BIOM Test Fixture

GROUP 7

ME476C – section 001

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INTRODUCTION

- What is the BiOM ?

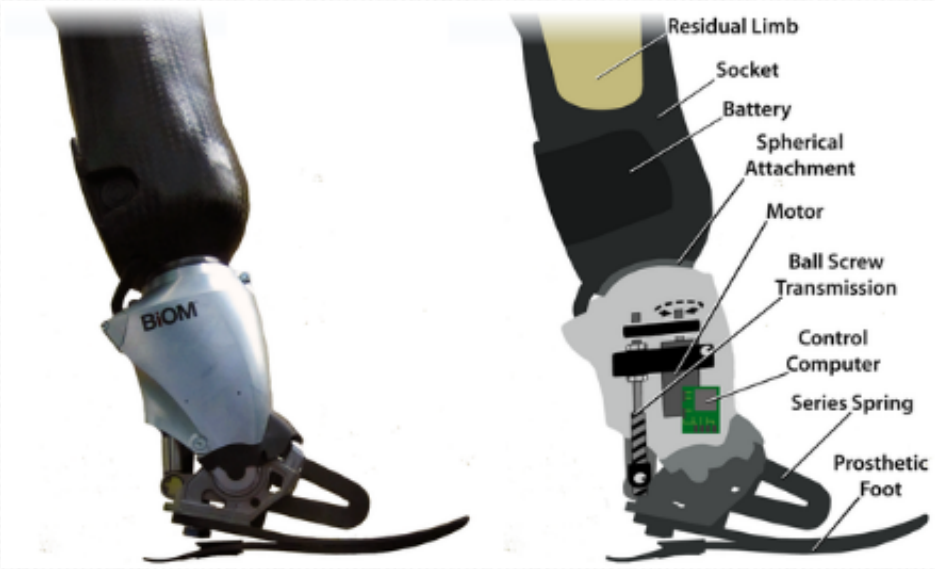
The BiOM is a prosthetic leg that is under the knee height. It replicates the ankle and muscles surrounding it, propelling the user forward with each step, developed by Hugh Herr, a survivor of lower limb amputation at MIT Media Lab's Biotronic research group

- What is a Test Fixture ?

A Test Fixture is a device that is used to run tests on any other device (Testing Electronics, Software's and Physical Devices)

Project description

- To design an automated, programmable test fixture for the robotic prosthetic lower limb. A single actuator, Pneumatic design was assigned for reference but were asked to design for either hydraulics or electric motor.



Biom Test Fixture
http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0135148#sec002/

Sponsors and clients

- The sponsor and client for this project is Dr. Tester.
- Dr. Tester has been conducting research on the BiOM for several years testing and collecting data on its performance.
- Dr. Tester is also the chair of Mechanical Engineering program at Northern Arizona University

EXISTING TECHNOLOGIES OF TRANSTIBIAL POWERED PROSTHESIS

- Single Actuator Configuration
  - A) PROPIO FOOT – Developed by Ossur
    - This propio foot design is envisioned to enhance dorsiflexion during the swing phase of gait cycle (Fradet et al, 2010; Darter and Wilken, 2014)
    - Dorsiflexion sensory feed back is achieved by a microprocessor using an artificial intelligence system
  - B) Kanazawa Institute of Technology Powered Prosthesis
    - This design features an internal model for regulating gait cycle
    - This concept does not require force sensors or pressure sensors (Suzuki et al, 2011)

