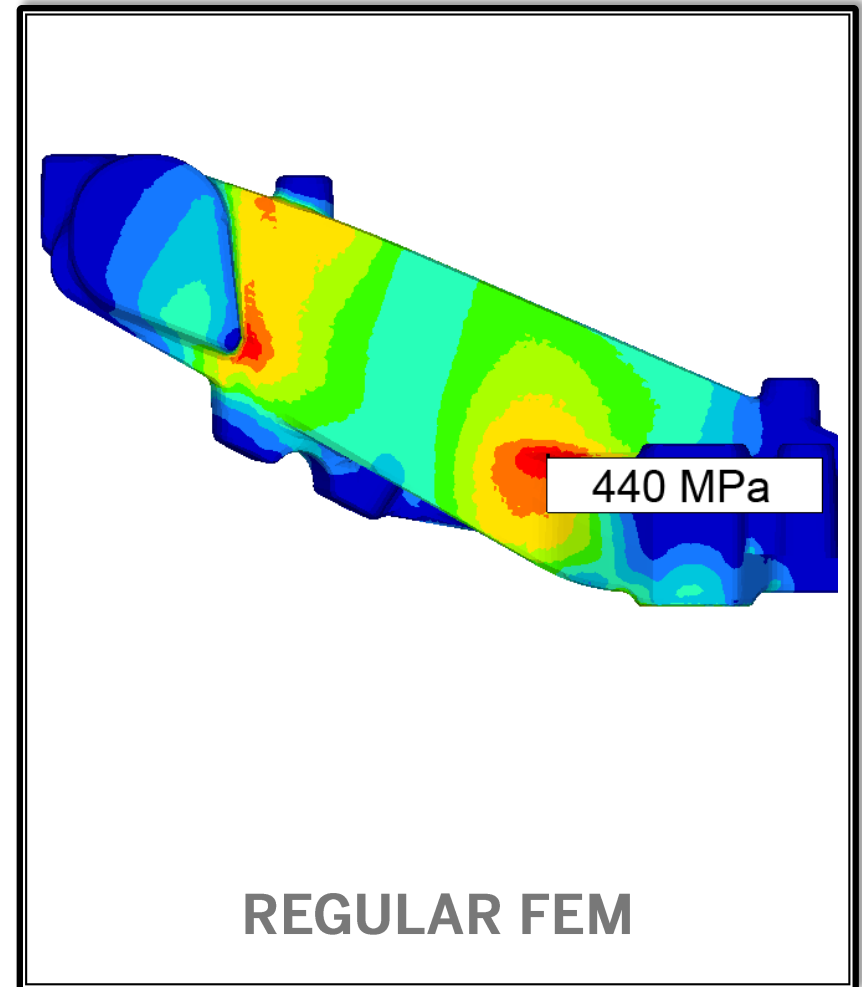
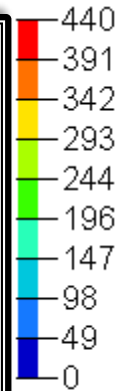
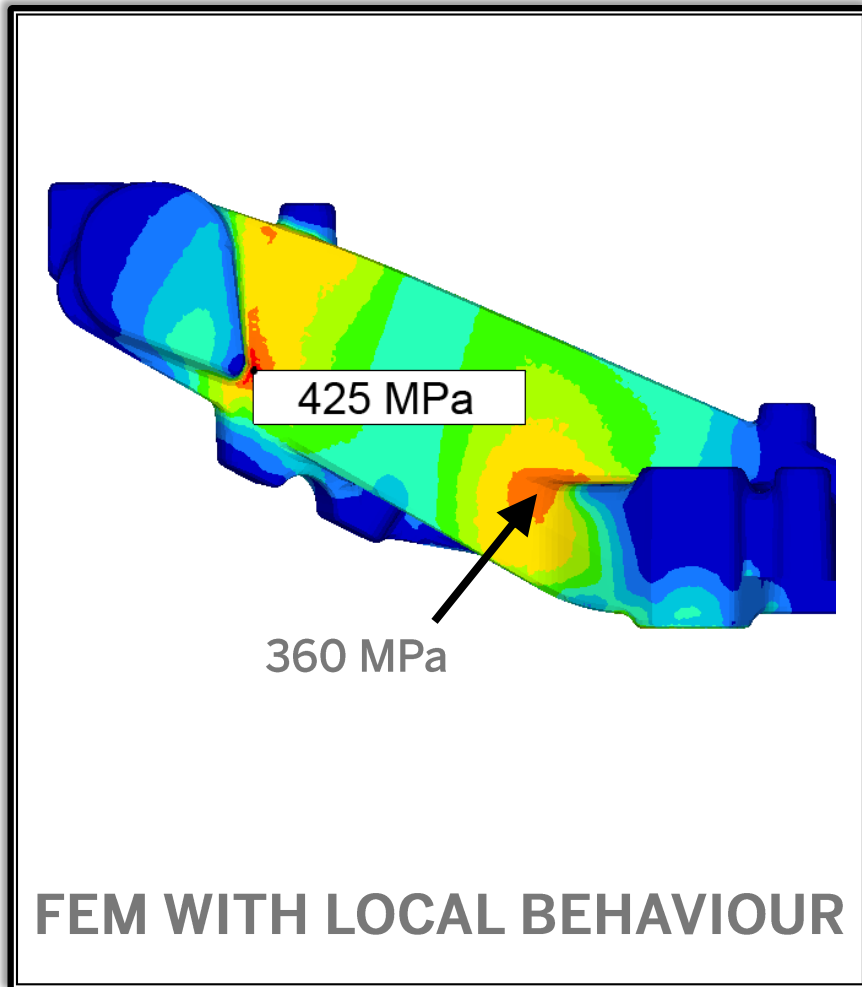
# SIMULATION STRATEGY

