
Plan Overview

A Data Management Plan created using DMPonline

Title: Investigation of the properties and behaviour of magnetically sensitive bodies and fluids for the design of advanced bearing elements

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Project abstract:

The topical problem encountered by the engineers is to reduce amplitude of lateral vibration of rotors caused by material damping. This is offered by application of hydrodynamic bearings. However, they tend to induce subharmonic vibration of large amplitude, which occurs especially if the rotors are vertical. This undesirable vibration can be suppressed by integrating permanent magnetic bearings into the hydrodynamic ones or by application of controllable magnetorheological liquids as lubricants. The project investigations are focused on effect of radially magnetized permanent magnetic bearings on vibration stability of vertical rotors supported by hydrodynamic bearings, which is a new emerging problem that has not been researched yet, and learning on tribological properties of magnetorheological fluids, the knowledge of which is still insufficient. From the point of view of fundamental research, the problem is transformed to investigation of vibration of bodies separated by a thin layer of lubricant and flow of magnetorheological fluids, both under the effect of a magnetic field.

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Investigation of the properties and behaviour of magnetically sensitive bodies and fluids for the design of advanced bearing elements

Data Collection

What data will you collect or create?

- **Data types**

- Simulation results (numerical values, parameters).
- Training logs and evaluation metrics.
- Documentation and metadata for reproducibility.
- Visualizations (graphs, plots).
- Experimental data

Data formats

- npz, csv, txt, png, jpg, pdf, ps, eps, tex, py, tar.gz, tgz

Volume of data

- several units of MB for source files
- approximately 2 TB for training data (rough estimation)

Use and Reuse potential

Chosen formats and software usually enable sharing and long access of data. There is some exception for validation data which is usually realized on closed commercial software. Open Science principles will be followed to ensure the dataset, models, and results are reusable for researchers working on python, optimization, reduced models,...

Data description

- Generated from custom simulations using scientific computing frameworks (e.g., TensorFlow, PyTorch, JAX).
Pre-existing datasets from open repositories when necessary (e.g., CFD datasets, PDE solutions).

FAIR Principles Compliance

- **Findable:**

Metadata will be generated using standard formats (e.g., JSON, YAML). All datasets and code will have Digital Object Identifiers (DOIs) via Zenodo. Repository URLs and versions will be documented.

- **Accessible:**

Code and datasets will be openly available on public repositories (see Section 5). Data will be accessible for download without restrictions. Licensing will ensure proper attribution.

- **Interoperable:**

Standard formats such as CSV, NPZ and HDF5 will be used for numerical data. Python-based machine learning scripts will follow best practices to ensure cross-platform compatibility. Metadata will adhere to standards for metadata annotation (JSON, YAML).

- **Reusable:**

Open-source licenses will apply (Apache 2.0 or MIT for code, Creative Commons for data). The repository will include README files with full documentation. Jupyter Notebooks will provide examples for reproducibility.

Only open data with no third-party obligations or any confidential agreements will be published.

How will the data be collected or created?

- Data will be generated using common numerical simulations in PyTorch/JAX, TensorFlow, Scikit-Learn,...
- Pre-existing datasets from public sources will be processed and used when relevant.
- Workflows will be documented in GitHub repositories.
- Scripts for data preprocessing, training, and evaluation of models will be provided.

Documentation and Metadata

What documentation and metadata will accompany the data?

A comprehensive README.md file will be included in all repositories (GitHub, Zenodo, Kaggle) and will provide:

Project Overview: A brief description of the research, objectives, and the dataset's purpose.

Dataset Description: Explanation of the files, structure, and contents.

File Formats: List of formats used (e.g., CSV, HDF5, JSON, YAML) and how they should be interpreted.

Data Collection & Processing: Description of how the data was obtained, preprocessed, and transformed.

Usage Instructions: Steps on how to load, analyze, and use the dataset.

Dependencies: List of required software libraries (e.g., PyTorch, NumPy, Pandas).

License Information: Details about the dataset's licensing (CC BY 4.0 for data; MIT/Apache 2.0 for code).

How to Cite the Work: DOI reference (if published on Zenodo).

A structured metadata file in JSON, YAML, or Dublin Core XML format will accompany the dataset, containing the common items e.g.:

Title: "Investigation of the properties and behaviour of magnetically sensitive bodies and fluids for the design of advanced bearing elements"

Description: A summary of the dataset, including its purpose and key features.

Creators: Names, affiliations, and ORCID IDs of the researchers.

Versioning: Version number of the dataset.

Keywords: Relevant terms (e.g., "Physics-Informed Neural Networks", "Neural Operators", "Numerical Simulation", "Machine Learning for PDEs").

Creation Date: When the dataset was generated.

Data Sources: If external data was used, proper attribution will be given.

File Structure: Hierarchical organization of data files.

Variable Definitions: Description of columns and variables in CSV/HDF5 files (e.g., parameters of differential equations, loss metrics).

Licensing: Open Science licensing information.

