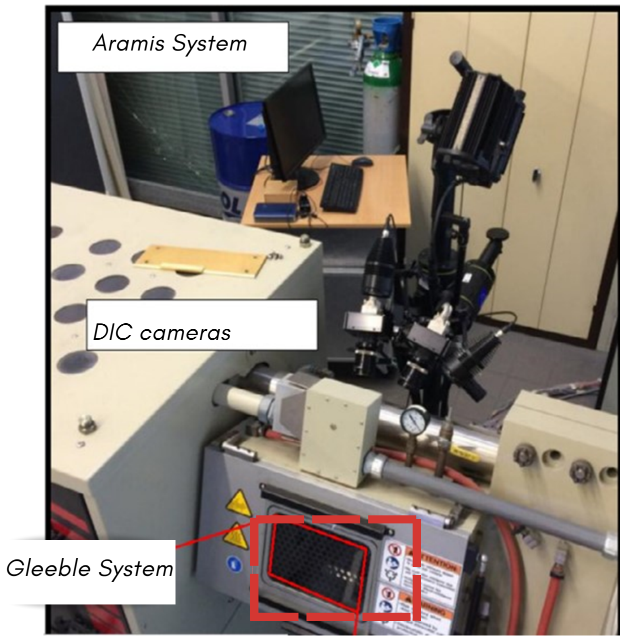
Project

NEWSLETTER

VForm-xSteels

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



What progress has been made?

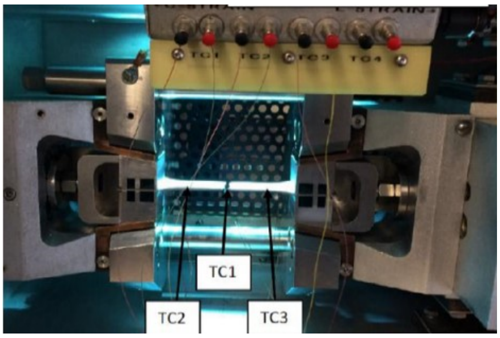
Conventional methods for calibrating thermo-elasto-viscoplastic models often require a multitude of tests, resulting in lengthy experimental processes. For that reason, it is proposed an innovative calibration approach that maximizes the use of comprehensive measurements from a diverse test.

This method combines the Virtual Fields Method with a thermo-mechanical test conducted on a Gleeble 3500 system. To evaluate the viability of this approach, it is applied to a modified Johnson-Cook model and DP980 dual-phase steel.

The model's three parameters related to strain-hardening, temperature, and strain rate effects are simultaneously calibrated for the material's thermo-mechanical behavior. Initial attempts involve a single test at a constant displacement rate, and the process is replicated for three tests at nominal strain rates of 10^{-4}, 10^{-3}, and $10^{-2} s^{-1}$.

While accurate predictions of flow stress are achieved, a single test falls short in capturing the positive strain rate sensitivity of the material.

Combining data from the three tests in an experimental database, however, results in reasonable predictions of positive strain rate sensitivity within the specified temperature range. These findings underscore the potential of this methodology to streamline the calibration of thermo-elasto-viscoplastic constitutive models.