FEM

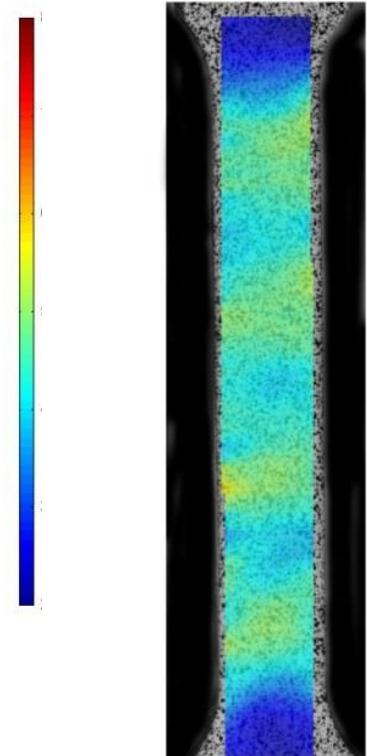
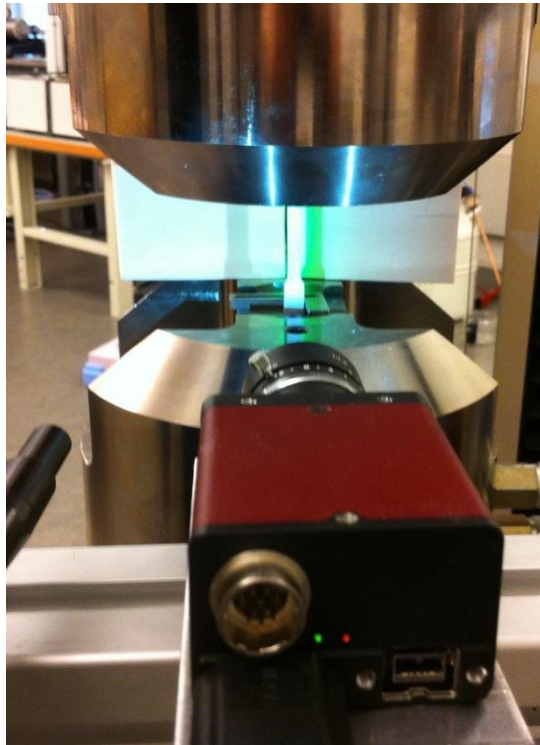
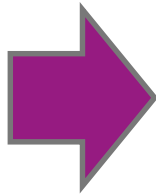
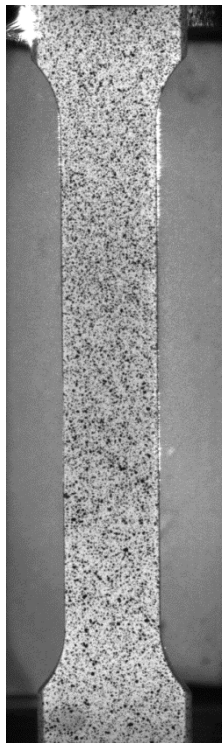
CASTING SIMULATION



# DUCTILE IRON: MACRO-SCALE FEM



# 2D DIGITAL IMAGE CORRELATION



# LOCAL BEHAVIOUR – DIC

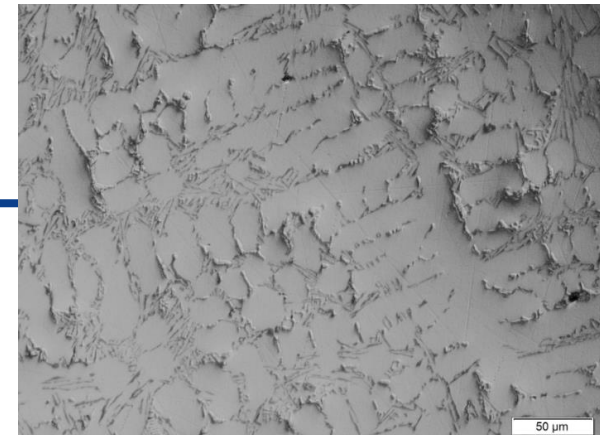
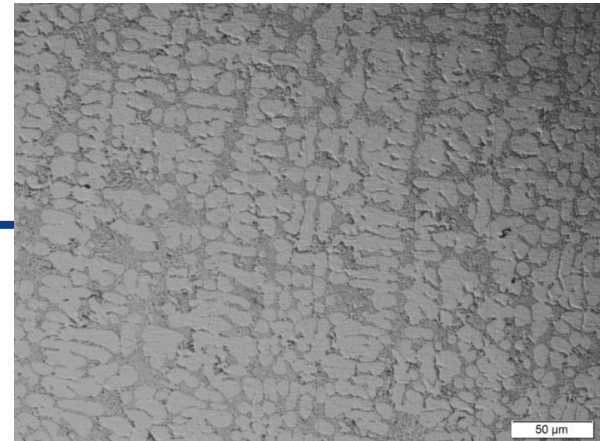
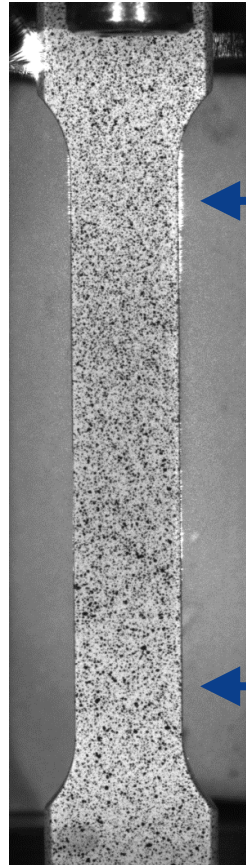
Directional solidification of Aluminium

SDAS [ $\mu\text{m}$ ]

10

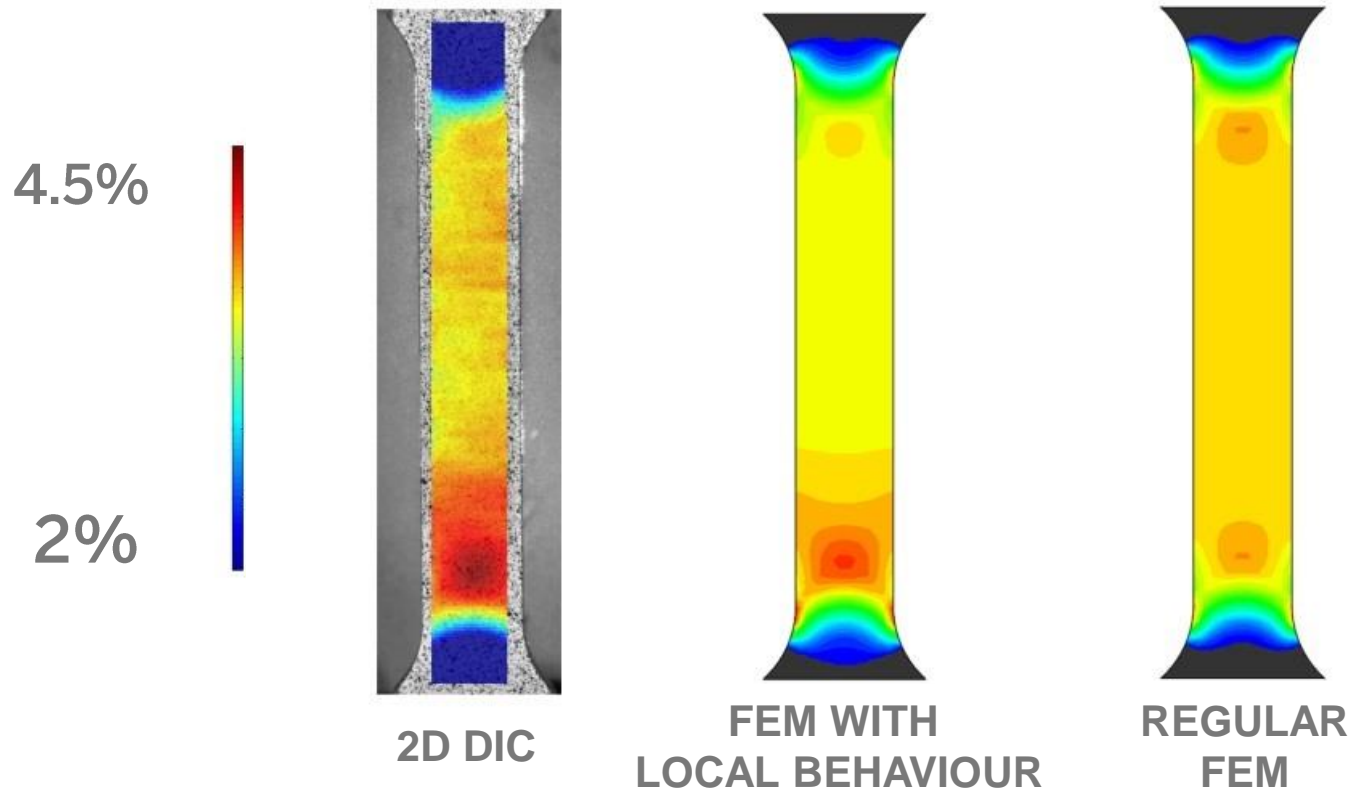
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20



