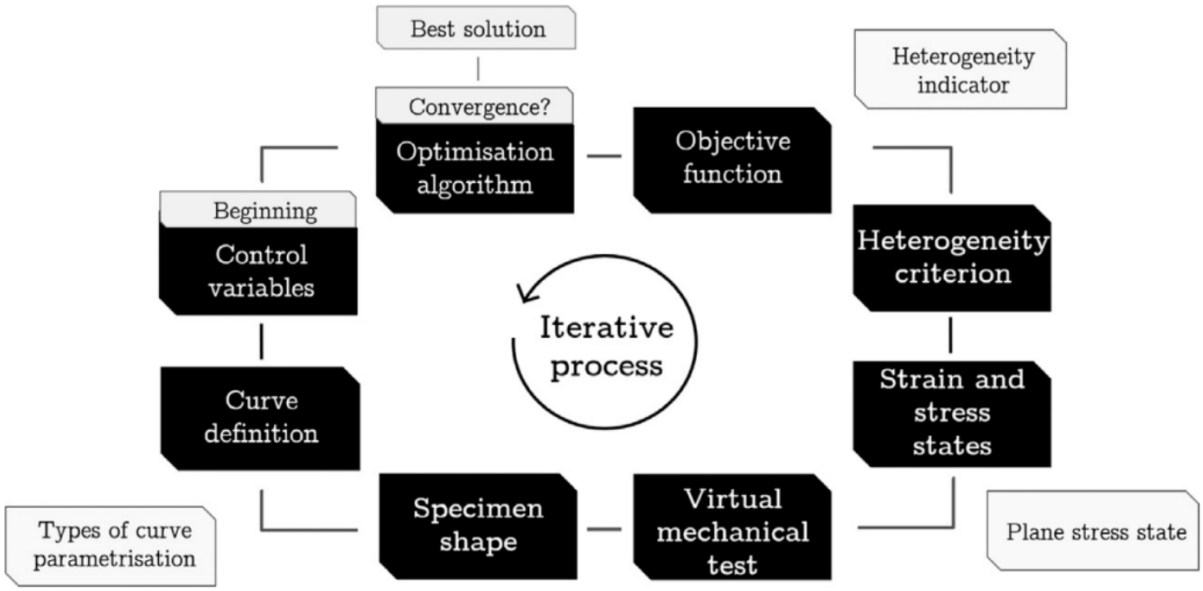
Project

NEWSLETTER

VForm-xSteels

Toward virtual forming and design: Thermomechanical characterization of high strength steels through full-field measurements and a single designed test



Specimen Design Enhances Material Characterization

In the 4th edition of our newsletter, we're excited to highlight a research project that transforms how we understand and identify material parameters.

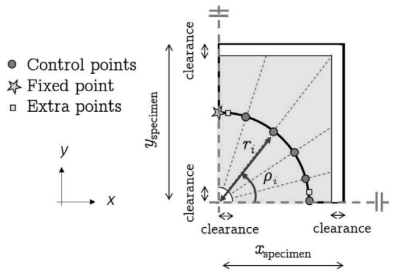
The study introduces a novel specimen design featuring an optimized interior notch, aimed at maximizing strain heterogeneity. This approach marks a significant departure from traditional methods, offering enhanced accuracy in material characterization.

The team employed a meticulous methodology, optimizing the specimen's shape through a specialized cost function. This technique is based on indicators of strain heterogeneity, ensuring the most effective design for parameter identification.

The research's validation through comprehensive numerical simulations is particularly noteworthy, showcasing the practical applicability of this new method in various engineering fields.

What sets this study apart is its potential to revolutionize material testing.

By improving parameter identifiability, it opens the door to more precise and efficient material usage in engineering applications. This advancement is not just a theoretical achievement; it has tangible implications for industries relying on accurate material characterization, from automotive to aerospace.



Representation of the specimen's interior notch, its curve control points and their search space.

