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## Plan Overview

*A Data Management Plan created using DMPonline.be*

**Title:** A testing platform for 4D-XCT of materials and biological tissues, a software toolbox for image enhancement and processing, and a database of XCT datasets and imaging protocols

**Creator:** n.n. n.n.

**Principal Investigator:** Jeroen Soete, n.n.

**Data Manager:** Jeroen Soete, n.n.

**Project Administrator:** Jeroen Soete, n.n.

**Affiliation:** KU Leuven (KUL)

**Funder:** KU Leuven (KUL)

**Template:** KU Leuven BOF-IOF

**Principal Investigator:** Jeroen Soete, n.n. n.n.

**Data Manager:** Jeroen Soete, n.n. n.n.

### Project abstract:

In the KU Leuven XCT Core Facility, the research partners have developed different in-situ testing rigs and software tools, currently tailored for fundamental research, for generating and processing data of 4D-XCT (time-resolved) experiments on different kinds of materials and biological tissues (such as composites, polymers, ceramics, metals, concrete, fruit and vegetables, bone tissue, explants, dental materials, and teeth). This project will manage and transition these tools and know-how from fundamental research-oriented functionality to broader applicability for third parties, being researchers and industrial partners. It will enable us to translate the developed tools, data, and know-how and to make it easily accessible to the worldwide community to resolve applied and interdisciplinary research questions in a wide range of materials and sectors (transport and energy sector, building industry, geology, food industry, biomedical industry, microelectronics, sport, and hospitals).

**ID:** 211921

**Start date:** 01-07-2024

**End date:** 30-06-2027

**Last modified:** 11-01-2025

## A testing platform for 4D-XCT of materials and biological tissues, a software toolbox for image enhancement and processing, and a database of XCT datasets and imaging protocols

### Research Data Summary

List and describe all datasets or research materials that you plan to generate/collect or reuse during your research project. For each dataset or data type (observational, experimental etc.), provide a short name & description (sufficient for yourself to know what data it is about), indicate whether the data are newly generated/collected or reused, digital or physical, also indicate the type of the data (the kind of content), its technical format (file extension), and an estimate of the upper limit of the volume of the data.

Dataset name / ID	Description	New or reuse	Digital or Physical data	Data Type	File format	Data volume	Physical volume
		<i>Indicate: N(ew data) or E(xisting data)</i>	Indicate: D(igital) or P(hysical)	Indicate: Audiovisual Images Sound Numerical Textual Model SOftware Other (specify)		Indicate: <1GB <100GB <1TB <5TB >5TB NA	
Standard operation protocols	4D-XCT imaging with in-situ stages and digital volume correlation	N	D	Other: written protocols	.docx	<1 GB	
3D images from CT	3D volumetric data acquired from lab-scale computed tomography (CT) and beamtime experiments.	N and D	D	I	.tiff	>5TB	
Mechanical testing results	Mechanical Testing Results from In-situ Rigs:	N and D	D	N	.csv .xls .xlsx	<1GB	
Avizo project files	Results from 3D an 4D image processing	N and D	D	SO	.hx	<100GB	
Algorithms and software	Image processing tools	N and D	D	SO & M	.m .pyscro	<1GB	
Finite element models	Constitutive models that incorporate calculated material properties	N and D	D	SO & M	.vtxvol .stl .vtk .vrml .odb .cae	<100GB	

If you reuse existing data, please specify the source, preferably by using a persistent identifier (e.g. DOI, Handle, URL etc.) per dataset or data type:

We will re-use internal data that has not been published yet. We therefore cannot list the identifiers at this stage.

**Are there any ethical issues concerning the creation and/or use of the data (e.g. experiments on humans or animals, dual use)? If so, refer to specific datasets or data types when appropriate and provide the relevant ethical approval number.**

- Yes, animal data (Provide ECD reference number below)
- Yes, dual use (Provide approval number below)

We will use animal data and handle dual-use goods. The necessary ethics requirements are already in place as part of the projects of the contributing PIs, so we don't need separate approvals.

**Will you process personal data? If so, please refer to specific datasets or data types when appropriate and provide the KU Leuven or UZ Leuven privacy register number (G or S number).**

- No

**Does your work have potential for commercial valorization (e.g. tech transfer, for example spin-offs, commercial exploitation, ...)? If so, please comment per dataset or data type where appropriate.**

- No

**Do existing 3rd party agreements restrict exploitation or dissemination of the data you (re)use (e.g. Material or Data transfer agreements, Research collaboration agreements)? If so, please explain in the comment section to what data they relate and what restrictions are in place.**

- No

**Are there any other legal issues, such as intellectual property rights and ownership, to be managed related to the data you (re)use? If so, please explain in the comment section to what data they relate and which restrictions will be asserted.**

- No

## **Documentation and Metadata**

**Clearly describe what approach will be followed to capture the accompanying information necessary to keep data understandable and usable, for yourself and others, now and in the future (e.g. in terms of documentation levels and types required, procedures used, Electronic Lab Notebooks, README.txt files, codebook.tsv etc. where this information is recorded).**

To ensure data remains understandable and reusable, the following approach will be followed for X-ray Computed Tomography Volumes. Metadata will include sample type, layout, dimensions, load and displacement for each in-situ scan. Scan settings (source and detector specifications, voltage, current, exposure time, number of projections, averaging procedures, voxel size, source-to-object distance, and source-to-detector distance) are (automatically) generated during the experiment and saved as .pca or .txt files. The data will be organised into structured folders (e.g., raw data, processed data, scripts) with consistent file naming conventions, including project name, data type, and date (e.g., XCT\_Sample1\_20241225). All experimental observations, settings, and key analysis steps will be systematically logged in an Electronic Lab Notebook, supplementing the metadata for each data type. All other data types (Avizo and in-situ rig data) will be directly linked to a particular XCT scan, and therefore immediately have the required metadata. In addition, detailed manuals/guides/demos are provided, explaining the workflow of experiments. The data and procedures are published in peer-reviewed international journals. Involved collaborators and companies are updated through scheduled meetings. A wider audience will be addressed through oral and poster presentations on scientific symposia.