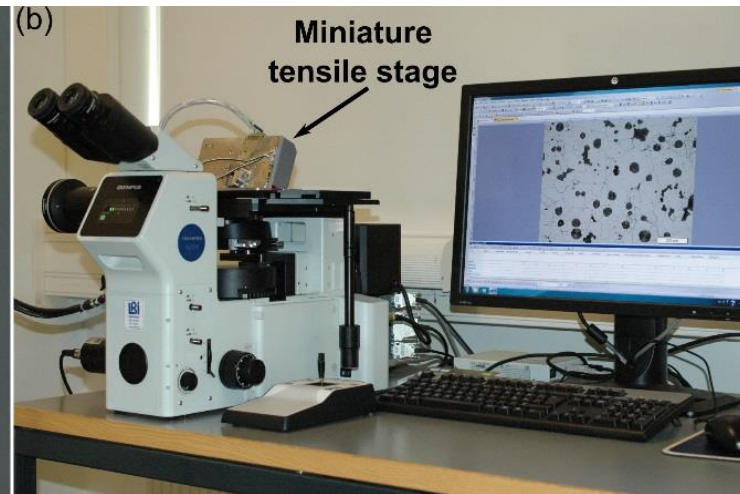
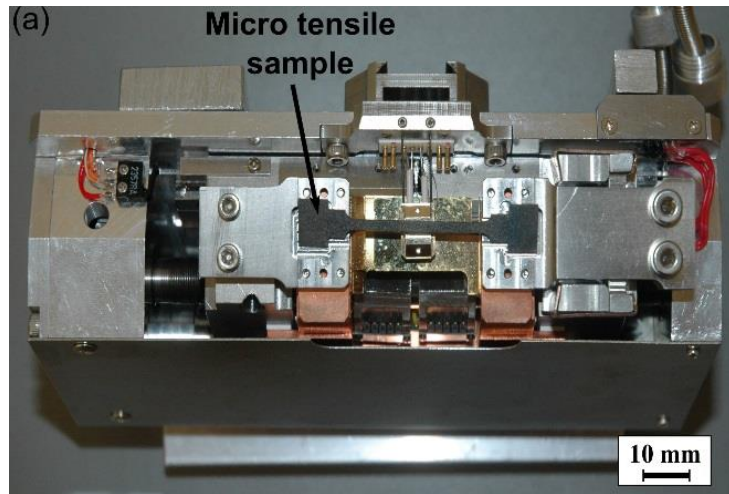
# LOCAL BEHAVIOUR – DIC

