Skysong Innovations
Advancing the Arizona State University Knowledge Enterprise

1475 N. Scottsdale Road, Suite 200
Scottsdale, AZ 85287-3538
Phone: 480 884 1996 Fax: 480 884 1984

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Inventors

Saivimal Sridar
Souvik Poddar
Wenlong Zhang

Contact

Jovan Heusser
jovan.heusser@skysonginnovations.com

Low Volume Inflatable Actuator Composites and Applications

The field of soft robotics has grown rapidly in the past decade with increased focus on actuators, sensors, and modeling and control methods. However, high energy costs for actuation and a lack of portable pneumatic sources capable of providing high pressures and air flow rates have historically hindered the widespread adoption of untethered pneumatic soft robots in wearable devices.

Researchers at Arizona State University have created novel low volume inflatable actuator composites (IACs) as well as compact portable pneumatic sources to generate high pressure and flow outputs. These IACs were designed to reduce energy costs of actuation and when used in tandem with the portable pneumatic source are able to overcome the aforementioned issues. These IACs can be used in wearable devices such as knee exosuits to make them more portable, faster and efficient compared to current market offerings. The IACs and portable pneumatic source were evaluated in a soft exosuit with three healthy participants for incline walking with a reduction of muscle activities observed for all participants.

These composites can be used to design faster, more efficient and portable pneumatic systems for use in wearable applications for human augmentation.

Potential Applications

- IACs for implementation in wearable devices for human augmentation
  - Knee exosuits
  - Hip exosuits
  - Shoulder exosuits
  - Other exosuits

Benefits and Advantages

- Higher actuator speed
- Lower energy losses by reducing the overall volume of the actuator

- Low cost and can be fabricated with traditional and modern methods
- High power to weight ratio
- Allows for untethered pneumatic soft robots
- The pressure-deflection characteristics of the fabricated IAC are compared with those of a completely fabric-based beam using experimental results and finite element analysis
- The portable pneumatic source is capable of generating a pressure and flow rates of 0.131 MPa and 21.45 SLPM, respectively

For more information about this opportunity, please see

Sridar et al – IEEE RA-L- 2020

For more information about the inventor(s) and their research, please see

Dr. Santello's departmental webpage

Dr. Zhang's laboratory webpage