Passive dynamic system for energy returning on trans-tibial prosthesis

Reformed Objectives and Schedule

Nikolay Prieto M.Sc.

Universidad Nacional de Colombia

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Introduction

Introduction

The purpose of this presentation is to let you know the general activities done to date, and to propose the reformed objectives and activities for this year.

Background of the objectives

General Objective

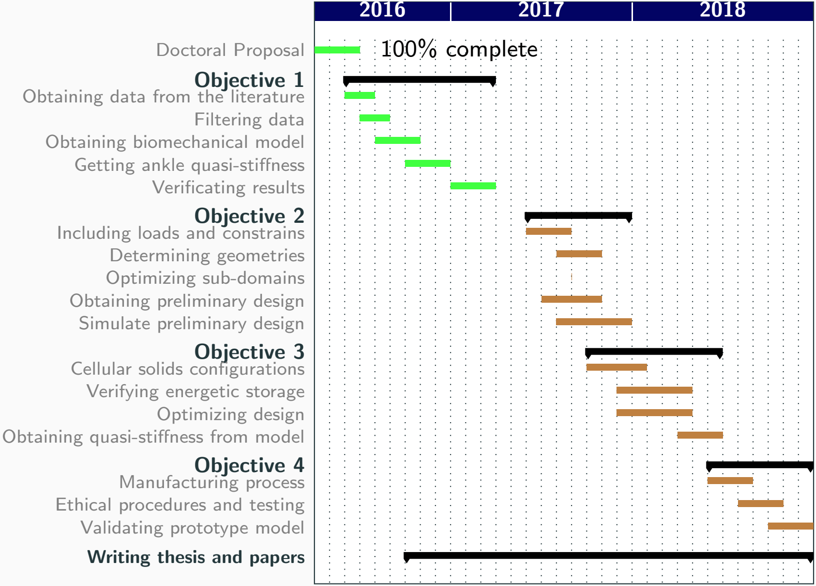
To suggest an ankle-foot prosthesis being able to generate — through a passive dynamic system — the positive work needed for push-off after dual-flexion phase, taking advantage of the energy lost at initial contact of the gait.

Background of the objectives

Specific Objectives

1. Identify biomechanical parameters and the work-loop slope of ESR prosthesis users and non-amputees aiming to obtain the ankle quasi-stiffness of both cases.
2. Obtain a preliminary model of the ankle-foot prosthesis capable of storing energy (during initial contact until late dual-flexion phase), and returning it at dorsi-flexion phase in a controlled manner through the passive dynamic system.
3. Determine detailed configurations of cellular solids that accomplish the requirements of the preliminary model.
4. Validate the dynamic model of the ankle-foot prosthesis in comparison to an ESR prosthesis.

Schedule proposed



Modifications

Purpose No. 01

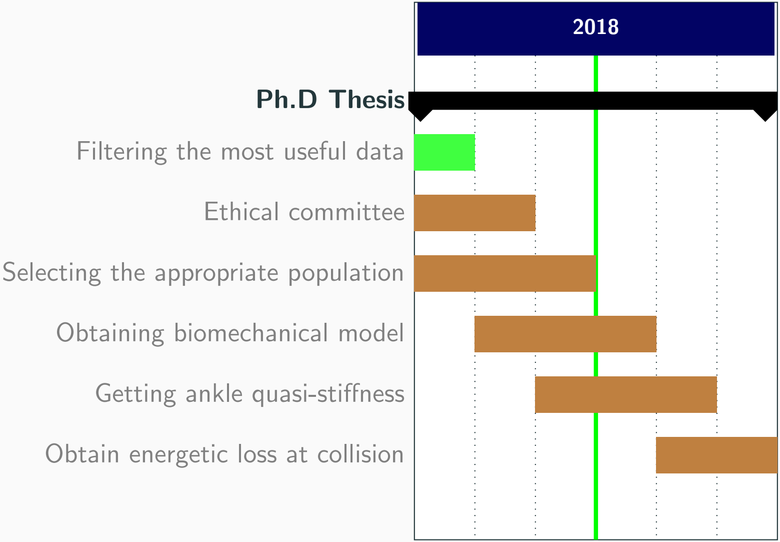
Option A

Through the extraction of experimental data, we will identify the biomechanical parameters and the work-loop slope in ESR prosthesis users and non-amputees, aiming to obtain the ankle quasi-stiffness of both cases.