Directional solidification of Aluminium

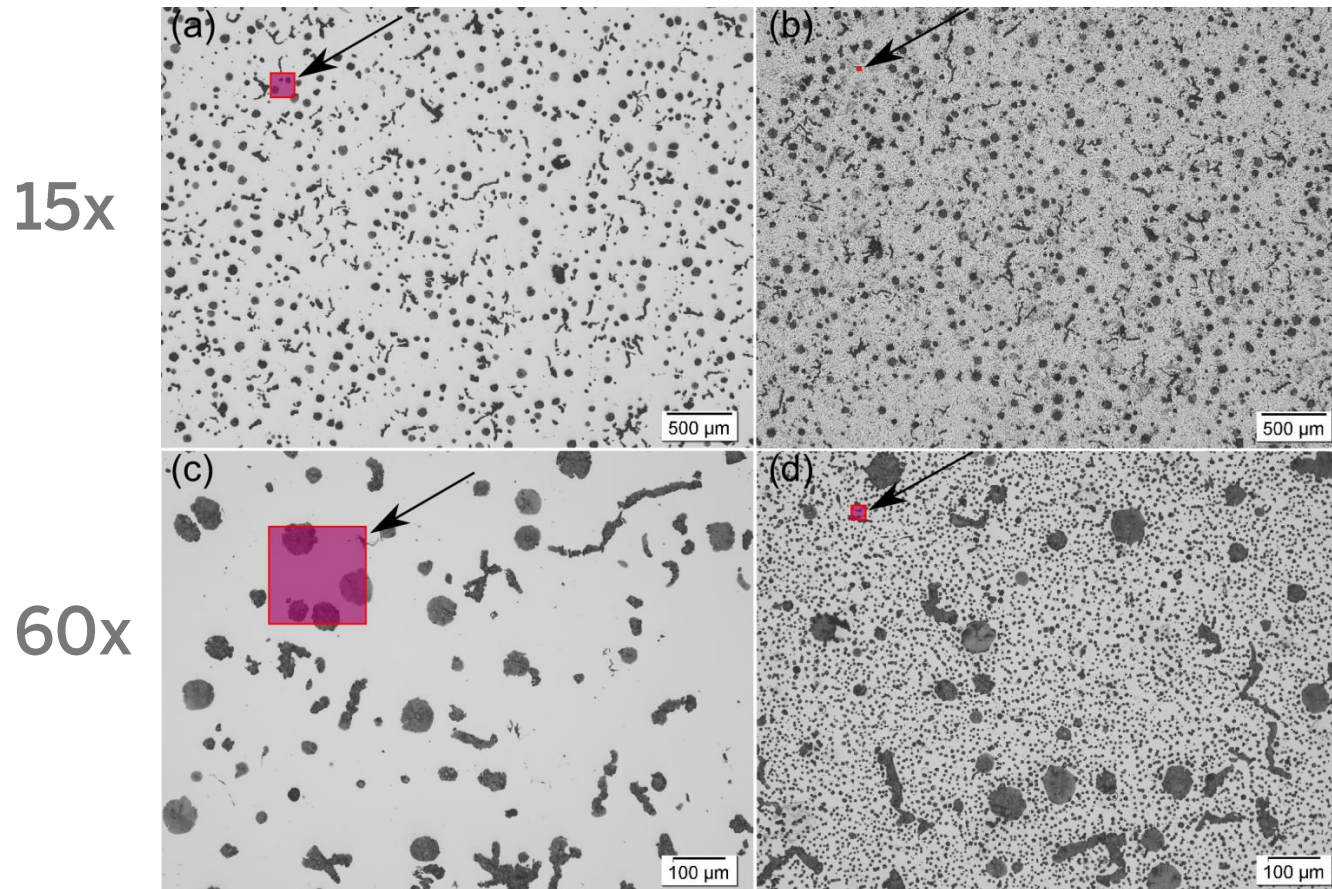




# MICRO-SCALE DIC

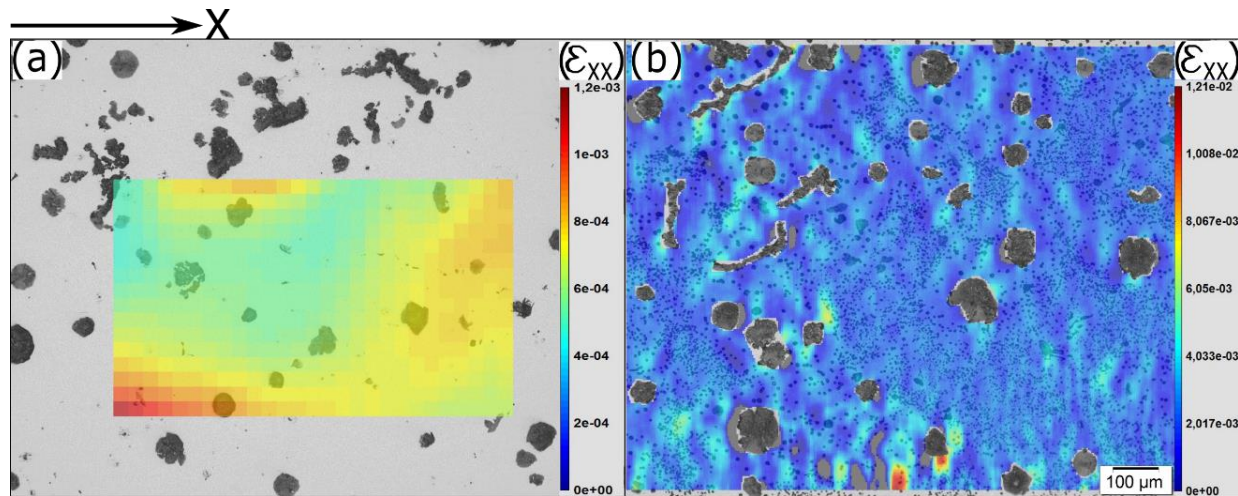


# MICROSTRUCTURE OF FERRITIC DUCTILE IRON

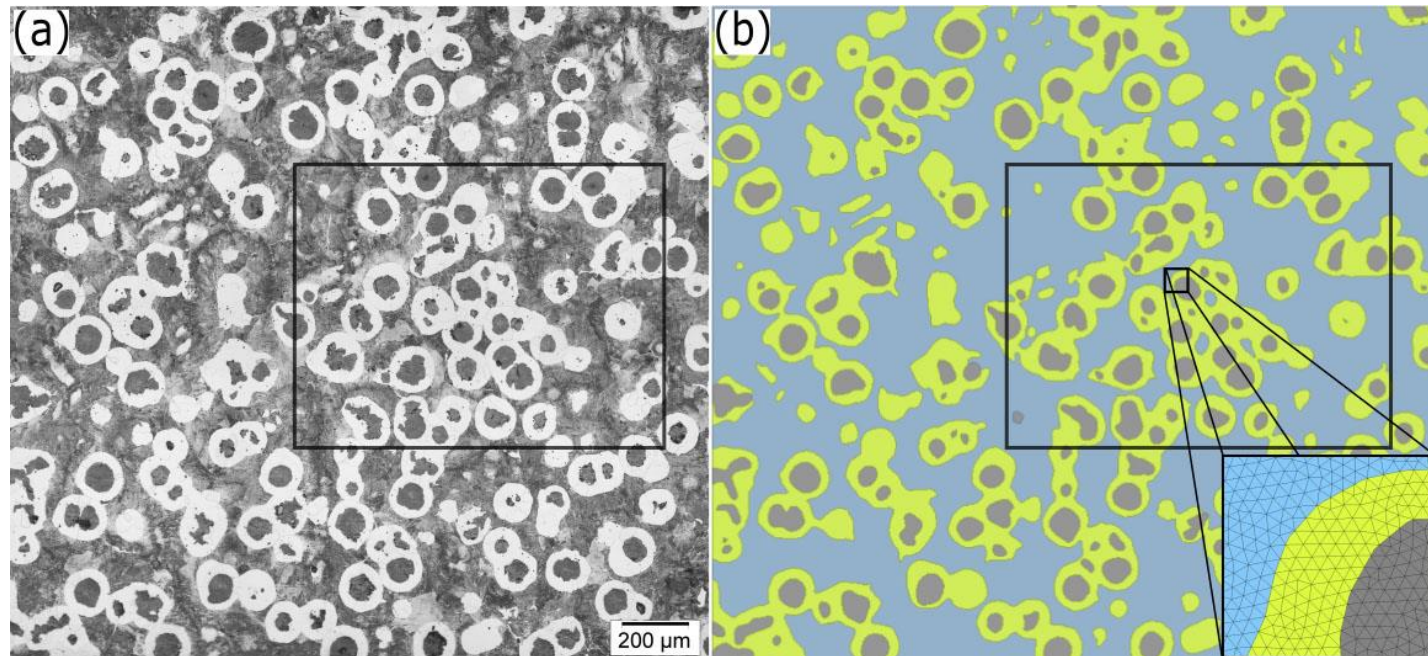


Natural microstructure      With pit etching

# EFFECT OF PIT ETCHING ON SPATIAL RESOLUTION

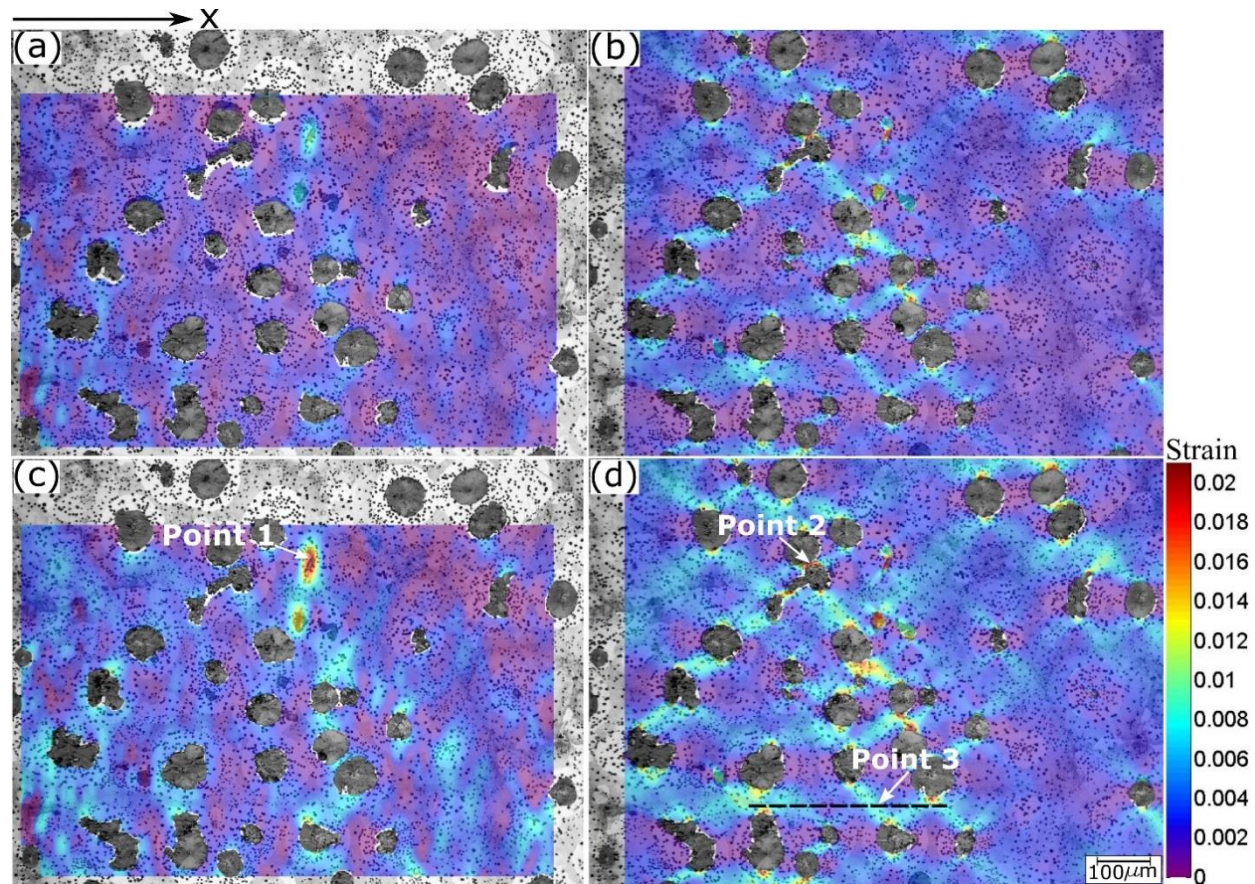


