Research for development of A Self-Fluctuating Actuator Air Prosthetic Liner with Memory Foam Design for Lower Limb Amputees to Improve Comfort, Stability, and Fluctuation in Prosthetic Sockets:
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Abstract and Background

• **Research question:** Can an air-based device reduce volume fluctuation and redistribute pressure inside a prosthetic socket for lower limb amputees? To possibly change the world of prosthetics to help amputees with quality of life.

• **Main objective:** Find a solution that can redistribute pressure in sockets to improve comfort and reduce the volume fluctuation to decrease pistoning of lower limb amputees inside of socket.

Lower Limb Amputees

• Estimated $12 billion cost to insurance companies annually. [1]
• Annual Users: 1,800,000 leg amputees [1]

Target Specifications

• Volume fluctuations can cause transiibal amputees detrimental harm to the skin or even deadly infections. e.g., verrucous hyperplasia, chronic ulcers, tumors, intertrigo, bacterial and fungal infections, etc.
• Proposed research aims at innovating a device that could replace stump socks and socket fillers to significantly reduce the constant fluctuation of volume and discomfort inside sockets in a variety of scenarios.
• Redistribute pressure points in specified areas
• Reduce pistoning and fluctuation inside sockets
• Increase Comfort and Stability

Prototype Design

![Prototype Design Image]

Infections Caused by Present Liners and Fluctuation

![Infections Caused by Present Liners and Fluctuation Image]

Figure 1: Shows Journal research of pressure points inside socket, dark grey areas are highest pressure points. [2]

Figure 2: Auto-cad drawing of prototype design. Materials used will be Gel silicone liner, air bladders, memory foam, and air actuators

Figure 2: Shape of residual limb.

Figure 3: Symptomatic heterotopic ossification. Focal verrucous hyperplasia is also visible posteriorly [3]

Future Directions

• Working with Dr. Sangram Redkar at polytechnic due to CO-VID 19 I haven’t had access to the lab to build design.
• More test data will be recorded in hopes to publish a peer reviewed journal and apply for grants
• Talks with investors, start ups, and ASU to collaborate in hopes to better the quality of life for many amputees around the world
• Build off of this project to do more things in research for amputees
• Use this research and more to be able to go on for a Ph. D in biomechanics, brain research, or prosthetics

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Plans of Design

Phase I: Build Design
• Will first use my old liners to insert air bladders inside
• At what points in socket could air pressure possibly redistribute other pressure forces acting against skin surface area by reducing fluctuation
• Test trial with own socket and old liner prototype design to get a feel of design for myself to gain more ideas
• Use plaster, silicon gel, and other orthotic materials to construct the design shown in (Fig. 2) a liner with air components and soft materials such as memory foam

Phase II: Test Design
• In Dr. Honeycutt’s Lab our team will use a high-tech treadmill and monitors to capture gait, stability, comfort and kinematics of the prostatic.

References