Abstract

Nowadays, Lower Limb Prosthesis (LLP) are changing at a very fast pace, due to technological developments implemented in such devices. In addition, users have new demands about their prosthesis and they require absolute comfort and good performance. Unfortunately, the demand of LLP has risen mostly in third world countries because of the increment of vascular diseases (e.g., Diabetes Mellitus). However, people do not have the enough funds to acquire advanced prosthesis that return the capabilities of walking or jogging in a proper way.

Despite the fact that active prosthesis help people to reduce metabolic cost, those are heavier and more expensive than *Energy Storage and Return*(ESR) prosthesis devices, produce uncomfortable noises and require more maintenance than passive ones. Moreover, components of the bionic prosthesis (i.e., actuators, battery, gearbox, among others) make the system highly inefficient. As a consequence, a higher quantity of external energy is required to allow the user having enough autonomy for a daily use.

The current work is a Ph.D. thesis, which purpose is manufacturing a novel customizable configuration of transtibial prosthesis. This device will provide the positive work needed for an amputee at the final stance phase through a passive dynamic system, it will take advantage of cellular solids properties for recycling the energetic lost at the initial contact of the gait.

To validate the results, a gait analysis is needed to quantify the work-loop of the ankle joint in users, and new measurement methods are available to obtain real-time data on gait. Thus, the devices we intend to acquire through this call will be helpful for other thesis related with the research group. In other words, not only will these devices help this Ph.D. thesis, but also will support other ones.

1 Work Plan

1.1 Objetive 1

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.

Activities

1. To filter the most useful data found in the literature, in order to use it as a benchmark parameter.

2. To acquire the Inertial Measurement Units (IMU's)

3. To select the appropriate population for each gait analysis.

4. To obtain biomechanical parameters for getting different ankle quasi-stiffness slopes of different ESR and able-bodied patients.

5. To make the biomechanical model of each subject with the purpose of acquiring non-measurable variables and predicting biomechanical behaviour through the forward dynamic technique in specific software like OpenSim®.

6. To obtain ankle quasi-stiffness slope by the combination of kinetic and kinematic variables.

7. To obtain energetic loss in the collision at initial contact of the gait.

8. To verify biomechanical models with similar publications in literature.

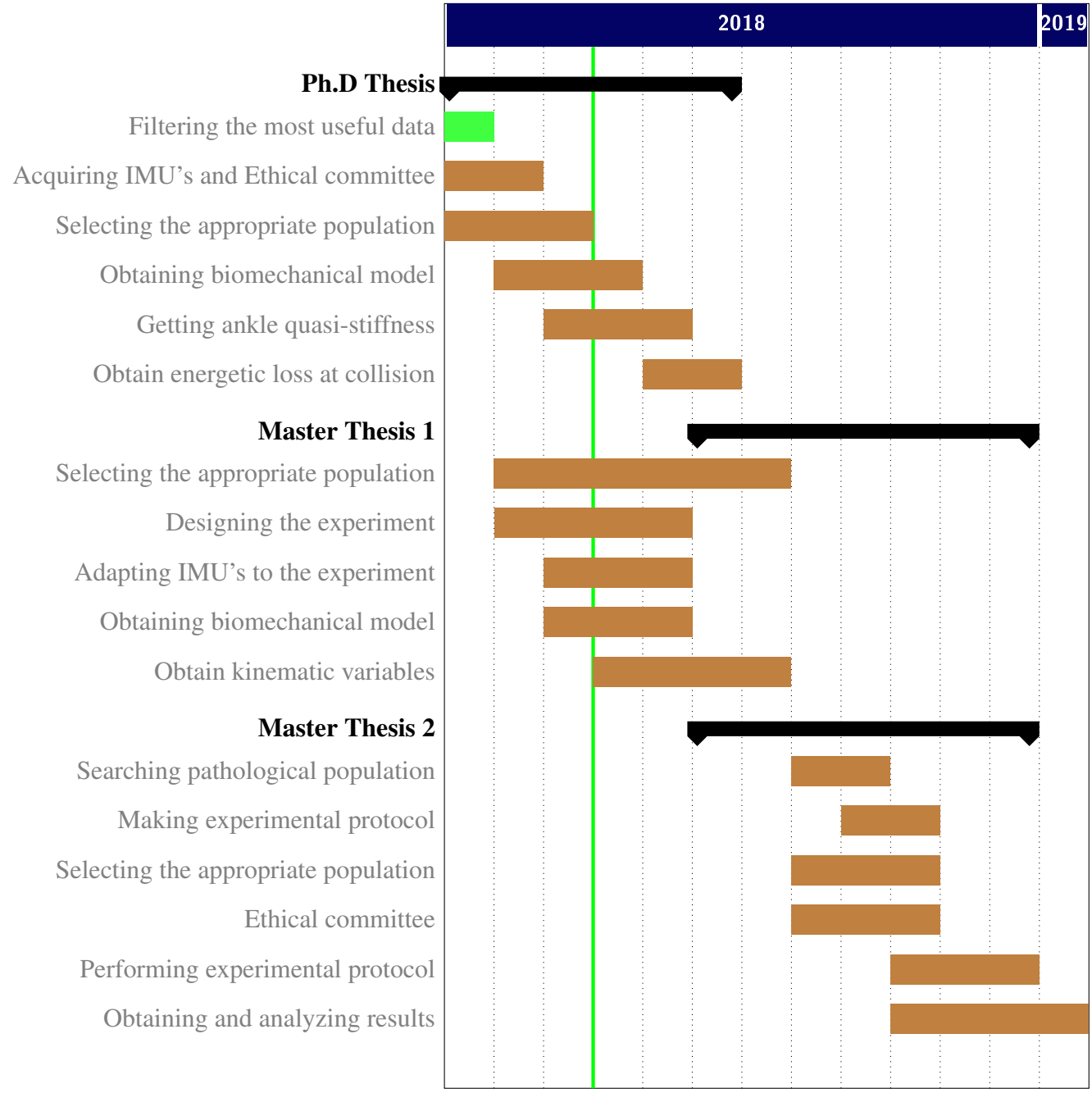
1.2 Objective 2

In order to take advantage of the IMU's, two Master thesis will use simultaneously these devices, with the purpose of getting the following measurements:

M.Sc. Thesis 1: To obtain gait kinematic variables in order to measure the balance in able-bodied people at different terrains.

M.Sc. Thesis 2: To validate a suggested protocol for proprioceptive stimulation in patients with Parkinson disease.

2 Schedule


2018
2019
Ph.D Thesis
Filtering the most useful data
Acquiring IMU's and Ethical committee
Selecting the appropriate population
Obtaining biomechanical model
Getting ankle quasi-stiffness
Obtain energetic loss at collision
Master Thesis 1
Selecting the appropriate population
Designing the experiment
Adapting IMU's to the experiment
Obtaining biomechanical model
Obtain kinematic variables
Master Thesis 2
Searching pathological population
Making experimental protocol
Selecting the appropriate population
Ethical committee
Performing experimental protocol
Obtaining and analyzing results

3 Budget

Table 1: Description of the needed equipment

Description	**Necessity**	**Quantity**	**Resources**	
			In kind	External
Inertial Measurement Unit MTi-G-710 GNSS.	To take real-time measurments in pathological and able-bodied human gait	3 units		$ 15.000.000.00
Total				$15.000.000.00