**Alfred University alumnus at forefront of soft robotics research**
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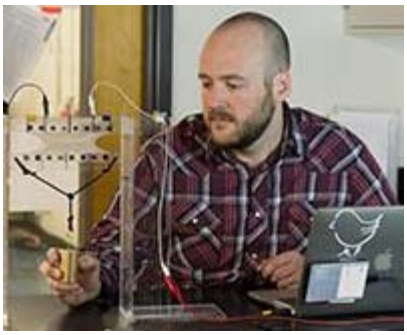

Tim Morrissey ⓫11 in the Keplinger Research Group lab. (Photo courtesy Keplinger Research Group)

BOULDER, CO A group of students at University of Colorado Boulder are at the cutting edge of soft robotics research, developing artificial muscles that closely resemble, in function and appearance, those found in the human body.

One of those students is Alfred University alumnus Tim Morrissey, who earned a BS degree in ceramic engineering in 2011. Now a fifth-year graduate student at Colorado set to earn a PhD in mechanical engineering in 2018, Morrissey has been working at Keplinger Research Group since its founding in 2015 by University of Colorado Boulder mechanical engineering professor Christoph Keplinger.

According to the organization&s website, the group&s research philosophy centers around “improving the quality of life by solving fundamental problems that impede human progress on global issues…We adopt a style of research that starts new projects by identifying practical problems and by approaching them with tools from diverse scientific disciplines.”

One of more than a dozen students (graduate and undergraduate) working at the lab, Morrissey has always been excited about the research he and his colleagues are performing, particularly because soft robotics is a relatively nascent field with the potential to significantly improve people&s lives.

“When I met Christoph (Keplinger) we chatted for a couple hours, he showed me what he wanted to do, and I met some people who were very passionate about” the research,” Morrissey said. “This (soft robotics/artificial muscles) is a very new field 10 to 30 years old depending on who you ask so I saw an opportunity for me to make a difference.”

Morrissey, who serves as laboratory manager, helped author a paper on the hydraulically amplified self-healing electrostatic (HASEL) actuator developed by Keplinger Research Group. The HASEL actuator is an electrically-activated device that can mimic the movement of human muscles. It consists of an electrically insulated liquid, similar to canola oil, encased in a soft, pliable plastic pouch connected to electrodes. When activated with a current of electricity, the shape of the pouch changes, replicating natural muscle movement. Another actuator that operates similarly, the Peano HASEL actuator, has the ability to contract. The HASEL and Peano HASEL actuators come in different shapes and thus can mimic different actions: flexing; gripping and releasing; lifting and dropping.

Research papers on the HASEL actuator and Peano HASEL actuator were presented in early January and appeared several publications, including Science and Science Robotics magazines. A unique feature of the actuators being developed by Keplinger Research Group, and what has attracted much of the publicity surrounding the research, is their self-healing abilities.

Morrissey explained that the downside of actuators that use electricity is the potential for device failure (damage) caused by powerful electrical currents.

“The electrical charge (used to activate the HASEL actuator) is thousands of volts; (and if the device shorts) it&s like mini-lightning bolts going through the materials,” Morrissey explains. The makeup of the HASEL actuators, namely the presence of liquid, is what makes them unique, giving them the ability to “self-heal.”

“As electricity passes through the liquid, it is redistributed,” preventing damage to the actuator&s soft material skin, Morrissey said. Other soft actuators which do not utilize hydraulics (electrostatic actuators, such as dielectric elastomer actuators) are prone to significant damage from electrical currents.

Developing the HASEL actuators is but the first in a process of what researchers at Keplinger see as dramatically improving robotics. Their goal is to create artificial muscle units that are used in soft-structured robots that more closely resembles a human not only in appearance and feel, but also in motion. Unlike with rigid, bulky conventional robots, robotics that utilize HASEL actuators have the capacity create a more compact artificial muscle.

“In the future, there may be service robots that interact with the elderly, or we may have nanny robots in our homes,” Morrissey said, explaining that a goal is to create robotic devices that are more human-like in appearance and function, and thus less intrusive.

Artificial muscles using soft robotics technology can also be applied to prosthetics, where electrically-controlled artificial limbs look and feel like human limbs.

“Prosthetics are usually made of hard, rigid material, but the human body is soft,” Morrissey said “When hard and soft materials are combined, it&s not the greatest marriage. This is where soft robotics can provide great benefits.”

When he left Alfred after earning his BS in ceramic engineering in June 2011, Morrissey moved on to the U.S. Department of Energy&s Oak Ridge National Laboratory in Tennessee, where he worked as a research associate in ceramic science and technology until December 2012. While at Oak Ridge, Morrissey worked with another AU graduate, Andrew Wereszczak (BS, ceramic engineering, 1987) in the Ceramic Science and Technology Group.

He began his graduate studies at University of Colorado Boulder in 2013, earning a Master of Science degree in mechanical engineering (material science track) in 2016. Morrissey&s road to Boulder, CO, and Keplinger Research Group began at Alfred University, and he credits the time he spent at AU with helping prepare him for the research he&s involved in now.

“Alfred is where I got my first lab experience. Getting that groundwork with Dr. (William) Carty (professor of ceramic engineering and materials science) was crucial. It really showed me how scientific research happens,” said Morrissey, who will be back on campus March 15 to deliver an engineering undergraduate seminar. “I was involved in a lot of clubs at Alfred and it gave me leadership skills. I didn&t realize how important that was, but it has really helped me at Keplinger, where I oversee about 15 students.”

Alfred is also where Morrissey met his wife of two years, Elizabeth “Elyse” (Fasano) Morrissey. She graduated from AU in 2011 with a BA degree in psychology and is the granddaughter of AU alumnus Joe Fasano &54. Elyse is a lead teacher at the Joshua School in Boulder, which specializes in teaching children with autism and development disabilities. She earned a master&s degree in special education and applied behavior analysis in 2016 from Endicott College

“Elyse single-handedly kept me in grad school during the tough times,” Morrissey said. “She&s the real rock star.”

Both Tim and Elyse have multi-generational family connections to Alfred University: Tim&s brother, Michael, earned a MS degree in literacy education in 2012, and he has two uncles and an aunt who went to AU; in addition to her grandfather, both of Elyse&s parents Michelle Fasano Reffner &84 (BA, political science) and the late Patrick Fasano

&80 (BS, ceramic engineering) are Alfred University alumni.

Morrissey said after he gets his PhD, he will continue working at Keplinger Research Group, which is drawing interest from commercial entities interested in funding additional research projects. In addition to soft robotics, another research field he has been closely involved in has been renewable energy. Morrissey and his colleagues at Keplinger have been studying ways to harvest energy from ocean waves, and Morrissey will be presenting a paper on that research in March and April of this year.

Morrissey said one of the things he enjoys most about his work is that it has the potential to improve the world and help people.

“When I started (at Keplinger) we had a lot of great ideas and I was helping spearhead that renewable energy program. The world needs new energy sources, more technologies to produce electricity,” he said. “We have a great team here that wants to dive in and learn together. We&re looking at big problems and finding ways to solve them and that&s made my work extremely gratifying.”