Contributions of muscle mechanics and sensorimotor control to agile locomotion

A Data Management Plan created using DMPonline.be

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Template: KU Leuven BOF-IOF

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Project abstract:

Humans and animals navigate complex terrain seemingly effortless. This is in stark contrast with even the most performant robots, illustrating that walking over complex terrains is by no means trivial. Our neuromusculoskeletal system is equipped with mechanisms that allow us to recover from unexpected perturbations. Two key mechanisms are muscle intrinsic mechanics and sensory-driven feedback control. Immediate changes in muscle force upon a perturbation allow the body to respond fast to sudden perturbations through quick-acting muscle mechanical responses. Feedback responses, slower due to transmission delays, are also critical to stability as they are more flexible whereas muscle mechanical responses are determined by feedforward control and muscle properties. We do not yet know how these pathways interact to help us maintain agility and robustness, in the presence of external
perturbations, or in the case of sensory loss. I aim to gain novel insights into how muscle mechanics and sensory feedback allow agile locomotion across conditions. I will unravel fundamental principles governing relative contributions of these mechanisms, using a blended experimental- and computational approach. I already collected a unique experimental dataset that I will combine with physics-based simulations. I will use novel approaches to predict locomotion patterns and feedforward and feedback control by optimizing performance criteria in presence of sensorimotor noise without relying on experimental data. Validation of simulation to experimental data allows us to evaluate which performance criteria and muscle properties drive observed interactions between muscle mechanics tuned by feedforward and feedback control. As many neurological disorders impair stable locomotion,
fundamental insights obtained through my project have potential to inform treatments. Lastly, novel insights in locomotor neuromechanics inspires designs of legged robots and prosthetics to assist during locomotion.

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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
		Indicate: ***N****(ew data) or* ***E****(xisting data)*	Indicate: **D**(igital) or **P**(hysical)	Indicate: **A**udiovisual **I**mages **S**ound **N**umerical **T**extual **M**odel **SO**ftware Other (specify)		Indicate: <1GB <100GB <1TB <5TB >5TB NA	
Ext01	Kinematics and muscle dynamics dataset of guinea fowl walking and running on a treadmill and overground (force plates).	E	D	N	Excel files, .mat files	<100 Gb	NA
Sim_xx	Data on successful simulation of kinematic and muscle dynamics data of the guinea fowl	N	D	N	.mat files	<1 Gb	NA

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:

Ext01 dataset (see above) is a dataset I collected during my previous post-doc at the University of California, Irvine (United States). Aspects of this dataset are already published (e.g., Doi: 10.5061/dryad.k0p2ngfbb), but others are currently being prepared to be published (awaiting manuscript acceptance by editor).
These data are collected in collaboration with Prof Monica A Daley (madaley@uci.edu) and she is fully aware of this reuse and agreed to assist in any way possible to make smooth reuse of the data possible. One of the ways is that I still have full access to the data set through UCI's safe data portal.

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)

All procedures, resulting in the data I aim to reuse here, were licensed and approved by the University of California Institutional Animal Care and Use Committee (IACUC protocol number: AUP 20–048).

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).

All data will be accompanied by README.txt files (according to DataDryad standards) at all times. These files will be proof-red by a colleague in the lab who is not part of the project themselves, so see if someone without pre-knowledge on the type and use of data understands the content.

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

The meta data will hold information on animal meta data (e.g., age, weight, leg segment lengths) and other data that will help interpret the data (e.g., maximum isometric forces, muscle shortening velocities, etc.).

Data Storage & Back-up during the Research Project

Where will the data be stored?

- OneDrive (KU Leuven)

The minimal data that will be produced through simulations will be stored on KU Leuven OneDrive.

How will the data be backed up?

- Standard back-up provided by KU Leuven ICTS for my storage solution

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

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

We will use password protection on all files and files will not be shared to third-parties, unless in an understandable format through DataDryad upon acceptance of the manuscript regarding these simulations.

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

No costs anticipated because data amounts will be very low.

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

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

- KU Leuven RDR

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

Minimal cost due to low amounts of data and anticipation of publication of all data through available formats (i.e., DataDryad).

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

Through publishing data with manuscripts, publishing through online repositories (i.e., datadryad), and websites (like github).

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

NA

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

Where will the data be made available?

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

- Other data repository (specify below)

Github (model, data), DataDryad (data), opensimtk (model)

When will the data be made available?

- Upon publication of research results

Which data usage licenses are you going to provide?

If none, please explain why.

- CC-BY 4.0 (data)

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?

DataDryad costs connected to guinea fowl model/simulation data can be covered through UCI license. Alternatively, we can use bench fees of my current grant to cover these. DataDryad data deposit costs ~$100.
Other repositories mentioned are free of charge to use.

Responsibilities

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

Main researcher will (Marie Janneke Schwaner)

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

Marie Janneke Schwaner

Who will manage data preservation and sharing?

Marie Janneke Schwaner

Who will update and implement this DMP?

Marie Janneke Schwaner