DMP title

Project Name A GREY-BOX APPROACH FOR ROBUST RESISTANCE PRESSURE WELDING MONITORING

Project Identifier C24E/21/026

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Description The project aims at combining experimental and numerical data in the creation of a robust digital twin for resistance pressure welding processes. We investigate how to deal with the large discrepancies in cost for generating data points as well as evaluating white and black-box models, in order to build an efficient grey-box model. Specific point of attention is the reliability of the model, especially where strong extrapolation is required. Experimental data will be collected for model validation, black-box model generation and refinement, weld quality assessment and process monitoring. Numerical data will be generated for weld process simulation, and mirroring.

Institution KU Leuven

1. Data Description

What data will you collect or create? Fill out the table below and/or describe.

Type of data	Format	Volume	How created?
1. Numerical first principle models	Ansys workbench <.wbdb>	300-400 MB	Models made in ANSYS by the applicants
2. Generated results of the models and data of the UQ methods	Comma Separated Values-files <.csv>, Matlab structure <.mat>	500 MB	Computer generated data after running the established models
3. Uncertainty quantification method and process optimization algorithms	Matlab functions/scripts <.m>, Python scripts <.py>	10 MB	Computer scripts written by the applicants
4. Signals acquired of the RW test bench for validation	Comma Separated Values-files <.csv>, Matlab structure <.mat>	10 GB	Measurements of force, displacement, temperature of the electrodes and current and voltage during welding
5. Quality measurement of the welded samples : UT bitmap and morphology characteristics of the weld nugget	Excel <.xlsx>, Comma Separated, Values-files <.csv>, Matlab structure <.mat>	100 MB	Measurement of the nugget diameter by ultrasonic sensor and tensile shear strength of welded joints
6. Cross-section spot weld imagery	Graphic files <.png, .jpeg, .svg>	5 GB	Raw and processed images obtained after microscopy of the cross-section of the welded joints

Do you intend to reuse existing data?

No reuse of existing data is intended.

Do you use personal data (i.e. all data possibly identifying an individual)?

- No

2. Documentation and Metadata

Describe the documentation that will be created for the data. This section deals with the way in which you will document how the dataset was created and subsequently processed.

1. All numerical simulations will be documented in terms of constraints (loading conditions), used coupling techniques, initial conditions, considered materials. The input files will be attached in a similar folder. The used command snippets will be included and provided with in-line comments clarifying their use.
2. Raw simulation data collected from the simulations tests and processed data generated from the UQ methods scripts. A description of what these data represent and how they were generated will be enclosed.
3. Every script is documented using in-line comments explaining the use of certain lines of code. A ReadMe file will give an overview of the general purpose and organization of all individual Matlab or Python scripts. This will also include a general overview of the methodology and underlying algorithms implemented in these scripts.
4. Besides datasheets of the used sensors and acquisition equipment, an overview of the lay-out of the measurement set-up will explain the data generation in detail in a measurement report. This report consists of enough detail to enable recreation of the experiment. Additionally, a ReadMe file will clarify the general structure of the structured data-files (<.csv> and <.mat>).
5. Datasheets of both the ultrasonic sensor and tensile bench are provided. The procedure of testing and general structure of the data is listed in the corresponding ReadMe file.
6. The dimensions and pre-processing of the samples and microscope settings will be described in detail in a ReadMe file of the image collection. Details of different steps of the pre-processing of the welded samples will make sure that the images can be recreated with different welded joints.

Describe the metadata for the data. This section deals with metadata: information contained in your dataset about the research data.

Metadata delivered by the testing equipment is stored automatically as provided by the instruments with the data files. This is applicable to the in-house equipment that will be used in the project:

- data acquisition using DEWETRON data logger
- images generated with Phantom VEO 640L high speed cameras
- ultrasonic testing results (instrument to be acquired during project)
- images from TESCAN and KEYENCE microscopes
- mechanical testing using INSTRON tensile benches

Numerical model input and output files will be documented using metadata as provided by the commercial software codes used in the project. Where possible, all related data are stored in the standard hdf5 format providing information on model geometry, boundary conditions, applied material models and parameters, solver settings and parameters and analysis results.

Additional custom metadata will be created for experimental data related to new features developed in the project:

- absolute time records of acquired data and images gathered in the on-line process monitoring, allowing synchronization
- experimental conditions for all generated weld samples (electrode geometry, sample dimensions, sample material)
- testing conditions for the (non-)destructive weld quality assessment tests

3. Ethical, Legal and Privacy Issues

Are there any ethical issues concerning the creation and/or use of the data?

No

Did you consider all issues about copyrights and IPR?

No copyright or IPR issues are expected.

Are the collected data considered to be â€œdata containing personal informationâ€ and are all the requirements about the collection of these data met?

The collected data does not include personal data in any form.

4. Data storage and Backup during Research

How and where will the data be stored during research?

- Centrally on storage facilities of the research unit
- Centrally on storage facilities of the university
- In a cloud service offered by the university
- In an external cloud service

Which back-up procedures are in place?

KU Leuven cloud using OneDrive takes automatic back-ups.

Describe the data security procedures and who has access to the data.

Data stored on the cloud solutions of KU Leuven are only accessible for people within the project, who need to be logged in with their personal account. Files on personal computers and not yet included in cloud systems will be transferred with Belnet sender, a secured file transferrer in KU Leuven.

The data doesn’t contain any personal data or trade secrets, so no extra security procedures are taken.

5. Data selection and Preservation after Research

What is the long-term preservation plan for these dataset(s)?

All data generated within this project will be stored in the ‘Archive storage’ drives of KU Leuven ICTS for a period of 10 years.

Data Selection: Which data will have long time value for the research and will be preserved?

Fully developed models and extensive datasets of signals during welding and weld joint characteristics will be preserved. These are of high value as they are time consuming to replicate and consist of state-of-the-art techniques.

6. Data Sharing

Are there any restrictions for sharing the data?

Extensions to the existing state-of-the-art in numerical modelling weld processes (add-ons, additional scripts) as well as new approaches for mixture of experimental and modelling data for on-line process monitoring will be shared only to the extent that this does not hinder future exploitation of the generated IP.

If there are no restrictions, which mechanisms will be in place to assure that the data are discoverable, accessible and intelligible?

NA

How will you share the data?

- Website

Numerical models of the welding process implemented and applicable in currently available state-of-the-art commercial software as used in publications will be shared upon request through our website.

Experimental measurement data from welding and (non-)destructive testing will be shared in the same way.

With whom will the data be shared?

- On request

Access will be considered after a request is submitted explaining the planned reuse. Only uses for research purposes will be allowed and commercial reuse will be excluded.

7. Responsabilities and Resources

Who is responsible for Data Management during the project? This will be the person who might receive questions on the data management aspects of the research project.

The PI's hold the end responsibility.

Which additional resources are needed for the execution of the Data Management Plan?

None.

Did you read the KU Leuven Data Management Policy? (find the link to the policy in the guidance).

- Yes