ORNL technology could mean improved prosthesis fitting, design

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ORNL biomedical engineers Boyd Evans and John Mueller are working to improve prosthetic fitting and design for young military amputees.

(PhysOrg.com) -- Soldiers returning from war who have lost a leg could lead a more active lifestyle with the help of a technology being developed by Oak Ridge National Laboratory researchers.

ORNL biomedical engineers Boyd Evans and John Mueller are perfecting a portable, wearable system to measure walking patterns that can be applied to real-world activities in a variety of settings.

"For example, if an amputee soldier wants to train and return to active duty, we need to understand how he or she would fare on a military training course, which you can't measure in a laboratory setting," said Evans, who leads the project.

Evans and Mueller are collaborating with Center for the Intrepid at Brooke Army Medical Center to improve prosthesis performance for young soldiers. Wounded soldiers tend to be between ages 18-25, need a prosthetic that will last a long time and are active so they are putting more stress on their healthy limb.

"Lower leg amputees in the military population are typically young, athletic and, besides their injuries, in top physical condition," Mueller said. "For this reason, most military patients want to remain active and in some cases return to active military duty. We are looking at how we can improve prosthesis fit, alignment and function."

Additionally, Evans and Mueller want to develop a gait analysis system that can be utilized outside of a confined laboratory setting. Typically, motion- capture gait analysis is performed in a large, multimillion dollar laboratory using controlled conditions and limited activities.

"The goal of our research is to use the recent advances made in video game technology to develop inexpensive tools for amputee rehabilitation," said Evans. "This will allow advanced rehabilitation techniques to both be used in smaller clinics and to be taken outside the clinic."

To monitor the motion and force of walking patterns, Evans and Mueller are collaborating with BAMC to utilize inertial measurement units and other sensors that can be strapped onto segments of a subject's leg, such as the thigh, calf and foot. The data collected from the IMU transfers to a computer, and algorithms calculate the motions and forces associated

with specific joints.

To test the effectiveness of IMUs, Evans and Mueller use a robot leg, which has been programmed with data from a walking person. Evans and Mueller plan on going to the Gait and Motion Analysis Laboratory at Center for the Intrepid in a few months to test their system on a human subject with a prosthetic and healthy leg.

If the prosthesis is not fit or aligned correctly, it could affect a patient's walking patterns, resulting in "asymmetric" gait. These abnormal gait patterns can increase the stress on the healthy limb, leading to problems later in life such as arthritis.

"We have high expectations for this system once it is fully developed," Mueller said. "We think it will improve the prosthetic fitting and aligning process and help lower the risk of chronic joint disease in this group of wounded warriors."

A subset to this overall project, called "Using Kinect for Xbox 360 and Computer Vision to Analyze Human Gait," won the Siemens Competition for Math, Science and Technology in early December. The multi-camera Kinect is connected to a computer that uses body-tracking algorithms to measure how different parts of the leg move when someone's walking. Summer interns Cassee Cain and Ziyuan Liu, who worked with Evans and Mueller, received the top Siemens team award for their project.

Evans and Mueller's work represent an overall collaboration with Otto Bock Healthcare and the Center for the Intrepid at Brooke Army Medical Center. ORNL researcher Randy Lind is developing an advanced platform to measure the forces associated with motion, and researchers Nance Ericson and Ethan Farquhar are integrating the entire system to incorporate wireless data collection.

Provided by Oak Ridge National Laboratory