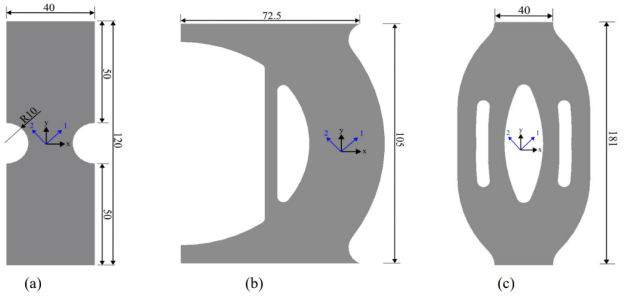
Authors: M. Conde, Y. Zhang, J. Henriques, S. Coppieters, A. Andrade-Campos

Find more by clicking the icon below:

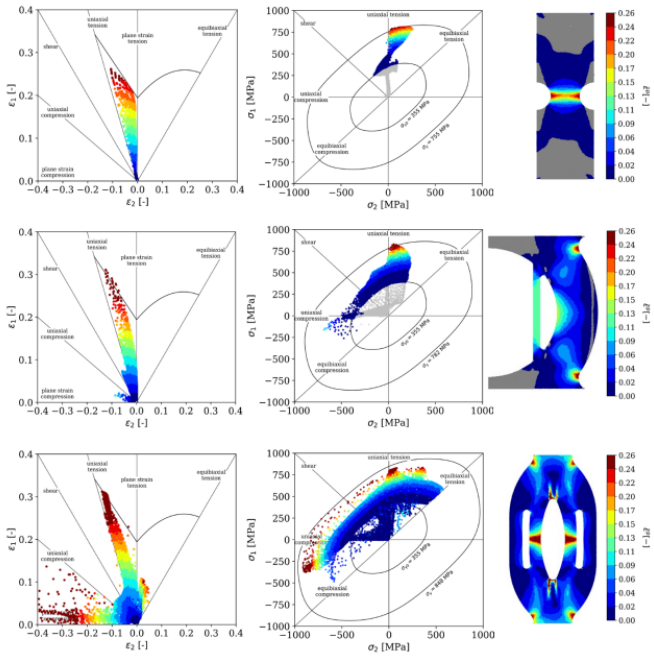
Design and validation of a heterogeneous interior notched specimen for inverse material parameter identification

A Comparative Analysis of Mechanical Tests

In their notable research, "On the Comparison of Heterogeneous Mechanical Tests for Sheet Metal Characterization," Gonçalves et al. explore advanced methodologies in material science, focusing on sheet metal. The study meticulously compares various mechanical tests to identify the most informative for understanding sheet metal behavior and improving model calibration. By introducing and utilizing Key Performance Indicators (KPIs), the research team evaluates these tests, employing numerical simulations to assess different test designs. They discover that some tests, due to their complexity, provide a more comprehensive range of mechanical data, crucial for detailed material analysis.



Specimen designs selected to be analysed in this work: (a) Notched, (b) D and (c) TopOpt.



Principal strains and stresses diagrams and equivalent plastic strain distribution for each test design at the moment just before rupture. Both the initial surface and the one associated with the maximum yield stress are plotted in the principal stress diagrams.

Authors: Mafalda Gonçalves, Miguel Guimarães Oliveira, Sandrine Thuillier and António Andrade-Campos

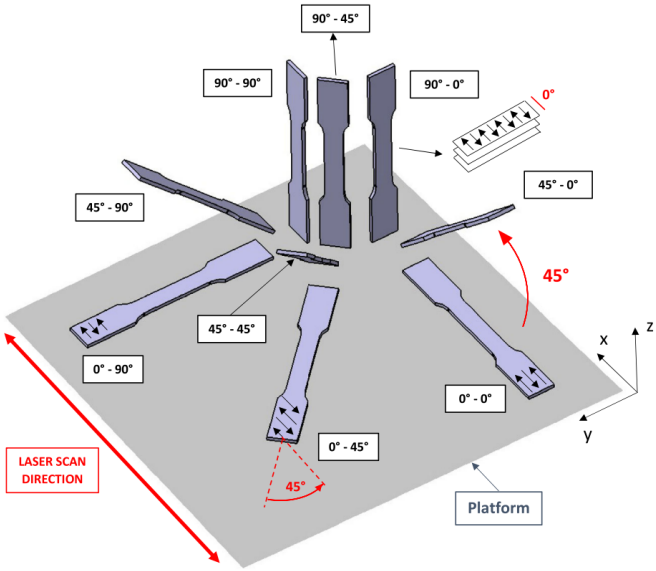
Find more by clicking the icon below:

On the comparison of heterogeneous mechanical tests for sheet metal characterization

This work is particularly significant because accurate material characterization can lead to innovations in design and manufacturing processes.