Ethics and Legal Compliance

How will you manage any ethical issues?

- No personally identifiable information (PII) or sensitive data is included in this research.
- Compliance with Open Science policies to promote transparency and reproducibility.

How will you manage copyright and Intellectual Property Rights (IPR) issues?

Data published under FAIR principle will be considered the following IPRs

Code: MIT or Apache 2.0 License.

Data & Models: Creative Commons Attribution 4.0 (CC BY 4.0).

Documentation: Creative Commons Attribution 4.0 (CC BY 4.0).

Storage and Backup

How will the data be stored and backed up during the research?

- Primary storage will be GitHub Repository (for source code and small datasets). Large datasets will be stored on Zenodo, Kaggle and in CESNET repositories (for extra large during computational tasks).
- Google Drive or Microsoft cloud services will be used for temporary storage and backup.
- Regular backups are planned to prevent data loss.

How will you manage access and security?

- Public repositories will be used whenever possible to promote Open Science.
- Sensitive data is not expected in this project just now.
- GitHub repositories will have regular access controls and read/write permissions for collaborators.

Selection and Preservation

Which data are of long-term value and should be retained, shared, and/or preserved?

Raw and Processed Datasets

Raw Data:

Original simulation outputs (numerical results of PDEs, physical field values).

Saved in HDF5, CSV, or NPZ formats for accessibility and interoperability.

Stored in Zenodo, Kaggle, or institutional repositories with proper versioning.

Processed Datasets:

Cleaned, formatted data used for training models.

Includes feature engineering results, normalized datasets, and preprocessed inputs.

What is the long-term preservation plan for the dataset?

- Zenodo will be used for long-term archiving of datasets and research artifacts.
- Regular updates and issue tracking will be maintained in GitHub repositories.
- Repositories and publication DOIs will ensure persistent access.

Data Sharing**How will you share the data?**

Source Code: GitHub (<https://github.com>)

Repository with version control and documentation.

Datasets: Zenodo (<https://zenodo.org>) - For long-term storage and dataset persistence with DOI.

Kaggle (<https://www.kaggle.com>) - For publicly sharing datasets with an interactive environment.

Jupyter Notebooks and Documentation: GitHub/GitHub Pages.

Preprints and Publications:

arXiv (<https://arxiv.org>) - For publishing preprints related to project.

Are any restrictions on data sharing required?

- Code, datasets, models, and documentation will be publicly available on repositories like GitHub, Zenodo, and Kaggle.
- Licensing ensures proper citation but allows unrestricted reuse (e.g., MIT for code, CC BY 4.0 for data).
- No confidential, personal, or sensitive data is involved, so full public sharing is permitted.
- The dataset and models are intended for scientific research and educational purposes only.
- A disclaimer will be included in the documentation, stating that users are responsible for ethical use.
- If any third-party datasets (e.g., pre-existing PDE datasets) are used they must be licensed for open use and cited accordingly. Any restrictions on these external datasets will be clearly stated in the dataset metadata.

Responsibilities and Resources

Who will be responsible for data management?

Petr Sikora will be in role of Data Manager or Data Steward

What resources will you require to deliver your plan?

Storage and computing resources

| Resource Type | Details | Purpose |
|---------------|---------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| Cloud Storage | Github | Version control, sharing source code, documentation, metadata |
| | Zenodo | Long-term dataset and model preservation |
| | Kaggle | Public dataset hosting with built-in tools for exploration |
| | Google drive/Institutional Cloud | Backup and temporary storage of large files before final transfer |
| HPC | Institutional HPC cluster or cloud services (e.g., Google Colab, AWS, or local GPU servers) | Running large-scale simulations, training |
| Local Storage | At least 1-2 TB disk space | Temporary storage of raw and processed datasets before archival |

Software and Tools

| Tool/Platform | Purpose | Open Source |
|-------------------------|----------------------------------------------------------------------------|-------------|
| Programming | Python (PyTorch, TensorFlow, JAX) | Yes |
| Version control | Git, GitHub | Yes |
| Dataset management | Pandas, NumPy, HDF5, NetCDF for structured data handling | Yes |
| Metadata, Documentation | YAML, JSON for structured metadata files | Yes |
| Notebook Environment | Jupyter Notebooks for reproducibility and tutorials | Yes |
| Workflow Automation | Node-Red / Snakemake / Makefiles for dataset and model pipeline automation | Yes |
| Data Archiving | Zenodo API | Yes |
| Visualization | Matplotlib, Seaborn, Plotly for data visualization | Yes |

Funding and budget

| Cost Category | Estimated Requirements |
|-------------------|--------------------------------------------------------------------------------------------------|
| Storage | Free (Github, Zenodo, Kaggle) or 100EUR/year for institutional cloud storage |
| HPC/GPU | Free (Institutional Computing) or 5000EUR/year for Public Cloud Computing |
| Personal training | Optional workshops on FAIR principles, Github principles to keep up2date (1000 EUR for training) |
| DOI registration | Free |

