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Advancing the Arizona State University Knowledge Enterprise

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Thermally Responsive Shape Memory Prosthetics

There are approximately two million people, in the US alone, suffering from limb loss and another 185,000 new limb loss cases each year. Upper limb prosthetics are typically categorized into body-powered and electric style systems. Body-powered systems lack feedback, cannot provide high force output and can be fatiguing. Electric systems are expensive, noisy and heavy, as much as 87% heavier than an average human hand. Neither system is able to provide actuated motion that mimics bulk skeletal muscle due to linear output generations. There are a few other actuator systems that overcome some of the above limitations, however, they also tend to be complex, require specialized equipment and are heavy.

Researchers at Arizona State University have developed novel shape memory materials for use as actuators in prosthetics, particularly upper-limb prosthetics. These materials have been shown to produce non-linear contractile properties, peak force and strain comparable to that of mammalian skeletal muscles. Measures are built into the materials to prevent overloading and subsequent release/deactivation. Additionally, rapid response times, low volume and low material costs make these materials have even greater utility in prosthetic applications.

These materials may be able to provide movement and force to joints within a prosthetic device that more closely mimic true muscle movements and result in greater patient satisfaction and utility.

Potential Applications

• Prosthetics

o Upper limb prosthetics: digit/wrist manipulation, grip force, rotation at the elbow

o Lower limb prosthetics

Benefits and Advantages

• Low operating temperatures

• High contractile strength

• Light weight

• Non-linear output

• A predetermined shape can be remembered and recovered with the application of heat

• Quick response time – 0.77 seconds

• Inexpensive material costs ($0.0098 per actuator)

For more information about the inventor(s) and their research, please see Dr. La Belle's laboratory webpage

For more information about this opportunity, please see Lathers et al – 3D Printing and Additive Manufacturing – 2017 Lathers Dissertation PDF - 2017