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Sparky prosthesis

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US researchers are working to create the next generation of powered prosthetic devices based on lightweight, energy-storing springs.

Researchers at Arizona State University's (ASU)'s Polytechnic campus and the Military Amputee Research Program at Walter Reed Army Medical Center are teaming up to create the next generation of powered prosthetic devices based on lightweight, energy-storing springs.

The device they are working on, nicknamed SPARKy – short for Spring Ankle with Regenerative Kinetics – will be the first-of-its-kind smart, active and energy-storing transtibial, or below-the-knee, prosthesis.

.Existing technology in prosthetic devices is largely passive and requires amputees to use 20 percent to 30 percent more energy to propel themselves forward when walking compared to an able-bodied person, according to Thomas Sugar, ASU assistant professor of engineering at the Polytechnic campus.

Once complete, SPARKy is expected to provide functionality with enhanced ankle motion and push-off power comparable to the gait of an able-bodied individual.

'A gait cycle describes the natural motion of walking starting with the heel strike of one foot and ending with the heel strike of the same foot,' Sugar said. 'The cycle can be split into two phases: stance and swing. We are concerned with storing energy and releasing energy (regenerative kinetics) in the stance phase.'

The mechanics of walking can be described as catching a series of falls, Sugar said. In the team's device, a tuned spring brakes falls and stores energy as the leg rolls over the ankle during the stance phase, similar to the Achilles tendon.

Sugar's team, made up of doctoral students Joseph Hitt and Matthew Holgate, and Barrett Honors College student Ryan Bellman, have coined SPARKy a "robotic tendon" because of its bionic properties.

'What we hope to create is a robotic tendon that stretches springs when the ankle rolls over the foot, thus allowing the springs to thrust or propel the artificial foot forward for the next step,' Sugar added. 'Because energy is stored, a lightweight motor can be used to adjust the position of a uniquely tuned spring that provides most of the power required for gait. Thus, less energy is required from the individual.'

The team is the first to apply regenerative kinetics to design a lightweight prosthetic device. Others are using large motors combined with harmonic drives, a monopropellant or extremely high-pressure oil.

Sugar's team already has proof that SPARKy is working. In recent experiments with able-bodied subjects outfitted with a robotic ankle orthosis, or a powered-assist device, the researchers found that the spring and motor combination was able to amplify the motor power by threefold. This finding will allow SPARKy to be downsized from a 6-to-7kg motor system to a 1kg (2.2lb) system, which is significant weight savings for those who wear a prosthesis.

The project is led by ASU's Human Machine Integration Lab, Arise Prosthetics and Robotics Group. Arise Prosthetics is helping in the fitting of the device, and Robotics Group is designing embedded processors and motor amplifiers.

The first phase of SPARKy featuring the robotic tendon is expected to be ready for demonstration in December.

'I will know it is successful when a wounded solider is able to walk using the device on a treadmill,' said Sugar.

Read more: http://www.theengineer.co.uk/news/sparky-prosthesis/299745.article#ixzz1EKSLSyDe