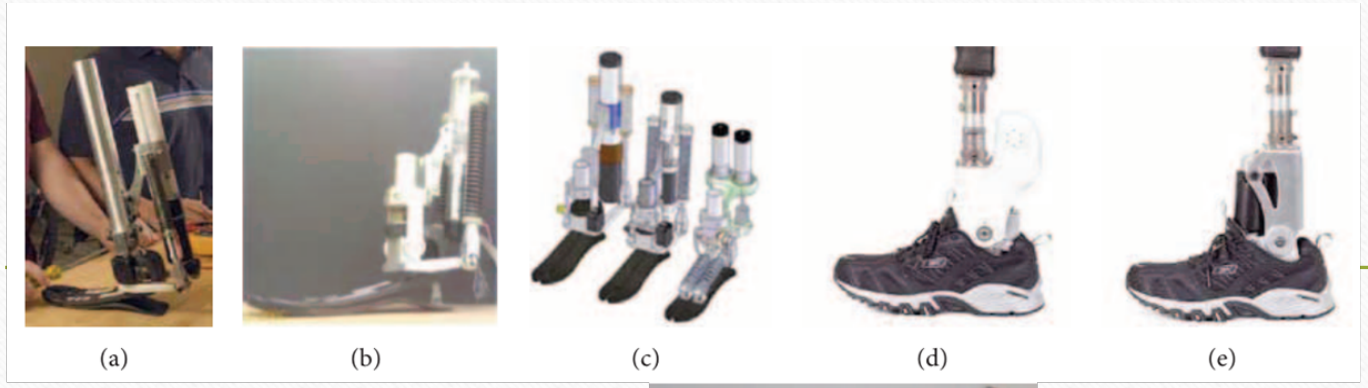
EXISTING TECHNOLOGIES OF TRANSTIBIAL POWERED PROSTHESIS

- Dual Actuator Configuration
  - A) PANTOE
    - The PANTOE powered prosthesis incorporates the contribution of forefoot during stance phase (Zhu et al, 2010)
    - Incorporates three operational models

      1) Accounting for battery out of power

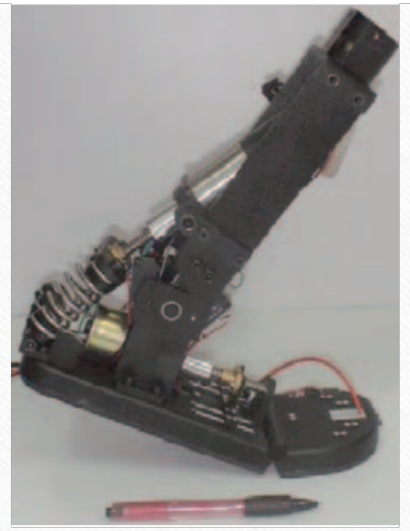
      2)Lower power scenario

      3)Synchronous use of both series elastic actuator positioned at the ankle joint and toe joint

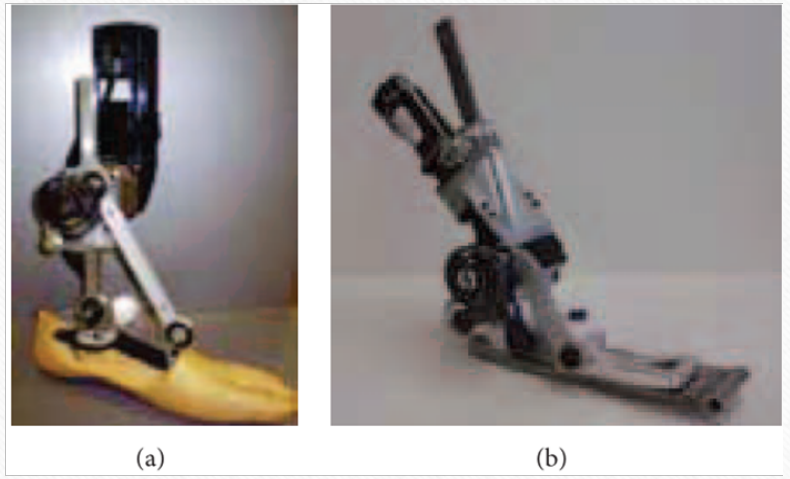


SPARKy Project,
Arizona State Universiy

Universite Catholique De Louvain, Belgium



Peking University, China



Marquette University, United States

Design Requirements (DRs)

- Cost (>=500)
- Robustness
- Stability
- Ease of Use
- Durability
- Versatility (Functionality – Speed, Power and Agility)

Customer Needs (CNs)

- A Test Fixture that can analyze the BiOM a prosthetic leg in a fixed and controlled environment.
- A good design that can work in an indoor laboratory environment (don't need to account for natural causes such as rain, wind and snow)
- Can replicate the same effects as if worn in real life.
- Easy to transport.
- Durability, needs to with stand forces over time.

