Adjustable smart limb socket

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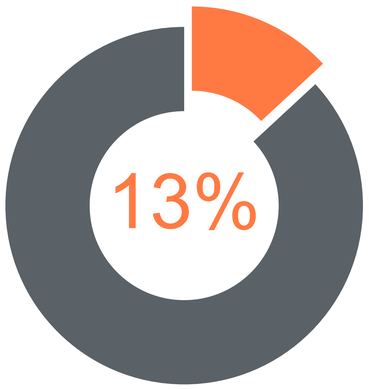
Introduction and Background

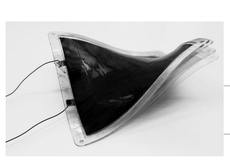


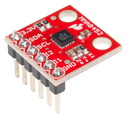
Artificial limbs can cost upwards of **$100,000** but because of an improper fitting socket, 13% of artificial limb users in third world countries abandon their prosthesis. (1)

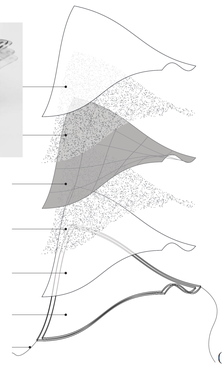
An improper fitting socket can even cause injury to the user.

Some problems with current prosthetic sockets are

- they use very tight pressure or suction to stay on
- non breathable material causes buildup of sweat which causes blisters and infection

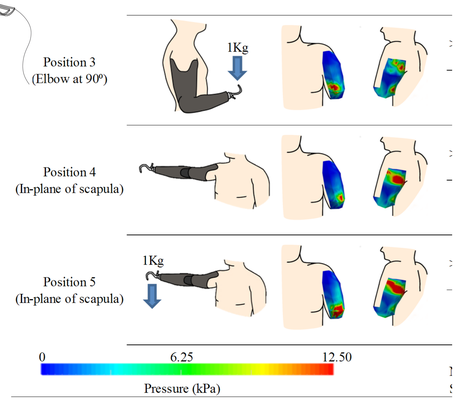






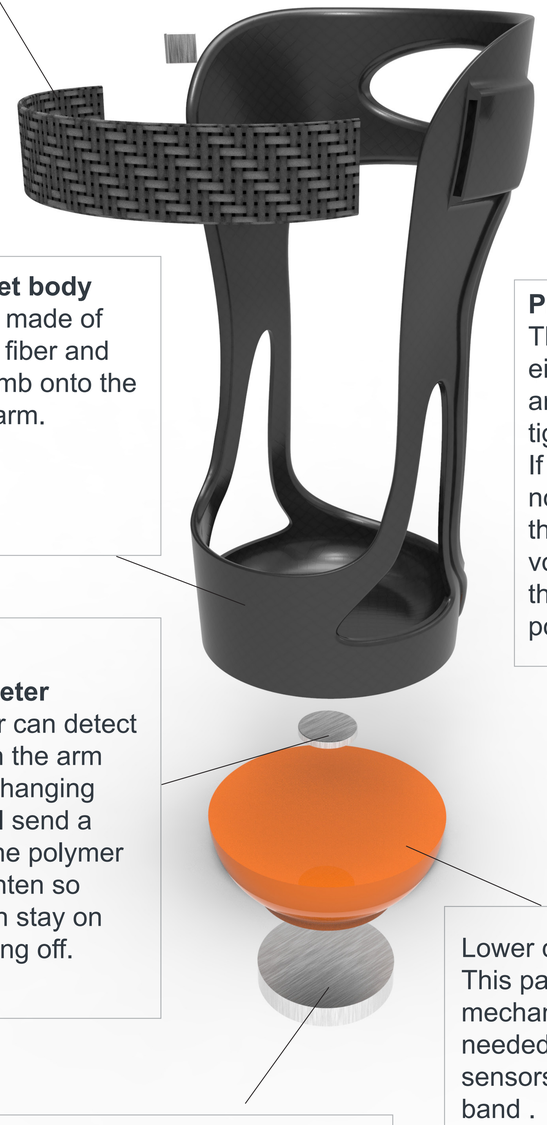
I chose to develop a minimal, well ventilated transhumeral socket that can adjust the pressure that it to applies to the arm by using sensors and electroactive polymers

The shape of the socket is based on pressure map studies done by plos journal (2), as well as trials done on my own arm.



How the Smart Socket works

Electroactive Polymer Band
This band is made of a polymer that contracts and expands depending on if a voltage is run through it. Whenever the sensors send a voltage, the band tightens.



Main socket body
This part is made of stiff carbon fiber and holds the limb onto the remaining arm.

Pressure Sensors
These sensors on either side of the arm can detect how tight the socket is. If it is too tight or not tight enough, they will send a voltage through the electroactive polymer band.

Triple axis accelerometer
This sensor can detect the position the arm is in. If it is hanging down, it will send a signal for the polymer band to tighten so the arm can stay on without falling off.

Lower chamber
This part holds all the mechanisms and wiring needed to connect the sensors with the polymer band .

Pressure Sensors
This part connects the socket to the rest of the prosthetic arm.

Testing

Here I used my own arm to test out various pressure points to find the best configuration for the socket body shape.

Conclusion

A more comfortable socket would greatly improve the lives of amputees. The socket that I have developed here could be the key to a truly self adjusting socket that also has plenty of ventilation and is ergonomic to truly fit the patients arm as best as possible. The next step in this project would be to experiment with electroactive polymers and have patients use the socket with the limb attatched to fine tune the force at which the elctroactive

Agnowledgements

- Professor Jeff Feng , faculty mentor

References

(1) Officer, Chief Technology. Affordable, Modular, and Breathable Upper-Limb Prosthetic Sockets for Use in Underdeveloped Areas with Hot, Humid Climates. 2 Mar. 2015,

(2) Schofield, Jonathon S., et al. “Characterization of Interfacial Socket Pressure in Transhumeral Prostheses” PLOS ONE, Public Library of Science