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## Soft-Inflatable Exosuit

The ability to perform activities of daily living (ADLs) is partially lost in human beings with physical conditions such stroke, cerebral palsy, and old age. Such conditions often lead to partial loss of muscle function as well as weakness and muscle atrophy. A large number of people experience a loss of control and/or weakness in their quadriceps responsible for the knee extension motion, critical to perform ADLs such as walking and stair climbing. Common treatment methods include physical rehabilitation and exercise. However in many cases, the observed improvement is often slow and not substantial.

Robotic rehabilitation devices are a potential therapeutic solution in aiding afflicted patients. Rigid exoskeletons and assistive devices, commonly used in physical rehabilitation of paretic limbs are very effective, however, they are bulky and have low portability. There have been technological improvements in rigid exoskeletons to reduce weight and form factor but problems such as joint matching still exist, causing discomfort or an unnatural gait, further hindering recovery. Lightweight devices that promote greater user compliance are needed to successfully assist in rehabilitation efforts.

Researchers at Arizona State University, in collaboration with researchers at Dignity Health have developed a novel soft-inflatable exosuit for knee rehabilitation. This lightweight and form fitting exosuit can assist humans with gait deficits due to hemi-paresis, cerebral palsy, or weakness in performing knee extension motions during walking and physical activities. Insole and inertial measurement unit (IMU) sensors are used to detect forces and determine where a user is at in their step to provide assistance with knee extension motion while soft actuators that interface well with the human body are used to increase user comfort and compliance. This exosuit is currently being tested on patients at the Barrow Neurological Institute and shows a promising reduction in muscle activity during the swing phase of the knee. Further, the assistance provided by the exosuit during the stance phase of walking and during activities such as sit-to-stand and stair climbing are being investigated.

This exosuit is the first of its kind and is aimed at reducing the load on physical therapists by assisting stroke patients as well as other users with a gait deficit. Its soft and flexible construction make it more comfortable and easier to wear, potentially increasing user compliance.

### Potential Applications

- Exosuit for knee rehabilitation
  - o Provides assistance to knee extension motion in scenarios such as walking, stair climbing and sit to stand
- Exosuit could be adapted to be used for elbows or other joints
- Exosuit could be used for resistance rehabilitation or workout
  - o Could be used in space for astronauts to maintain muscle tone
- Full body exosuit for use as a wearable workout system
- Full body exosuit could be used for recreational activities
  - o Skiing, hiking, golf, etc.

### Benefits and Advantages

- High power-to-weight ratio
- Soft and flexible
- Low fabrication costs
- Greater chance of user compliance
- Relatively easy to manufacture

For more information about this opportunity, please see [ABC15 News StorySridar et al – IROS - 2017Sridar et al – Front. Robot. AI - 2018](#)

For more information about the inventor(s) and their research, please see [Dr. Polygerino's laboratory webpage](#)