Deliverables

An article relating the Dynamic Joint Stiffness of the ankle-joint — and other joints if it is possible — of a good statistical sample of lower limb amputees.

Activities and Schedule



Purpose No. 01

Option B

Through the analysis of pure data found in the literature, we will attempt to give insights about the dynamic behaviour of the ankle could describe unseen aspects of different types of gait and also to identify non-linear approximations of the quasi-stiffness.

Deliverables

An article relating a methodology to give more accuracy in the linear regressions or predicting relationships between different parameters of the gait (i.e. Velocity, Body length, Body mass).

Example of analyzed data

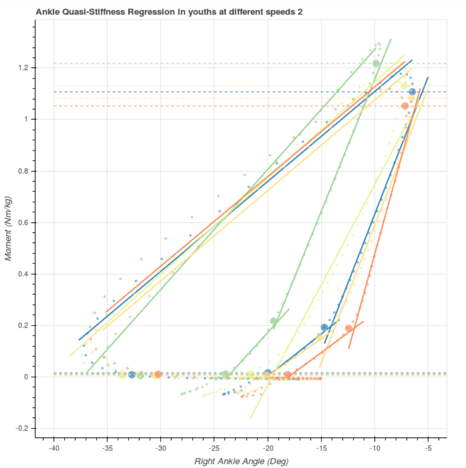


Figure 1: Dynamic Joint Stiffness of the ankle, being linearized according to each sub-phase of the gait

Purpose No. 02

Option B

Trying to get a topology optimization algorithm for the optimal design of cellular materials and composites with periodic microstructures so that the resulting macro-structure has the maximum energy returning capacity.

Deliverables

Two articles, the first is with respect to the optimization algorithm, and the second one is related with the verification of the dynamical process of the gait.

Example of the optimization activity

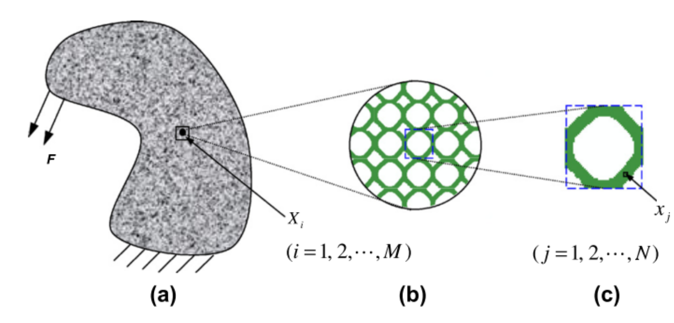
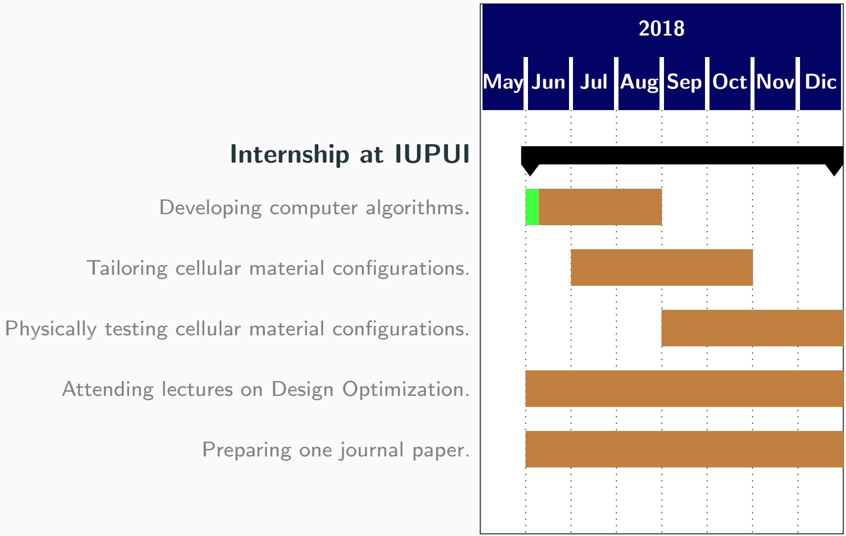


Figure 2: A structure composed of cellular materials or composites (a) macro-structure; (b) micro-structure; (c) a unit cell.

Internship



2018
May
Jun
Jul
Aug
Sep
Oct
Nov
Dic
Internship at IUPUI
Developing computer algorithms.
Tailoring cellular material configurations.
Physically testing cellular material configurations.
Attending lectures on Design Optimization.
Preparing one journal paper.

Questions

Thank you!