Master project proposition

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Introduction

After working a semester on the implementation and optimization of a stumbling correction reflex on a reflex-based bio-inspired walking model, I got very interested in the matter, and would like to continue working in this field for my master project.

I have done my previous work with a 2D model, and I would like to use the 3D one for this master project. As the world we live in is in 3D, such a model would be more realistic, but also more difficult to control as more degrees of freedom are present. I also open the possibility to compare the two models.

This model could then be used in the Symbitron project that aims to control an exoskeleton with this kind of model.

Since this model cannot walk under 0.6m/s, I would like to evaluate if it is possible to overcome this limit with the 3D one, and assess which components are essential for this behavior.

A new model also means new control; an optimization step will be necessary to make the 3D model to walk slowly. I intend to use PSO in order to perform this step. As I discovered last semester, performing PSO in the Simulink environment can be quite difficult, this is why I intend to write a PSO algorithm that is easy to set up and to use. Such an algorithm should be reusable for further research on similar models.

The last steps of the project will consist on the implementation of different functionalities on the model. I am particularly interested in achieving a sit-to-stand movement with this model. Such a behavior would be very useful in a real life utilization of the exoskeleton.

Objectives

- Develop a user friendly PSO algorithm for reflex model.
- Demonstrate walking with the 3D model
- Compare 2D and 3D models in terms of ability to walk slowly
- Determine what components, if any, allows the 3D model to walk at very slow speeds (less than 0.6 m/s).
- I'm interested in two possible extensions from this point
    - Modulate the walking speed
    - Sitting and getting up