# FEM MODEL OF MICROSTRUCTURE



FEM model with cohesive elements in the boundary between microstructural constituents to enable crack initiation and graphite debonding

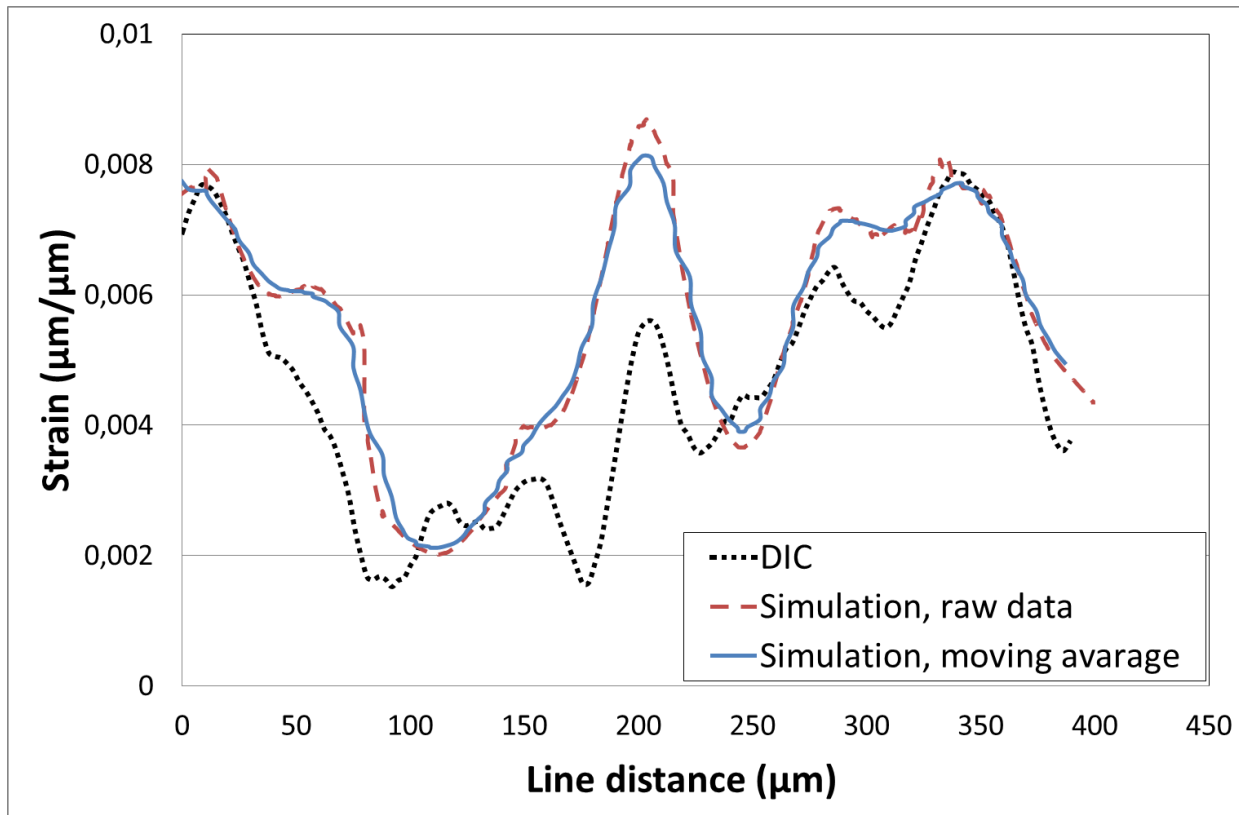
# MICRO-SCALE DIC AND FEM



DIC

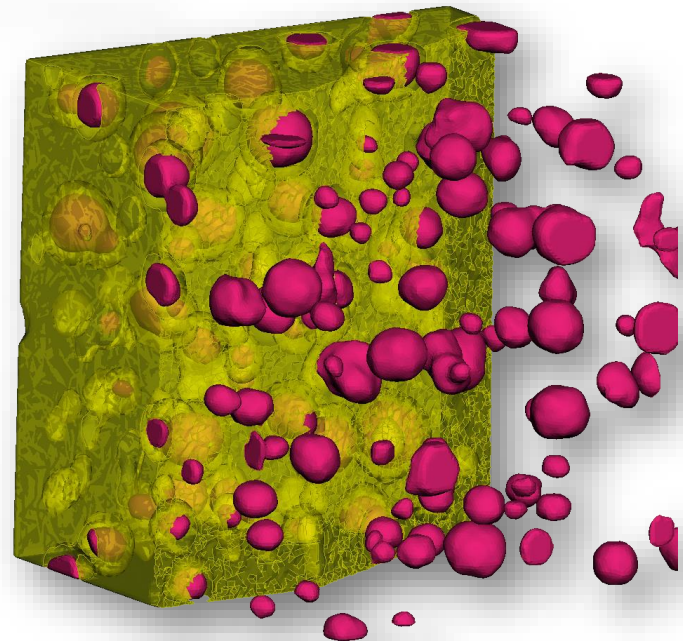
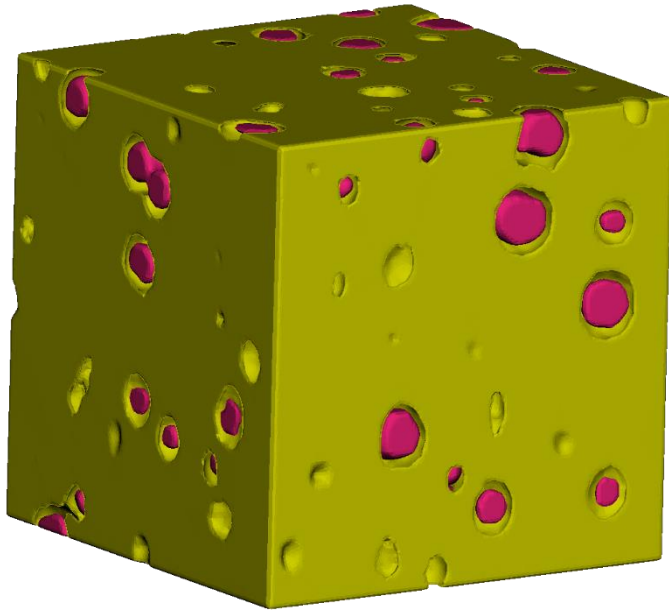
FEM

