
Micro-disturbances in compact hybrid magnetically suspended flywheel systems

A Data Management Plan created using DMPonline.be

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Project abstract:

Flywheel systems are often the primary source of undesired vibrations aboard satellite platforms, degrading the overall pointing stability and performance. With recent developments in satellite earth observation and laser communication, the reduction of micro-disturbance sources has become a driving factor in the development of silent flywheel systems. The growing interest in smaller satellite platforms introduces additional challenges in terms of solution compactness and cost-efficiency. This research project investigates a novel compact magnetic suspended flywheel system, characterised by low microvibration emission, using permanent magnetic bearing technology. The application potential of compact silent flywheel systems reaches far beyond the space industry, including use as artificial stabilisers for mobile robotics, compact energy storage systems and rotor support in turbomachinery. The first step of this research is the numerical modelling of the structural dynamic behaviour and disturbance sources to characterise the microvibration emission of the proposed flywheel configuration. The subsequent step involves the reduction of these micro-disturbances through off-line and on-line balancing techniques. Finally, the effectiveness of using a hybrid levitation system, consisting of passive and active magnetic bearings, is investigated to suppress remaining disturbance sources.

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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
Rotor dynamic simulations	Simulations in MATLAB & Simulink	Generate new data	Digital	Simulation data & Software	.m, .mat, .dat, .fig, .jpg, .mp4, .gif	<100GB	NA
Finite-element simulations	Electromagnetic finite element simulations in Ansys Maxwell	Generate new data	Digital	Simulation data	.aedt, .csv	<5TB	NA
CAD Models	CAD Models & Technical drawings for the design of the prototype	Generate new data	Digital	Other	.par, .asm, dft, .stl	<100GB	NA
Unprocessed vibration measurement data	Readout of accelerometers, force transducers, and other sensors	Generate new data	Digital	Observational & Experimental	.lms, .csv	<5TB	NA
Processed vibration measurement data	Processed data in Matlab	Generate new data	Digital	Experimental & Software	.m, .mat, .dat, .fig, .jpg, .xlsx	<100GB	NA
Flywheel prototype	Prototype flywheel, magnetic bearings,..	Generate new data	Physical	Experimental	NA	NA	< 1 m ³
Test setups	Test setups, dedicated test rigs, test equipment,..	Generate new data	Physical	Experimental	NA	NA	< 3 m ³

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:

No

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.

- Yes

Our project holds commercial potential through algorithm development for vibration reduction and prototype demonstration of new bearing technology for flywheels. LRD will be consulted before disseminating data.

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).

1. Code for simulations and data processing is accompanied by:

- A README.txt file explaining the code's purpose, inputs, outputs, connection to other files, assumptions, scope
- Documentation heading explaining the code's purpose, inputs, outputs, assumptions, and paper on which it is based
- Comments throughout the code for clarification
- Clear data structure to store all code

2. Each newly generated data set is accompanied by an experiment report which describes/contains:

- A logbook containing the data acquisition settings and measurement procedures
- Goal of the experiment
- Overview of the operational conditions, including images of the test setup
- Structure of the generated data (folder structures and file names)

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?

- All code, simulation data and project files are version-controlled and stored on the hard drive of the researcher's computer and uploaded to GitLab and OneDrive.
- Small simulation files and measurement data are stored on the hard drive of the researcher's computer and uploaded to GitLab and OneDrive.
- Large simulation files and measurement data can be saved on an external hard drive and on a large volume storage: a shared file system available to members of the group via PCs and laptops managed by ICTS KU Leuven or our local KU Leuven IT department.

How will the data be backed up?

Digital data

- GitLab and OneDrive
- Standard back-up provided by KU Leuven ICTS.
- Back-up on external hard drive

Non-digital data

- Material is stored in a secure lab at the KU Leuven.

**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

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

The project will not use any personal data. All generated data is stored securely on KU Leuven's servers (GitLab, OneDrive) and behind proper authentication. During the project, the researcher and the promotor will evaluate how and when to share data. Sharing of data will occur through a secure channel such as Belnet Filesender.

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

- Data storage costs on GitLab and OneDrive and hard drive capacity on the research laptop are covered by the internal ICT contributions.
- The cost of large-volume storage (€ 104,42 / TB / year) and storage on the external hard drive (estimated € < 70 / TB) will be covered by available internal funds.

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...).

All data will be retained and possibly reused for future research projects for at least 10 years.

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

The data will be stored on the external hard drives and on the large volume storages. Additionally, the dataset, code and documentation will be deposited in the KU Leuven Research Data Repository.

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

The cost of large-volume storage (€ 104,42 / TB / year) will be covered by available internal funds.

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, ...)

The full dataset and code and documentation will be deposited in the KU Leuven Research Data Repository.

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

Members of the research group will be able to access the data. In future, the data can be shared in possible collaborations with other researchers/research groups.

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.

The full dataset and code and documentation will be deposited in the KU Leuven Research Data Repository.

When will the data be made available?

Datasets and software will be published and released as soon as we see fit and definitely upon publication of the research results.

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

We will provide the Creative Commons Attribution (CC-BY-4.0) license. This is the standard creative commons license that gives

others maximum freedom to do what they want with our work (they are free to share and adapt), but they need to give appropriate credit and indicate if changes were made.

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

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

The cost for data sharing in the RDR are covered by the institution's internal ICT contributions. If publishers require datasets to be stored elsewhere, related costs are expected to be marginal since individual publications are not accompanied by very large amounts of data (expected <10GB per publication). These costs will then be covered by the project's consumable budget.

6. Responsibilities

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

The researcher is responsible for code and datasets with proper metadata.

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

The researcher is responsible for data storage & back up during the project. This is supervised by Dirk Vandepitte, the promotor.

Who will manage data preservation and sharing?

The researcher is responsible for ensuring data preservation and reuse. This is supervised by Dirk Vandepitte, the promotor.

Who will update and implement this DMP?

The researcher bears the end responsibility of updating & implementing this DMP.