Engineering Requirements (ERs)

- Size (80x40x35 cm)
- Time needed for testing (15 - 25 minutes)
- Types of planes for testing (0^0, level ground testing)
- weight (<= 15Kg , 33lbs)
- Material (Carbon Fiber and Titanium offer lower weight, Aluminum)
- Hydraulic system (90 psi)
- A system able to respond exactly like a particular foot
- Cost (>=500$)
- Torque
- Rotation

House of Quality

House of Quality (HoQ)

Customer Requirement	Weight	Engineering Requirement	size (80x40x35 cm)	time needed for testing(15-25 minutes)	types of planes for testing(0) level ground	weight (<= 15Kg , 33lbs)	Material (Carbon Fiber and Titanium offer lower weight, Aluminum)	Hydraulic system (90 psi)	A system able to respond exactly like a particular foot	Cost, (>500$)	Rotation	Torque
1.A Test Fixture that can analyze the BiOM a prosthetic leg in a fixed and controlled environment	5		3	3	3	3	9	9	9	3	9	9
2. A good design that can work in an indoor laboratory environment	4		9	1	3		3			1		
3.can replicate the same effects as if worn in real life	4			9	3	9	3	3	9		9	9
4. Easy to transport	2		3					1				
5. durability, needs to with stand forces over time	3		1	9		9	9		3	1	1	1
6. elctric motor or hydraulic system	1			1		3		9	3	9	9	9
7. Frame that doesn't obstruct the battery for the BiOM	3		9	1		3	1					
Absolute Technical Importance (ATI)	35		875	840	315	945	875	770	840	490	980	980
Relative Technical Importance (RTI)			0.71	0.69	0.26	0.77	0.71	0.63	0.69	0.4	0.8	0.8

Schedule

Biom Test Fixture

Project Lead: [John Tester]
Project Start Date: 1/16/2018 (Tuesday)
Display Week: 1

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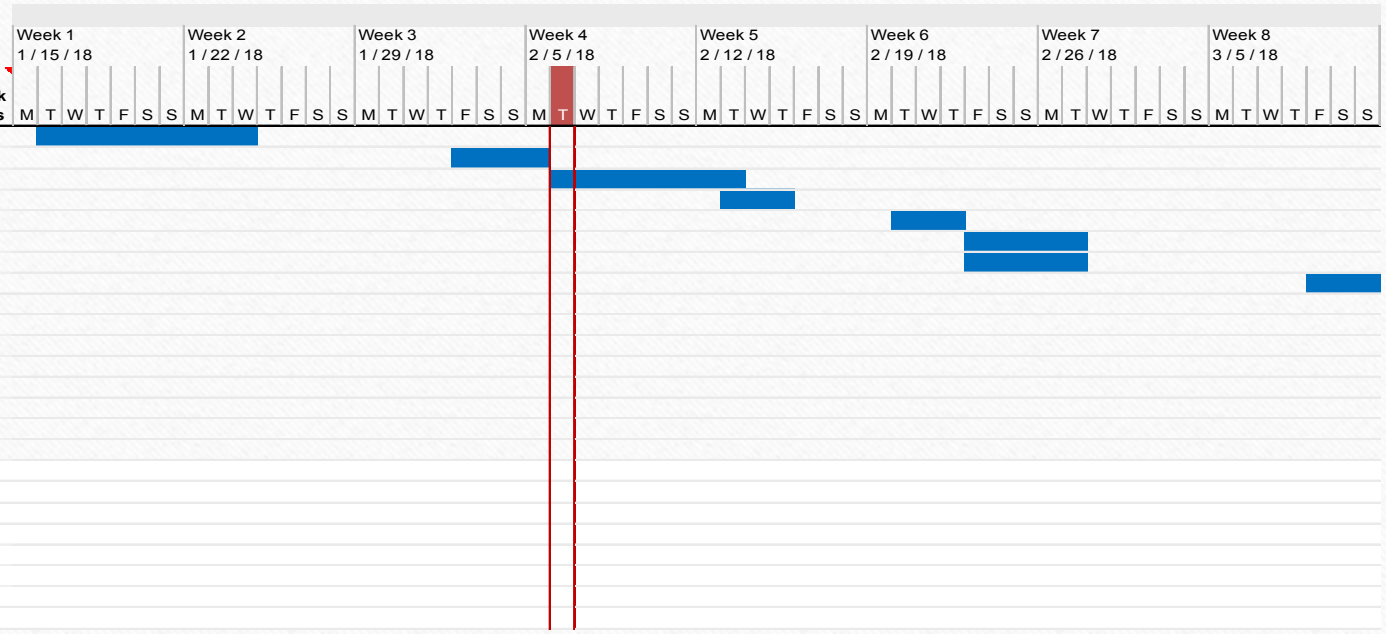
See info on Gantt Chart Template Pro

