Modeling musculoskeletal kinematic and dynamic redundancy using null space projection

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Overview

This repository contains the setup scripts, documentation and source code relevant to the publication "D. Stanev and Konstantinos Moustakas, Modeling musculoskeletal kinematic and dynamic redundancy using null space projection, PLoS ONE, 14(1): e0209171, Jan. 2019, DOI: `https://doi.org/10.1371/journal.pone.0209171`".

How to run the Docker image

In order to provide a portable setup on which the published simulations and analyses can be interactively reviewed, modified and executed, the provided environment is built as a Docker image. Docker is available a multitude of platforms and detailed installation instructions are provided as part of the project's online documentation. After installation, switch to the toplevel directory of this repository and build the docker image:

```
docker build -t ubuntu_opensim_stanev .
```

You can change the name of the image (here `ubuntu_opensim_stanev`) to your liking. After building, which should take a few minutes, the image can be run in a container with the following command:

```
docker run -it -p 4000:80 ubuntu_opensim_stanev
```

The `-it` option instructs `docker` to run in interactive terminal mode, while the `-p 4000:80` option bind the port 80 of the image to the port 4000 of the localhost. Of course, the image name should match the one used in the build command and the port 4000 can be substituted with any available port on the localhost. After running the docker, open `http://localhost:4000` in your browser and fill in the string 'stanev' (without the quotes) in the password prompt.

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Demos

The user can navigate into the corresponding folders and inspect the source code. The following case studies are provided in the form of interactive Jupyter notebooks:

- **arm_model/model.ipynb** presents a case study using muscle space projection to study the response of segmental level reflexes
- **arm_model/muscle_space.ipynb** demonstrates muscle space projection in the context of segmental level (reflex) modeling
- **arm_model/feasible_muscle_forces.ipynb** uses task space projection to simulate a simple hand movement, where the feasible muscle forces that satisfy this task are calculated and analyzed
- **feasible_joint_reaction_loads/python/feasible_joint_reaction_loads.ipynb** demonstrates the utilization of the feasible muscle forces to calculate the bounds of the joint reaction loads during walking

The .html files corresponding to the .ipynb notebooks included in the folders contain the pre-executed results of the demos.