**Will a metadata standard be used to make it easier to find and reuse the data?  
If so, please specify which metadata standard will be used.**

**If not, please specify which metadata will be created to make the data easier to find and reuse.**

- Yes

Metadata generation is performed automatically for the computed tomography operations (1) and (2), e.g., generation of the 'scan settings.txt' or .pca files through the XCT acquisition software. For TIFF file extensions, we will follow the ISA-Tab standard. For the XCT data, we will follow the NeXus standard, which was specifically developed for this data type.

Manually generated structural or descriptive metadata will be provided as ASCII files, containing all settings and technical descriptions of the experiment or simulation. The metadata is provided in a structured manner, following the Dublin Core (DC) metadata standard, which provides the following standard elements in three categories:

- Content: Title, description, subject, relation, source, coverage and type
- Intellectual property: Creator, contributor, publisher and rights
- Instantiation: date, language, identifier, format and software

The DC metadata standard will be modified/extended to match experiment/simulation specific needs.

## **Data Storage & Back-up during the Research Project**

**Where will the data be stored?**

- ManGO
- OneDrive (KU Leuven)
- Large Volume Storage
- Other (specify below)

OneDrive will be used only for the smaller files, coming from in-situ rigs and Avizo project files. Other data will be backed up using multiple copies on local PCs, hard drives and NAS's already available in the groups of the various PIs involved.

**How will the data be backed up?**

**Is there currently sufficient storage & backup capacity during the project?**

**If no or insufficient storage or backup capacities are available, explain how this will be taken care of.**

- Yes

All PIs already store large quantities of XCT data for their existing projects, so they have the necessary storage available.

**How will you ensure that the data are securely stored and not accessed or modified by unauthorized persons?**

Data on hard drives and NAS's will be encrypted and password protected. OneDrive and ManGO are also password protected.

**What are the expected costs for data storage and backup during the research project? How will these costs be covered?**

No additional costs expected beyond what is already foreseen in the XCT Core Facility (2 LVS contracts) and in the other projects of the PIs.

## **Data Preservation after the end of the Research Project**

**Which data will be retained for 10 years (or longer, in agreement with other retention policies that are applicable) after the end of the project?**

**In case some data cannot be preserved, clearly state the reasons for this (e.g. legal or contractual restrictions, storage/budget issues, institutional policies...).**

- All data will be preserved for 10 years according to KU Leuven RDM policy
- All data will be preserved for 25 years according to CTC recommendations for clinical trials with medicinal products for human use and for clinical experiments on humans

All mentioned datasets will be preserved for at least 10 years, or 25 years where this is needed.

**Where will these data be archived (stored and curated for the long-term)?**

- Large Volume Storage (longterm for large volumes)

The various PIs have different data storage practices, depending on their own preferences and the quantity of the required storage. Some PIs use multiple copies on hard drives, whereas others use Large Volume Storage or NAS.

**What are the expected costs for data preservation during the expected retention period? How will these costs be covered?**

The costs for hard drives, NAS, and Large Volume Storage are accounted for in the XCT Core Facility and other projects of the PIs. This translation project will mainly work on that existing data.

## **Data Sharing and Reuse**

**Will the data (or part of the data) be made available for reuse after/during the project?  
Please explain per dataset or data type which data will be made available.**

- Yes, as open data
- Other (specify below)

We will publish the data as much as possible as open data.

**If access is restricted, please specify who will be able to access the data and under what conditions.**

not applicable

**Are there any factors that restrict or prevent the sharing of (some of) the data (e.g. as defined in an agreement with a 3rd party, legal restrictions)?**

**Please explain per dataset or data type where appropriate.**

- No

We will not have any limitations in terms of the dual use or ethical aspects in terms of data sharing.

**Where will the data be made available?**

**If already known, please provide a repository per dataset or data type.**

- Other data repository (specify below)

Zenodo or Mendeley Data

**When will the data be made available?**

- Upon publication of research results

As soon as the corresponding publication has been accepted.

**Which data usage licenses are you going to provide?**

If none, please explain why.

- CC-BY 4.0 (data)
- GNU GPL-3.0 (code)

**Do you intend to add a persistent identifier (PID) to your dataset(s), e.g. a DOI or accession number? If already available, please provide it here.**

- Yes, a PID will be added upon deposit in a data repository

**What are the expected costs for data sharing? How will these costs be covered?**

There will be no costs for data sharing.

## **Responsibilities**

**Who will manage data documentation and metadata during the research project?**

Yentl Swolfs and Jeroen Soete

**Who will manage data storage and backup during the research project?**

Yentl Swolfs and Jeroen Soete

**Who will manage data preservation and sharing?**

Yentl Swolfs and Jeroen Soete

**Who will update and implement this DMP?**

Yentl Swolfs and Jeroen Soete