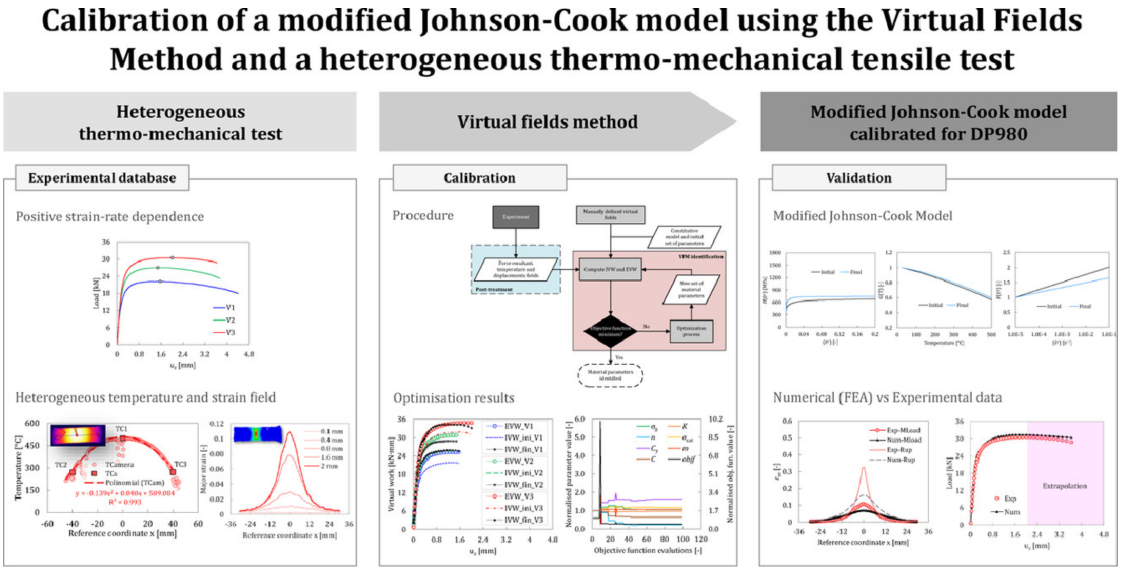
On the image, there's the Gleeble chamber. The temperature field is monitored through three thermocouples (TC1, TC2 and TC3)

Authors: J.M.P. Martins, S. Thuillier, A. Andrade-Campos

Find more by clicking the icon below:

Calibration of a modified Johnson-Cook model using the Virtual Fields Method and a heterogeneous thermo-mechanical tensile test

Thermomechanical Characterization and Modeling of Advanced Steels



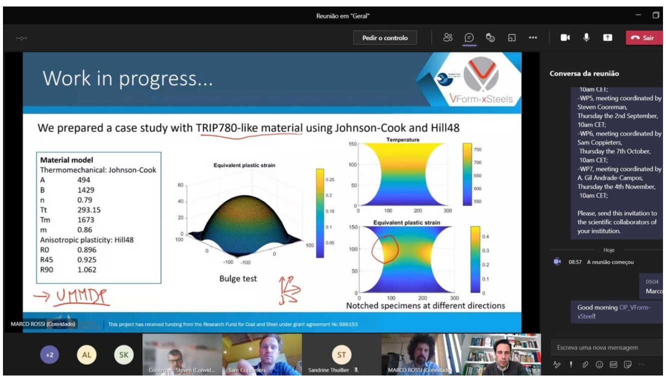
Still in the context of the article "Calibration of a modified Johnson-Cook model using the Virtual Fields Method and a heterogeneous thermo-mechanical tensile test", above there's a research summary on DP980 high-strength steel, showcasing its stress response at different strain rates and temperatures. A calibration process via virtual fields method refines a modified Johnson-Cook model, aligning it with observed data. The final validation contrasts simulation results with actual experiments, highlighting the model's predictive capabilities for material behavior under stress.

Consortium meetings

On June 3, 2021, the meeting for the entire consortium regarding one of the work packages (WP2) took place. The aim of this package was the "Development of a robust and accurate numerical methodology for thermomechanical parameter identification using full-field measurements of temperature and strain."

The deliverables that are expected by the end of the current year were reiterated, which include:

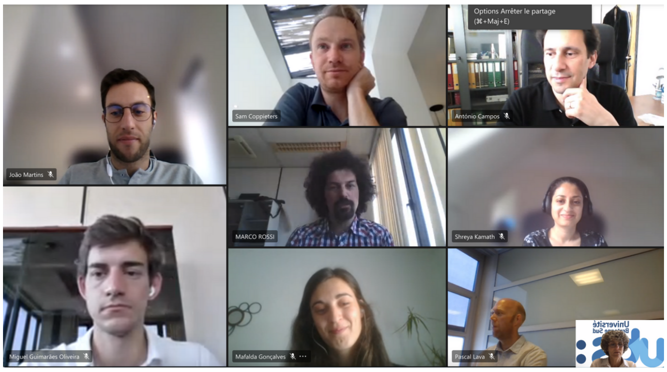
- VFM software for thermomechanical parameter identification using temperature and strain full-field measurements;
- FEMU software for thermomechanical parameter identification using temperature and strain full-field measurements;
- Final (hybrid) VFM/FEMU software for thermomechanical parameter identification using temperature and strain full-field measurements.