# MICRO-SCALE DIC AND FEM

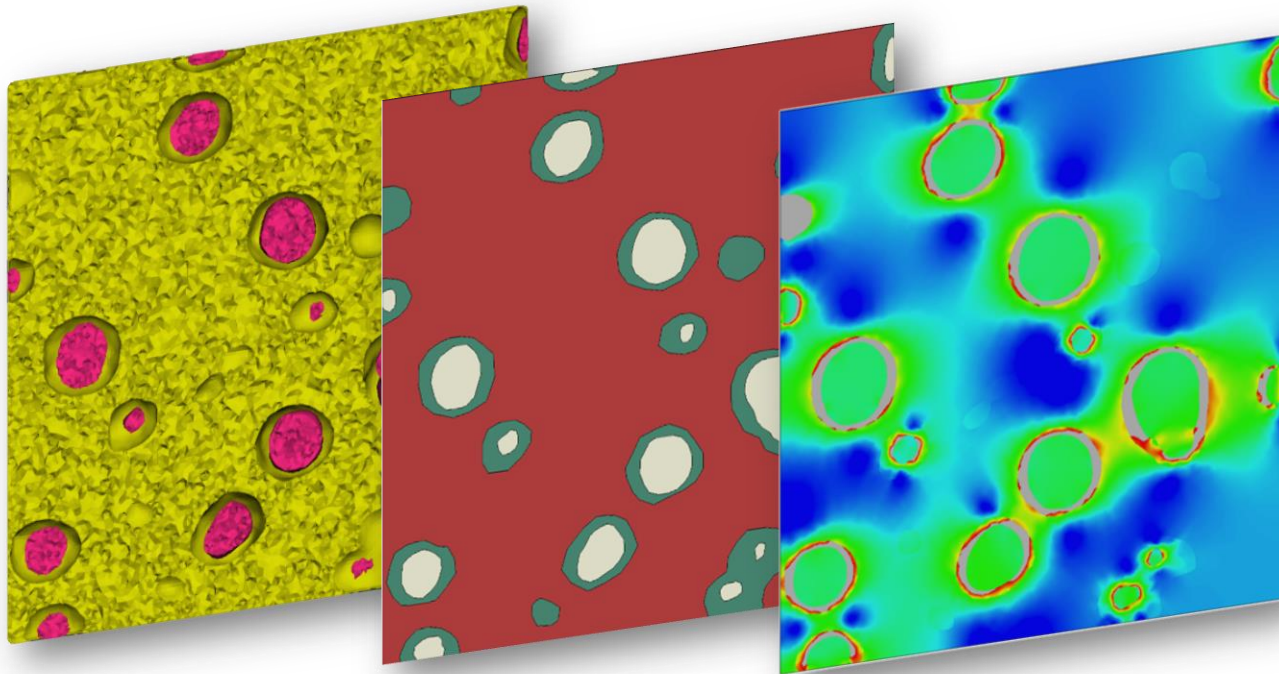


# MICRO-SCALE FE-MODEL

FROM X-RAY TOMOGRAPHY

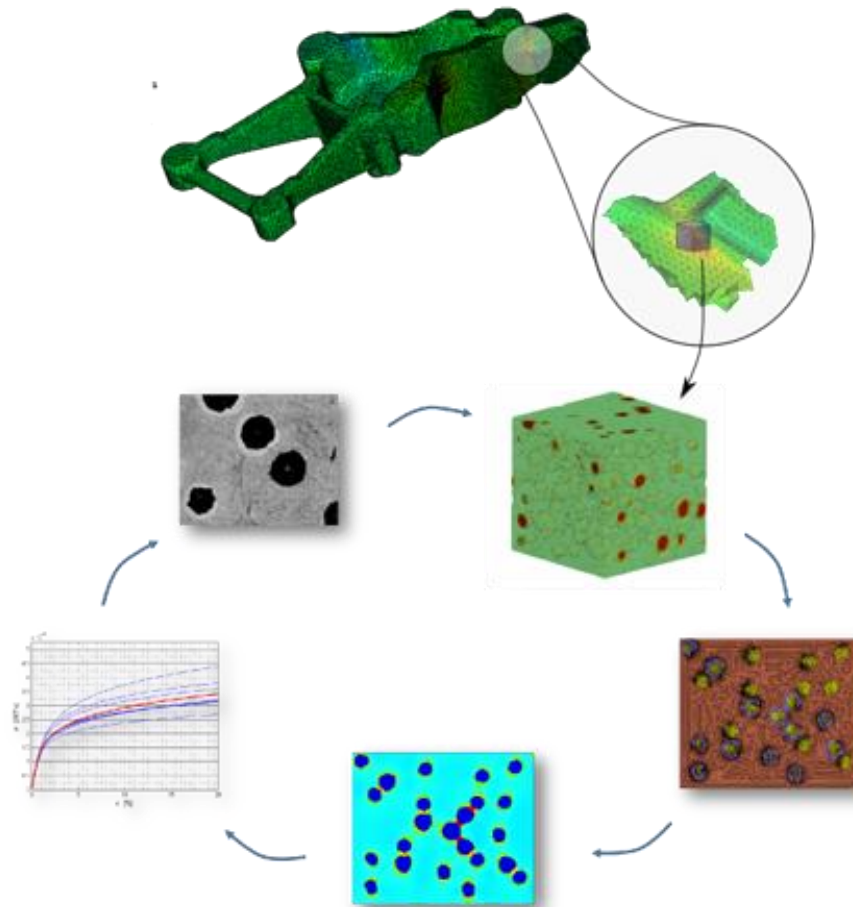


# FE-MODEL FROM X-RAY TOMOGRAPHY

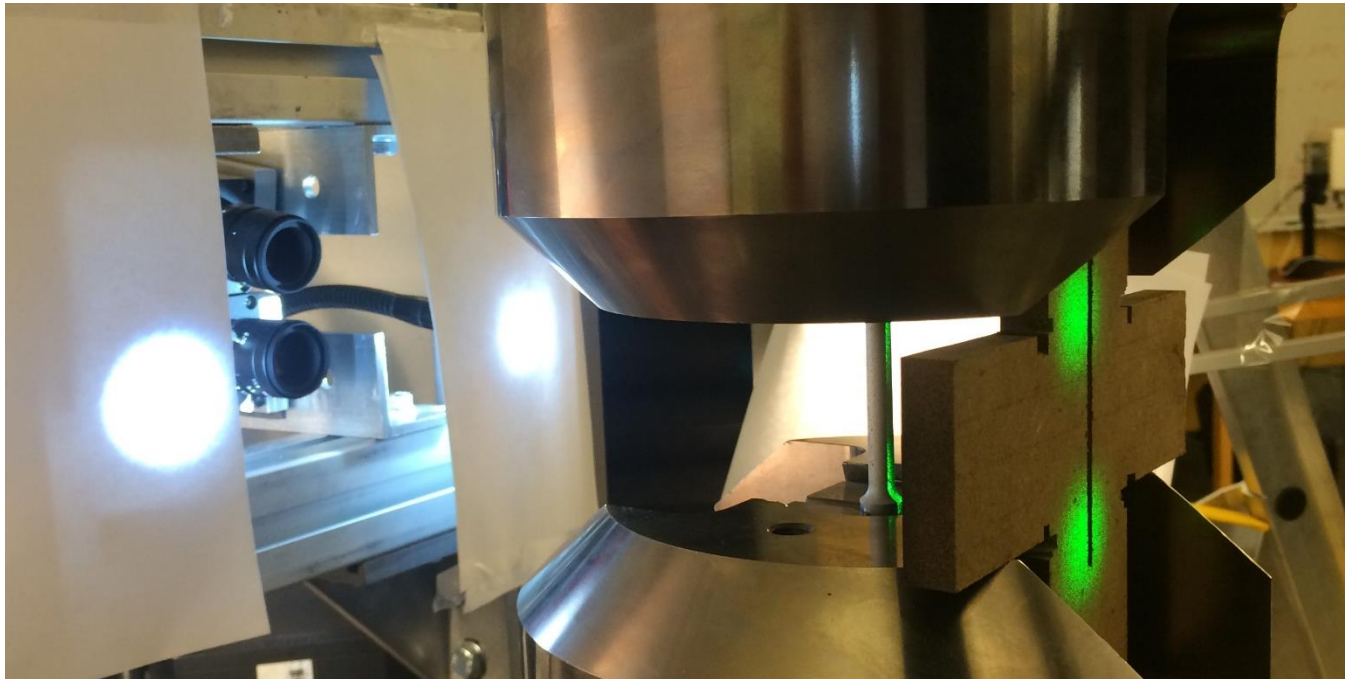




