Plan Overview

A Data Management Plan created using DMPonline.be

Title: Advanced insights into reinforcement corrosion and related concrete cracking through multi-physics LDPM simulation and 4D visualization

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Project Administrator: Els Verstrynge

Affiliation: KU Leuven (KUL)

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Template: FWO DMP (Flemish Standard DMP)

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Project abstract:

Recent collapses of degrading reinforced concrete (RC) structures have raised international awareness on the vulnerability of ageing infrastructure. Many severe cases of degradation are due to aggressive pitting corrosion of the reinforcing steel, caused by chloride penetration. As most research focuses either on chloride transport in concrete or on structural effects of rebar corrosion, an important research challenge lies in bridging these scales to advance our fundamental understanding of the interaction between the RC layout, chloride ingress, and corrosion damage. In this project, we will develop and experimentally validate multi-physics lattice discrete particle models (M-LDPM) that couple the mechanical analysis with reactive transport models, to study the spatial and temporal variability of the corrosion process in relation to concrete heterogeneities. Advanced 4D visualization techniques are applied for validation of the M-LDPM simulations. X-ray Computed Tomography (XCT) is used to characterize the inner structure of small RC samples as input for sample-specific M-LDPM, and 4D-XCT visualizes the kinetics of the corrosion process in space and time during natural corrosion tests. At the larger scale, RC prisms are subjected to accelerated corrosion and monitored with 4D Acoustic Emission (AE) sensing. RC samples with various layouts are tested to validate M-LDPM that account for randomly distributed aggregates and discrete pre-existing mechanical cracks.

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Application DMP

Questionnaire

The questions in this section should only be answered if you are currently applying for FWO funding.
Are you preparing an application for funding?

- Yes

Describe the datatypes (surveys, sequences, manuscripts, objects …) the research will collect and/or generate and /or (re)use. (use up to 700 characters)

The data generated consists of general measurement data acquired during standard tests (mechanical and transport properties of the materials) and corrosion testing (crack width measurements, pictures, pit dimensions) next to displacement and strain fields derived from digital image correlation (tif files) as well as specific datatypes associated with XCT scanning (images, data files) and acoustic emission monitoring (AE signals in time and frequency domain). M-LDPM numerical modelling will require three types of data, C++ code in relation to modified or new features (*.cpp and* .h files), model input files (text files of format *.mrs). Simulations are excepted to generate vast data files including time history data on monitoring quantities and full 3D data on nodes and facets including degrees of freedom and state variables. The latter are stored as paraview files.

Specify in which way the following provisions are in place in order to preserve the data during and at least 5 years after the end of the research? Motivate your answer. (use up to 700 characters)

During the research, experimental data, raw generated data and codes are managed by each of the three researchers, in consultation with the supervisors. Processed data and models are brought together in a protected, online data platform managed by KU Leuven (responsible: E. Verstrynge) to enhance research interactions and joint publications. This platform will also host meeting reports.
After the research, each of the supervisors remains responsible for the preservation of the raw data: E. Verstrynge for experimental data, R. Wan-Wendner for numerical data and codes (stored in a UGent git repository and fileservers for the raw data), respectively. The joint, processed data repository is stored at both institutes.

What's the reason why you wish to deviate from the principle of preservation of data and of the minimum preservation term of 5 years? (max. 700 characters)

/

Are there issues concerning research data indicated in the ethics questionnaire of this application form? Which specific security measures do those data require? (use up to 700 characters)

NA

Which other issues related to the data management are relevant to mention? (use up to 700 characters)

NA

For whom might your data be useful outside of the research project, e.g. researchers or other stakeholders? How will you share this data?

Other researchers working on similar topics: processed data will be shared through scientific publications, other data made available upon request.

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DPIA

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Have you performed a DPIA for the personal data processing activities for this project?

- Not applicable

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GDPR

GDPR

Have you registered personal data processing activities for this project?

- No

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FWO DMP (Flemish Standard DMP)

1. 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.

				Only for digital data	Only for digital data	Only for digital data	Only for physical data
Dataset Name	Description	New or reused	Digital or Physical	Digital Data Type	Digital Data format	Digital data volume (MB/GB/TB)	Physical volume
EXPERIMENTAL PART							
WP2							
Samples WP2	Reinforced concrete and mortar samples for accelerated and natural corrosion tests	New	Physical				12 small-scale reinforced concrete or mortar samples (cylinders diameter 32 mm, height 50 mm)
Standard tests WP2	Standard concrete and mortar samples for material characterization	New	Physical				Min. 3 concrete cubes (150x150x150 mm3) per concrete batch Min. 3 concrete prisms (150x150x600 mm3) per concrete batch Min. 3 mortar beams (40x40x160 mm3) per mortar batch Small-scale mortar and concrete cylinders (diameter 32 mm, height 50 mm) for chloride profile determination