WBS	Task	Lead	Predecessor	Start	End	Cal. Days	% Done	Work Days
0.1	Team Charter	GROUP		Tue 1/16/18	Wed 1/24/18	9	100%	7
0.2	Presentation	GROUP		Fri 2/02/18	Mon 2/05/18	4	100%	2
0.3	Report 1	GROUP		Tue 2/06/18	Tue 2/13/18	8	70%	6
0.4	Website 1	SAOOD		Tue 2/13/18	Thu 2/15/18	3	0%	3
0.5	Peer Eval 1	GROUP		Tue 2/20/18	Thu 2/22/18	3	75%	3
0.6	Presentation 2	GROUP		Fri 2/23/18	Tue 2/27/18	5	0%	3
0.7	Conceptual Report	GROUP		Fri 2/23/18	Tue 2/27/18	5	6%	3
0.8	Analyses Memo			Fri 3/09/18	Tue 3/13/18	5	0%	3
0.9	*Client Meeting*	*Husain*		Mon 01/28/18	Tue 05/05/18	5	20%	
0.10	Website 2	SAOOD		Sun 3/25/18	Tue 3/27/18	3	0%	2
0.11	Analytical Reports	GROUP		Thu 3/29/18	Tue 4/03/18	6	0%	4
0.12	Peer Eval 2	GROUP		Mon 4/09/18	Tue 4/10/18	2	0%	2
0.13	Presentation 3	GROUP		Fri 4/13/18	Tue 4/17/18	5	2%	3
0.14	Final Report	GROUP		Fri 4/13/18	Mon 4/23/18	11	0%	7
0.15	Website 3, BOM, CAD	GROUP		Thu 4/26/18	Tue 5/01/18	6	0%	4
0.16	Peer Eval 3	GROUP		Tue 5/01/18	Tue 5/01/18	1	0%	1



Student Names:
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Budget

- This project is an analytical project focusing on CAD simulations.
- After consulting Dr. Tester we were given a 0$ budget.
- A prototype can be built if required and a budget of maximum 500$ is set if team moves forward with the prototype.
- Highest cost = Actuator

References

- Smithsonian Magazine https://www.smithsonianmag.com/innovation/future-robotic-legs-180953040/
- Robert LeMoyne, "Advances for Prosthetic Technology: From Historical Perspective to Current Status to Future Application", Springer, Japan, 2016. (Department of Biological Sciences, Northern Arizona University, Arizona, USA) ISBN 978-4-431-55814-9
- Lower Limb Prosthesis – Design Considerations
- Review Article-P. Cherelle, G. Mathijssen, Q. Wang, B. Vanderborght & D. Lefebe, "Advances in Propulsive Bionic Feet and Their Actuation Principles", Advances in Mechanical Engineering, Volume 2014.

THANK YOU FOR YOUR TIME

ANY QUESTIONS