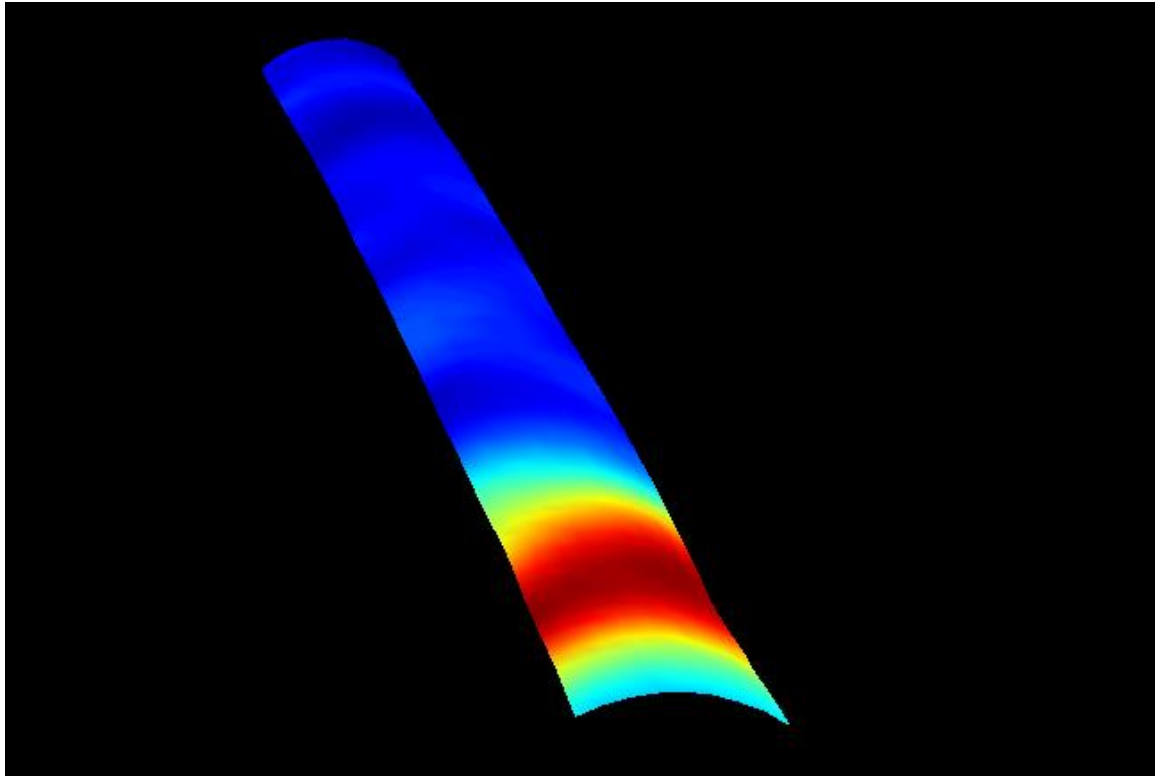
# COMBINING SIMULATIONS ON MULTIPLE SCALES



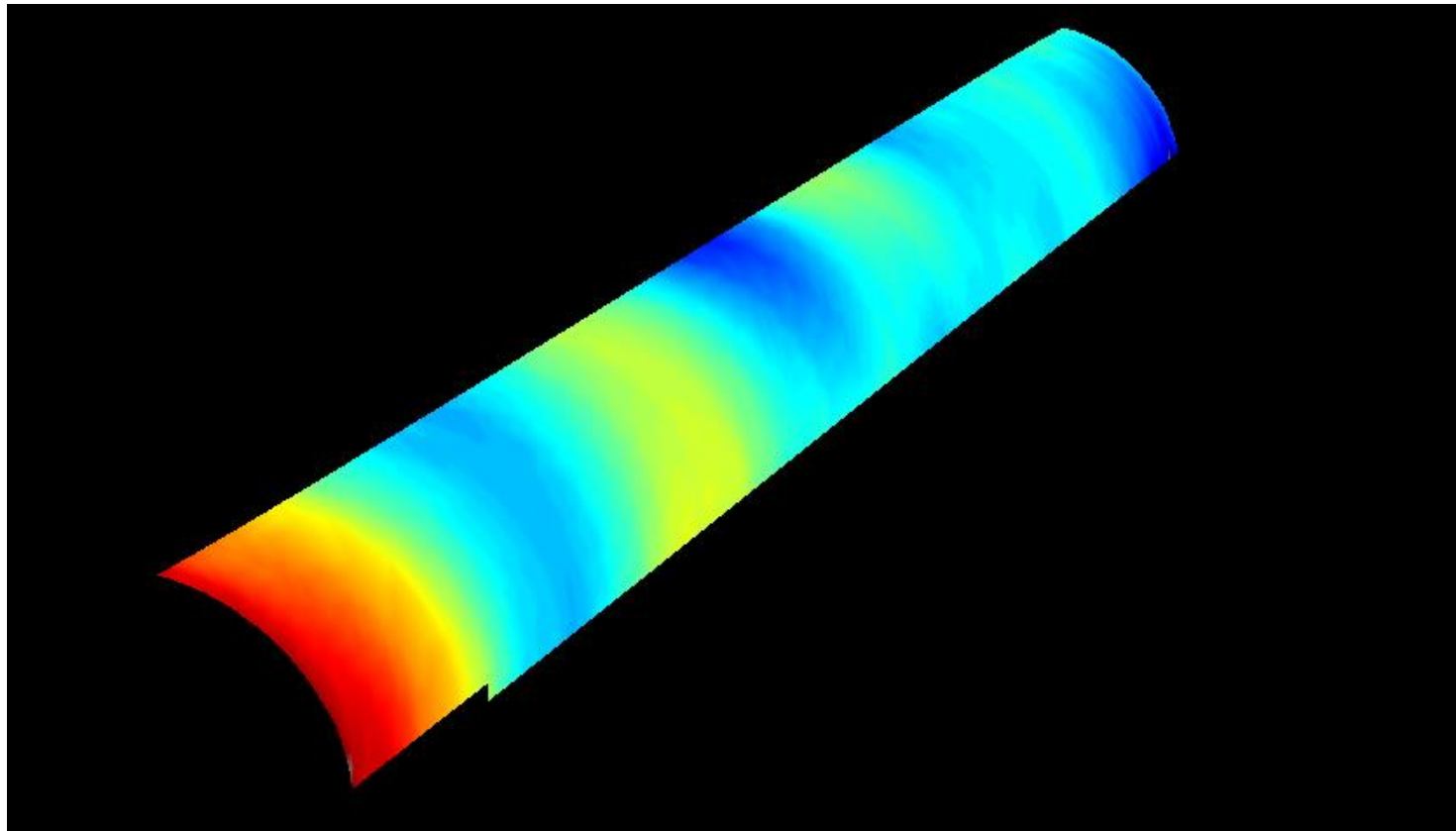
# STEREO-DIC: 2 CAMERAS



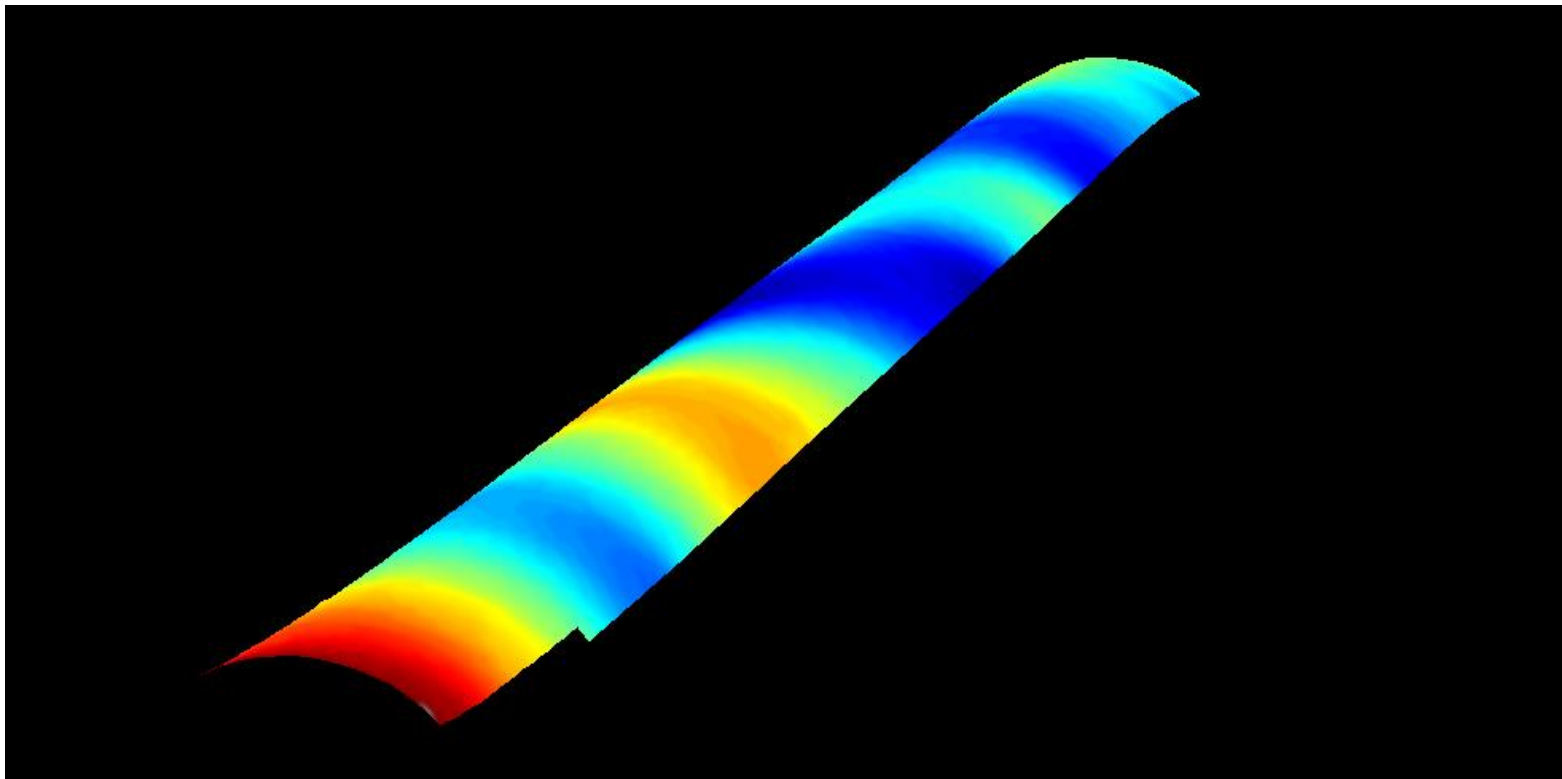
# STEREO-DIC: AL AT NECKING



# STEREO-DIC: GREY CAST IRON



# STEREO-DIC: GREY CAST IRON



# Microstructure and deformation behaviour of ductile iron under tensile loading

Licentiate thesis by Keivan Amiri Kasvayee

9 OCT 2015





JÖNKÖPING UNIVERSITY  
*School of Engineering*

