


Experiment Report Form

	Experiment title: In-situ investigation of strain and damage interaction during ductile fracture via laminography combined with digital volume correlation	Experiment number: Ma1932
Beamline:	Date of experiment: from: 14 mai 2014 to :18 mai 2014	Date of report: 03/2018
Shifts:	Local contact(s): Marco Di Michiel	<i>Received at ESRF:</i>
Names and affiliations of applicants (* indicates experimentalists): Lukas Helfen, KIT Thilo Morgeneyer, Mines ParisTech Mouhcine Kahziz, Mines ParisTech Maik Horn, TU Freiberg/ Mines ParisTech H. Tu, Uni Stuttgart		

Report on the experiment:

During this experiment we performed in situ mechanical loading tests on different samples made of ductile cast iron. Different local stress states were applied by choosing different sample geometries. Surface images were taken that corresponded to the scans to perform surface image correlation. The force levels was also recorded.

The following nodular **cast iron samples** were in situ tested:

1. Shear sample
2. Tensile sample with a central hole
3. Tensile samples with two small holes
4. Compact tension (CT) like specimen

A deeply notched CT-like sample made of **steel s355** was also tested in situ during this experiment. A dual phase **ferrite-bainite steel** was tested by in situ tomography to identify

the damage mechanisms. The work was processed in the PhD thesis of Mouhcine KAHZIZ (Chapter 3).

The highly contrasted nodular cast iron material microstructure could be used to perform digital volume correlation within the sample. Finite element modelling by explicitly meshing the nodules was performed. The simulations were driven by the measured boundary conditions.

The data on the shear experiment is currently being processed in the framework of a German French ANR-DFG program.

Publications:

The work on **nodular cast iron** was published in the following paper and a book chapter during the PhD of Ante Buljac:

- A. Buljac, M. Shakoor, J. Neggers, M. Bernacki, P.O. Bouchard, L. Helfen, T. F. Morgeneyer, F. Hild, "Numerical Validation Framework for Micromechanical Simulations based on Synchrotron 3D Imaging", *Computational Mechanics*, 59 (2017) 419–441
- Ante Buljac, Modesar Shakoor, Jan Neggers, Marc Bernacki, Pierre-Olivier Bouchard, Lukas Helfen, Thilo F. Morgeneyer, François Hild, Experimental-Numerical Validation Framework for Micromechanical Simulations. Jurica Sorić, Peter Wriggers, Olivier Allix. *Multiscale Modeling of Heterogeneous Structures*, 86, Springer, pp.147-161, 2018, Lecture Notes in Applied and Computational Mechanics book series (LNACM),
- The experiment and procedure and results of the entire experiment have been described in the Master thesis of Maik HORN from TU Freiberg, Germany
Poster: http://tu-freiberg.de/sites/default/files/media/technische-mechanik---festkoerpermechanik-16567/Mitarbeiter/Lutz_Zybell/poster_horn.pdf

A paper on the failure of **s355 steel** that is currently being revised.

The work on **ferrite bainite steel** is written up in the PhD thesis of Mouhcine KAHZIZ (chapter 3 in the thesis) :

- Mouhcine Kahziz. Experimental and numerical investigation of ductile damage mechanisms and edge fracture in advanced automotive steels. *Materials*. Ecole Nationale Supérieure des Mines de Paris, 2015. English.
Available at: <https://pastel.archives-ouvertes.fr/tel-01305952/document>