MBDyn - GSoC Project

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Briefly Overview about My Background

Education:

- PhD, Mechanical Engineering
  - Cleveland State University
  - Research Area: Energy regeneration applied to robotics.
  - Publications:
    - **Santos, EG.** and Richter, H., "Design and Analysis of Novel Actuation Mechanism with Controllable Stiffness." Actuators. Vol. 8. No. 1. Multidisciplinary Digital Publishing Institute, 2019.
    - **Santos, EG.** and Richter, H., "Modeling and Control of a Novel Variable-Stiffness Regenerative Actuator." ASME 2018 Dynamic Systems and Control Conference.
- Bachelor of Science, Automation and Control Engineering
  - FEI University, Sao Paulo, Brazil
  - Thesis: "Power-Assisted Wheelchair Controlled by EMG Signal": https://www.youtube.com/watch?v=rjgii2i_xP4
  - Publications:
    - **Santos, E. G.** et. al., "Optimal Control of the Wheelchair Wheelie." IASTED -International Conference on Modelling, Simulation and Identification (MSI 2016).

Experience:

- *Student Developer*, **Google Summer of Code 2018** under GNU Octave
  - Developed an Interactive Tool for Single Input Single Output (SISO) Linear Control System Design for GNU Octave, also known as *sisotool* in Matlab.
- *Roboticist* at **Artificial Intelligence and Robotics Laboratory** at FEI University
  - February 2011 - July 2013
  - Responsible for the software that controls robots to play soccer. The main software was built in C++ programming language. Assistance for mechanical and electronic maintenance of the robot.

Resume:

- One page resume / Curriculum Vitae

Consistent Inertia in Beam Elements

Motivation

The study of compliance elements is extremely pivotal for a variety of applications. One branch of this study is to use compliance elements in Variable Stiffness Actuators (VSA), which presents several advantages for Human-Machine Interaction (HMI) system, advanced powered prosthetics and exoskeleton. After some literature review of the compliance elements for robotics applications, it was found several applications which uses beam elements. For example, a compliant prosthetic limb to modulate stiffness is proposed in (A, Dahiya, & Braun, 2017) which uses a stack of leaf springs to provide the required compliance. In (Shepherd & Rouse, 2017) proposes an actuator which uses beams with variable cross section beam area. Finally, I also proposed in (Santos & Richter, 2019) an actuator which uses cantilever beam as a compliance element of the VSA, which is also capable on restoring energy. In conclusion, there are a variety of researchers studying beam elements and MBDyn can improve the analysis of these system.

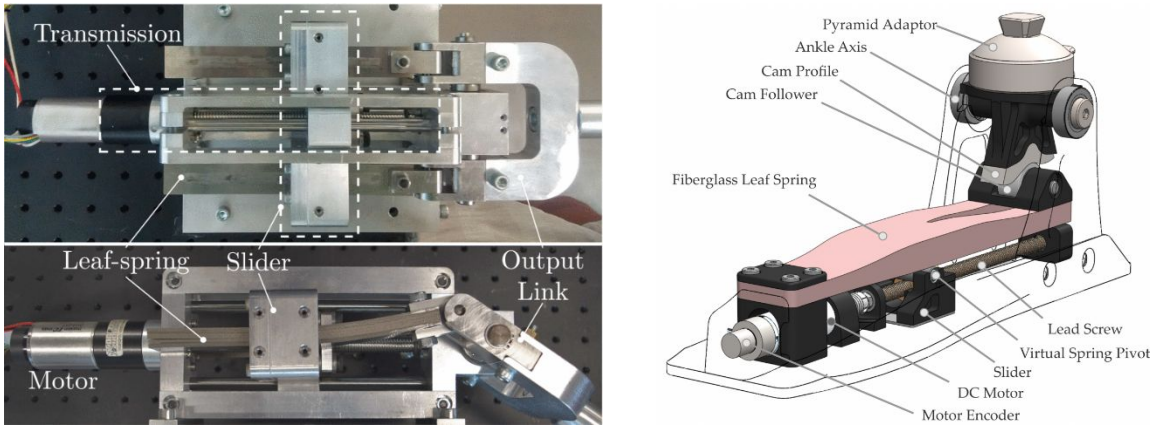

Figure 1. Left – Compliant Prosthetic Limb. Right- Variable Stiffness Prosthetic Ankle

Goals

1. Further development of beam elements by providing consistent inertia terms;
2. Generate output which facilitates the visualization of internal forces in post-processing software;
3. Study and implement post-processing software's, such as Blendyn for the output results of the beam element.

Milestones/Timeline

Community Bonding: (May 6 - 27, 2019)

Students spend a month learning more about their organization's community.

First Evaluation

I. Week 1 (05/27 - 06/02)

Create developing environment for MBDyn and study the currently beam module.

II. Week 2 (06/03 - 06/09)

Create Beam Analysis example on MBDyn formulation.

III. Week 3 (06/10 - 06/16)

Formulate the beam theory used in this project;

IV. Week 4 (06/17 - 06/23)

Add Inertia Terms I.

V. Week 5 (06/24 - 06/30)

This is the submission of Phase 1. Then, in this week it will be prepared a detailed documentation with example, videos and a post about this first period at

https://eriveltongualter.github.io/GSoC2019-MBDyn/blog.html

Second Evaluation

VI. Week 6 (07/01 - 07/07)

Continue adding Inertia terms on the beam module.

VII. Week 7 (07/08 - 07/14)

Perform tests and create examples.

VIII. Week 8 (07/15 - 07/21)

Post-processing using Matlab.

IX. Week 9 (07/22 - 07/28)

This is the submission of Phase 2. Then, in this week it will be prepared a detailed documentation with example, videos and a post about the second period at https://eriveltongualter.github.io/GSoC2019-MBDyn/blog.html

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Final Evaluation

X. Week 10 (07/29 - 08/04)

Study Blendy software to use as a visualization of internal forces in post-processing I.

XI. Week 11 (08/05 - 09/11)

Study Blendy software to use as a visualization of internal forces in post-processing II.

XII. Week 12 (08/12 - 06/19)

Prepare Complete **Final** Post about the Coding period of the project with detailed documentation with examples, videos, tutorial and final post at https://eriveltongualter.github.io/GSoC2019-MBDyn/blog.html.

Additional schedule Information

Between the week 6 and week 7, I will be out of town and probably will not have access internet for 4 days.

Entry Test

I prepared the following page summarizing the results for the entry test:

https://eriveltongualter.github.io/GSoC2019-MBDyn/entry-test.html

Bibliography

A, Dahiya, A., & Braun, D. J. (2017). Efficiently tunable positive–negative stiffness actuator. *IEEE International Conference on Robotics and Automation (ICRA)*, 1235–1240.