Sensor Technology for Enhanced Prosthesis Production (STEPP)
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Abstract

- Inspired by Range of Motion Project in Quito, Ecuador
- Students worked directly with amputees and prosthetists
- Patients travel for hours, or even days, to receive prosthetic care
- Prosthetics now - artisanal process, highly specialized
  1. Molding
  2. Casting
  3. Manufacturing
  4. Final Socket

- This artisanal method quickly becomes tedious and time-consuming.
- Can be difficult to achieve a socket that fits the patient perfectly.
- STEPP is saving prosthetists time and money by improving the fit of sockets for patients.

Objectives

1. Reduce the number of fittings needed
2. Reduce manufacturing costs
3. Improve fit of socket for patients
4. Reduce time needed to make prosthetics

Methods

The STEPP team began solving the problem by focusing on designing a device to test for the tissue stiffness of residual limbs. This gives quantitative data that can be integrated with a topographical image of the residual limb.

1. 3D scanner gives topographical image of residual limb
2. Force probe used to measure tissue stiffness (first prototype)
3. Scanned image mesh is translated into heat intensity map for tissue differentiation
4. Computer Aided Design (CAD) is made from scanned image
5. Additive manufacturing is used for prosthetic socket

Results

- Four Material Properties: Stiffness, Relaxation, Creep, Hysteresis
  - Total of 8 materials tested and 28 combinations when comparing to every other material
  - An unpaired t-tests with 99.9% confidence compared all 28 combinations
  - All 28 combinations of materials, were compared against each other and demonstrated that the material properties were successfully differentiated

Budget

- Prosthetics Now
  - Labor cost = 30-40% of total cost
  - Each socket built to last about 3 – 5 years
  - Average cost for one patient in 6 years = $35,000

STEPP
- Testing device = $150
- Printed socket= $550
- Other costs = maintenance and printing filament
- Significant Cost Reduction Per Patient

Conclusions

- STEPP's testing device successfully differentiated material properties from 8 different samples. This demonstrates that our device is on the right path to be able to differentiate biological tissues in the residual limb in order to fulfill the need for manufacturing prosthetic sockets.

Contact Information

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References


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