Observations WP2	Additional observations and measurements made during the tests of WP2, this includes crack measurements, results from standard tests and other related observations/measurements	New	Digital	Observational/experimental	.xlsx	< 100 MB	
Raw XCT scans WP2	Raw scans obtained with X-ray computed tomography of accelerated and natural corrosion tests	New	Digital	Experimental, images	.jpg or .tiff	< 1 TB	
Processed XCT scans WP2	Processed scans obtained with X-ray computed tomography, processed means after filtering and image enhancement	New	Digital	Experimental, images	.jpg	< 1 TB	
Pictures WP2	Pictures taken from small-scale samples during testing	New	Digital	Experimental, pictures	.jpg	< 1 GB	
Algorithms WP2	Various algorithms for data processing in Matlab	New	Digital	Software	.m	< 100 MB	
WP3							
Samples WP3	Reinforced concrete prisms for accelerated corrosion tests	New	Physical				18 reinforced concrete prisms (200x150x800 mm3)
Standard tests WP3	Standard concrete samples for material characterization	New	Physical				Min. 3 concrete cubes (150x150x150 mm3) per concrete batch Min. 3 concrete prisms (150x150x150 mm3) per concrete batch
Observations WP3	Additional observations and measurements made during the tests of WP3, this includes crack measurements, results from standard tests and other related observations/measurements	New	Digital	Observational/experimental	.xlsx	< 100 MB	
Raw AE data WP3	Raw acoustic emission data in original software	New	Digital	Experimental	.pridb and .tradb	< 100 GB	
Processed AE data WP3	Processed acoustic emission data in Matlab, processed means after filtering	New	Digital	Experimental	.mat	< 100 GB	
Pictures WP3	Pictures taken from reinforced concrete prisms during testing	New	Digital	Experimental, pictures	.jpg	< 1 GB	
Algorithms WP3	Various algorithms for data processing in Matlab	New	Digital	Software	.m	< 100 MB	
MODELLING PART							
WP1							
M-LDPM framework WP1	Implementation of extended LDPM framework	New	Digital	Modelling	various, TBD	<1TB	

WP2							
M-LDPM WP2	Multi-physics lattice discrete particle models of the XCT samples of WP2	New	Digital	Modelling	various, TBD	<1TB	
WP3							
M-LDPM WP3	Multi-physics lattice discrete particle models for corrosion-induced concrete cracking of RC prisms of WP3	New	Digital	Modelling	various, TBD	<1TB	

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:

Martens, Constantijn; Vandecruys, Eline; Van Steen, Charlotte; Nasser, Hussein; Verstrynge, Els, 2024, "KUL-edCCRC: Experimental Datasets for Concrete Cracking due to Reinforcement Corrosion", https://doi.org/10.48804/WO62A4, KU Leuven RDR, V1

Are there any ethical issues concerning the creation and/or use of the data (e.g. experiments on humans or animals, dual use)? Describe these issues in the comment section. Please refer to specific datasets or data types when appropriate.

- No

Will you process personal data? If so, briefly describe the kind of personal data you will use in the comment section. Please refer to specific datasets or data types when appropriate.

- 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/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

2. 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).

Data are saved in standard file types (e.g. Office), an overview of available datasets is made at the end of the project and saved together with the data on KU Leuven servers. In case of more comprehensive data types or coding (e.g. Matlab), readme files and comment lines will be foreseen within the code.

Will a metadata standard be used to make it easier to find and reuse the data? If so, please specify (where appropriate per dataset or data type) which metadata standard will be used. If not, please specify (where appropriate per dataset or data type) which metadata will be created to make the data easier to find and reuse.

- No

3. Data storage & back-up during the research project

Where will the data be stored?

During the research, raw generated data and codes are managed by each of the two researchers at the partner institutes, in consultation with their supervisors. Processed data and models are brought together in a protected, online data platform managed by KU Leuven (responsible: E. Verstrynge) to enhance research interactions and joint publications. This platform will also host meeting reports.

How will the data be backed up?

During the research, raw generated data and codes are managed by each of the two researchers at the partner institutes, in consultation with their supervisors. Each researcher is responsible for backup of their PC on their respective host servers.

Is there currently sufficient storage & backup capacity during the project? If yes, specify concisely.
If no or insufficient storage or backup capacities are available, then explain how this will be taken care of.

- Yes

All partners have decent backup facilities and server space.

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

All partners have decent/protected backup facilities and server space.
The collected data does not contain sensitive or personal information. Therefore, no specific security measures are taken.

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

A few 100 euro/year, covered by the project funding

4. Data preservation after the end of the research project

Which data will be retained for at least five 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...).

Processed data and models are brought together in a protected, online data platform managed by KU Leuven (responsible: E. Verstrynge) to enhance research interactions and joint publications. This platform will also host meeting reports.
After the research, each of the supervisors (E. Verstrynge, R. Wan-Wendner) remains responsible for the preservation of the raw data. In addition, the structure of the joint data repository is optimized to ensure maximum preservation and reusability of data in future projects.

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

KU Leuven and UGent backup servers.

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

100 euro/year, covered by other project funding

5. Data sharing and reuse

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

- Yes, in a restricted access repository (after approval, institutional access only, …)

After the research, each of the supervisors remains responsible for the preservation of the
raw data. In addition, the structure of the joint data repository at KU Leuven is optimized to ensure maximum preservation and reusability of data in future projects.
An open access repository is under consideration, yet will depend on the project results.

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

Members of the research groups of E. Verstrynge and R. Wan-Wendner if they need it for their research.

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 in the comment section per dataset or data type where appropriate.

- No

Where will the data be made available? If already known, please provide a repository per dataset or data type.

If an open access repository is set up, it may likely be RDR. Others are possible and will be considered.

When will the data be made available?

After publication of the research results.

Which data usage licenses are you going to provide? If none, please explain why.

Not yet known.

Do you intend to add a PID/DOI/accession number to your dataset(s)? If already available, you have the option to provide it in the comment section.

- Yes

If an open access repository is set up, a DOI will be linked.

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

Deposition of smaller datasets in data repositories is usually covered by the repository. For sharing physical data, the cost is typically paid by the researcher requesting the materials.

6. Responsibilities

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

The researchers under supervision of their promotors.

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

The researchers under supervision of their promotors.

Who will manage data preservation and sharing?

The promotors.

Who will update and implement this DMP?

The researchers under supervision of their promotors.