DMP 1S60222N

Project Name Stability and adaptive control of flapping wing nano air vehicles - DMP 1S60222N

Project Identifier 1S60222N

Grant Title 1S60222N

Principal Investigator / Researcher Thomas Roelandt

Project Data Contact Thomas Roelandt, 0478819778, thomas.roelandt@kuleuven.be

Description The stability of flapping wing fliers is poorly understood. This project investigates the parameters and phenomena that influence stability of flapping wing fliers, applied to a flapping wing nano air vehicle being developed at KU Leuven. A good understanding of flapping wing flier stability will improve vehicle performance, relax demands on the flight controller, improve agility in maneuvering flight, allow for adaptive control under changing conditions or after redesign. Sensitivity analyses both around trim conditions and of long free flights are performed through simulation. Simulation results are then verified through experiments. These experiments involve collecting sensor readings and visual footage of either a fixed or free flying flapping wing drone. Results of this project include a map of stability as a function of input parameters, a description of the mechanisms by which different input parameters influence stability, and an algorithm for self-updating the flight controller after design changes or changes in environmental conditions.

Institution KU Leuven

1. General Information

Name applicant

Thomas Roelandt

FWO Project Number & Title

1S60222N Stability and adaptive control of flapping wing nano air vehicles

Affiliation

- KU Leuven

2. Data description

Will you generate/collect new data and/or make use of existing data?

- Generate new data

Describe in detail the origin, type and format of the data (per dataset) and its (estimated) volume. This may be easiest in a table (see example) or as a data flow and per WP or objective of the project. If you reuse existing data, specify the source of these data. Distinguish data types (the kind of content) from data formats (the technical format).

Type of data	Format	Volume	How created
Simulation-generated data	.m, .mat, .dat, .fig, .jpg, .mp4, .gif	10-50GB	Simulations run in MATLAB & Simulink
Unprocessed sensor readings	.xlsx	max 1GB	Pin readings from Nordic Semiconductor nRF component
Processed sensor readings	.mat, .dat, .fig, .jpg, .xlsx	max 1GB	Filtering/interpreting/... of unprocessed sensor readings in MATLAB
Unprocessed images and videos	.jpg, .avi, .mp4	10-100GB	Readout from camera(s)
Processed images and videos	.jpg, .avi, .mp4	10-100GB	Image processing by use of GIMP and MATLAB image processing toolbox

3. Legal and ethical issues

Will you use personal data? If so, shortly describe the kind of personal data you will use. Add the reference to your file in KU Leuven's Register of Data Processing for Research and Public Service Purposes (PRET application). Be aware that registering the fact that you process personal data is a legal obligation.

- No

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, add the reference to the formal approval by the relevant ethical review committee(s)

- No

Does your work possibly result in research data with potential for tech transfer and valorisation? Will IP restrictions be claimed for the data you created? If so, for what data and which restrictions will be asserted?

- No

Do existing 3rd party agreements restrict dissemination or exploitation of the data you (re)use? If so, to what data do they relate and what restrictions are in place?

- No

4. Documentation and metadata

What documentation will be provided to enable reuse of the data collected/generated in this project?

1. Code for simulations and code for data processing is accompanied by: a README.txt file explaining the code's purpose, inputs, outputs, structure of the generated data, connection to other files, assumptions, scope; comments throughout the code for clarification. Units and a brief explanation are placed after the declaration of each variable.

2. Simulation data and sensor readings are accompanied by: a README.txt file with a description of dimensions, units and physical meaning of the data, date and conditions during data collection. Sensor readings are also accompanied by images and a description of the measurement setup.

3. Images and video footage of experiments are accompanied by: A description of the date and conditions under which the footage was collected; a description of the contents of the footage; images and a description of the experimental configuration itself

4. For each project there is: A README.docx that describes the project purpose and methodology, structure of all data folders in the project, links between all files and folders within the project.

5. File naming is done by consistently using the following structure: ProjectName_Description_ResearcherInitials_DDMMYYYY_Version. This structure is explained in a README.docx that accompanies each project. Any deviation from this naming structure is explained in the description of the appropriate data files.

Will a metadata standard be used? If so, describe in detail which standard will be used. If no, state in detail which metadata will be created to make the data easy/easier to find and reuse.

- No

To the researcher's knowledge there is no formally acknowledged metadata standard in the context of flapping wing fliers or aerial robotics. Therefore, it will be ensured that all metadata are described consistently throughout the project and are well documented. For any datasets where there is an interest to publish, it will be investigated if the use of domain-agnostic metadata standards (e.g. Data Package, DDI, Dublin Core) or metadata standards from possibly connected fields (e.g. Darwin Core) is feasible within the project.

5. Data storage and backup during the FWO project

Where will the data be stored?

All code, simulation-/measurement data and project files are version controlled and stored in GitLab and OneDrive. The choice for GitLab and OneDrive is made because the project does not

involve sensitive personal data and to facilitate collaboration, should an oportunity present itself. For the duration of each sub-project, data, code and project files are also stored on the researcher's computer hard drive. This hard copy serves as an easy access alternative for instances when there is no (secure) internet connection.

How is backup of the data provided?

Both storage locations (GitLab and OneDrive) have adequate backup strategies in place. The risks and loss of time associated with data loss or damage are mitigated by the use of multiple storage locations (GitLab, OneDrive, hard drive).

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 storage locations (GitLab, OneDrive, hard drive) have sufficient capacity to store all data of the entire project.

What are the expected costs for data storage and back up during the 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.

Data security: 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.

6. Data preservation after the FWO project

Which data will be retained for the expected 5 year period after the end of the project? In case only a selection of the data can/will be preserved, clearly state the reasons for this (legal or contractual restrictions, physical preservation issues, ...).

Simulation-generated/measurement datasets related to publications, code and metadata are stored in the KU Leuven Research Data Repository (RDR). The data within the RDR are openly available and linked to the publications through Lirias, ORCID and ResearchGate to maximize dissemination. Video footage to support publications and presentations are released on the project's YouTube channel. A copy of the video footage to support publications is stored in the RDR as well.

Where will the data be archived (= stored for the longer term)?

The retained data is archived in the KU Leuven RDR.

What are the expected costs for data preservation during the retention period of 5 years? How will the costs be covered?

The amount of preserved data is expected to not exceed 50GB. This amount of storage on the KU Leuven RDR is covered by the internal ICT contributions.

7. Data sharing and reuse

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

- No

No 3rd party agreements or legal restrictions will prevent the sharing of software or data.

Which data will be made available after the end of the project?

The full dataset and code and documentation will be deposited in the KU Leuven Research Data Repository and made available as open access.

Where/how will the data be made available for reuse?

- In an Open Access repository

The full dataset and code and documentation will be deposited in the KU Leuven Research Data Repository and made available as open access.

When will the data be made available?

- Upon publication of the research results

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

Who will be able to access the data and under what conditions?

The full dataset and code and documentation will be deposited in the KU Leuven Research Data Repository and made available as open access. Therefore, it will be available to anyone for any purpose, provided that they give appropriate credit to the creators.

What are the expected costs for data sharing? How will the 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.

8. Responsibilities

Who will be responsible for data documentation & metadata?

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

Who will be responsible for data storage & back up during the project?

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

Who will be responsible for ensuring data preservation and reuse ?

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

Who bears the end responsibility for updating & implementing this DMP?

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