Innovations in 3D Printing

The study presented in the article "Combined effect of process variables on the plastic behaviour of 316L stainless steel printed by L-PBF" delves into the intricate world of 3D printing, specifically examining how various process variables influence the plastic behavior of 316L stainless steel when printed using laser powder bed fusion (L-PBF). It was concluded that the orientation of the 3D printed specimens and the laser scan strategy significantly impact the mechanical properties and plastic behavior of 316L stainless steel.The research provides valuable insights into optimizing printing strategies for this material, with potential implications for enhancing the durability and performance of 3D printed stainless steel components. A must-read for anyone interested in the cutting-edge developments in material science and 3D printing technology.



Schematic representation of various orientations and angles used in a laser powder bed fusion (L-PBF) 3D printing process. The different specimens shown are oriented at specific angles relative to the laser scanning direction, which is indicated by the red arrows.

Authors: Luca Morichelli, Gianluca Chiappini, Attilio Lattanzi, Eleonora Santecchia, Marco Rossi

Find more by clicking the icon below:

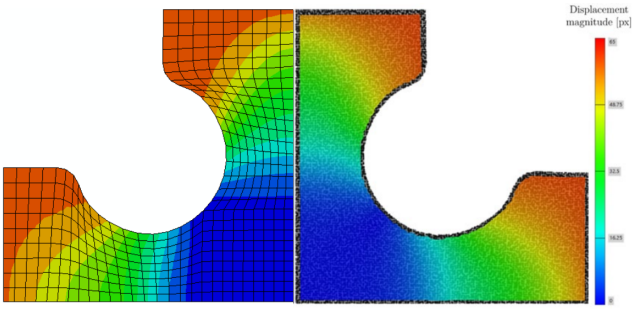
Combined effect of process variables on the plastic behaviour of 316L stainless steel printed by L-PBF

Calibrating Models with Precision

The research by Prates et al. integrates machine learning with material science to enhance the calibration of elastoplastic constitutive models used in metal sheet forming. This methodology involves constructing a comprehensive database from finite element analysis simulations and employing digital image correlation for the creation of virtual experiments.

The machine learning model, trained on this robust database, demonstrates strong accuracy in predictive performance, overcoming common alignment issues in material testing. The study underscores the potential of virtual experiments to replicate real-world scenarios, offering a promising bridge between computational simulations and practical applications in the industry.

In the picture below, there's a comparison of the displacement magnitude in the cruciform test, between FEA (left) and virtual experiments (right):



Authors: Pedro Prates, João D. F Henriques, Jose Pinto, Nelson Bastos and António Andrade-Campos

Find more by clicking the icon below:
Coupling machine learning and synthetic image DIC-based techniques for the calibration of elastoplastic constitutive models

This project has received funding from:

The Research Fund for Coal and Steel under grant agreement No 888153

European Commission

Research Fund for Coal & Steel

Consortium Meetings

On June 27, 2023, representatives of the partner organizations gathered in Ancona for a physical meeting regarding the Vform-xSteels project.

Photographic record of the meeting
From left to right: Sam Coppieters, Pascal Lava, Sandrine Thuillier, António Andrade-Campos, Marco Rossi and Steven Cooreman

Partners

universidade de aveiro
University of Aveiro (UAVR)

Université Bretagne Sud
ubs
University of South Brittany (UBS)

KU LEUVEN
KU Leuven (KUL)

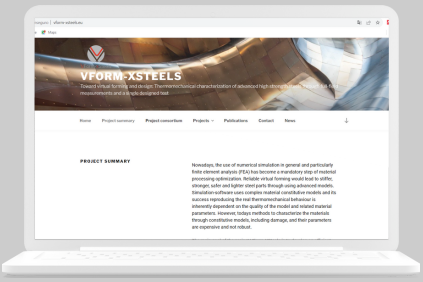
MatchID
MatchID (MID)

UNIVERSITÀ POLITECNICA DELLE MARCHE
Università Politecnica delle Marche (UNIVPM)

DAF
DAF TRUCKS NV (DAF)

OCAS
Onderzoekscentrum voor Aanwending van Staal nv (OCAS)

Visit the official website of the project:



Click on the icon or go to http://www.vform-xsteels.eu/