The meeting regarding Work Package n°3 (WP3) took place on June 29, 2021. S. Thuillier recalled the aims of WP3, entitled "Design of a novel test using an integrated topology-shape optimisation methodology and a thermo-mechanical indicator". WP3 encompasses three tasks: designing a heterogeneous numerical test, validating the test for model calibration using the Virtual Fields Method (VFM), and the mechanical design to collect experimental data. To evaluate this method against traditional ones, quasi-homogeneous tests will be conducted at UBS and UNIVPM. M. Rossi proposed comparing results from both institutions as an additional benchmark using a shared protocol.

WP3's essence was highlighted in two presentations. Mafalda Gonçalves, a PhD student, discussed her thesis on designing novel heterogeneous thermomechanical tests using topology-based optimization, showing preliminary results on a new optimized geometry. João Martins, a post-doc, shared his PhD findings on calibrating anisotropic plasticity models using a different heterogeneous test (butterfly specimen) and the Virtual Fields Method, comparing predictions from this model with tension and shear experiments. This illustrates WP3's focus on innovative test design and model calibration.

Regarding the meeting about WP3, a photographic record was also made:



The MatchID DIC course

MatchID, one of the partners, offered an intensive 5-day course on Digital Image Correlation (DIC), focusing on the system's basic principles, functionalities, result interpretation, and error measurement. The course blended theoretical lectures with hands-on lab sessions and individual data analysis. Participants learned advanced techniques, including high-speed imaging and model validation strategies, which enhanced their skills for producing accurate, quantitative results.
The 2021 edition took place from January 25th to 29th, with several project partners being involved.

Webinar

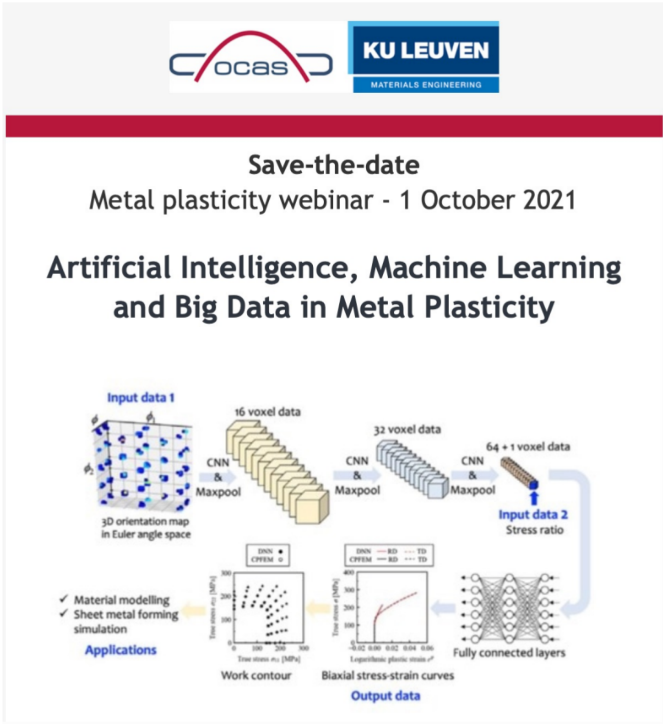
On October 1, 2021 the Webinar titled "Artificial Intelligence, Machine Learning and Big Data in Metal Plasticity," will take place.
Hosted by OCAS and KU Leuven, it will discuss the integration of AI and Machine Learning techniques in the field of metal plasticity, showcasing how large datasets can be used to enhance material modeling and simulation applications.

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

The poster related to this event is shown below:



Partners

University of Aveiro (UAVR)

University of South Brittany (UBS)

KU Leuven (KUL)

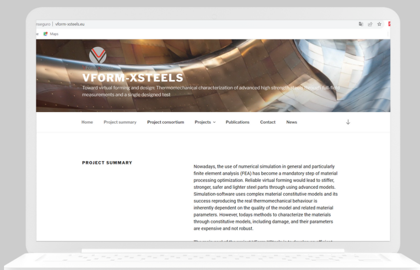
MatchID (MID)

Università Politecnica delle Marche (UNIVPM)

DAF TRUCKS NV (DAF)

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/