Dexterous Piezomuscle for Robotics

Auburn University is seeking a development partner for a novel microactuator that has the building property of muscle cells.

Overview: While robotics technology has advanced significantly in the past several decades, one of the most fundamental gaps of knowledge in the creation of human-like machines is how to create artificial muscles. Although numerous muscle cell-like actuators on the market attempt to remedy this, they often have prohibitive issues such as poor force or displacement magnification, or high voltage requirements, leaving them unable to mimic muscle cells as accurately as could be possible. These issues are solved by the s-drive, the first manufacturable microactuator with the building block property of muscle cells, allowing it to scale to have the size and functionality of real muscle of all sizes. This technology has potential applications in the robotics, prosthetics, and manufacturing sectors.

Advantages:

- **CONNECTABLE -** Can be connected similar to the how muscle cells are connected to form muscle tissue. Able to contract and expand.
- **SCALABLE -** Readily scales several orders of magnitude for motion. Single units can deflect by microns while larger arrays may deflect by decimeters or meters. Force scales similarly.
- **HIGH DEFLECTION** - Upon applying the same voltage, experiences a deflection nearly 300 times larger than that of the comb drive.

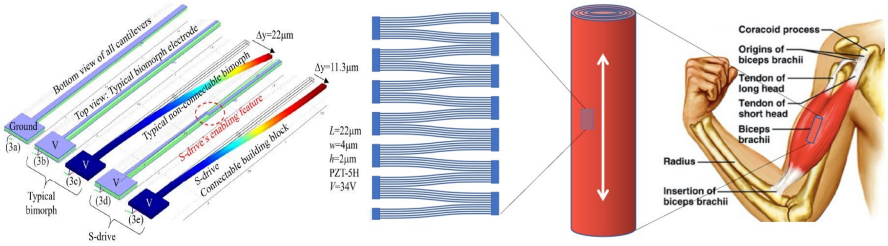

Figure: (Left) The difference between a typical bimorph and s-drive. The cantilevers are made of piezoelectric material (green) sandwiched between conductive films (purple).(Right) S-drives may be connected in combinations of series or parallel for desired performance.

Description: Although significant progress has been made in the field of artificial muscles, today's MEMS actuators do not have the same force and deflection magnitude as real muscle cells, leaving them unable to mimic muscle movements as well as they could. By adjusting the shape of typical piezoelectric bimorphs, the s-drive has both considerable deflection and high connectability. The s-drive is differentiated from a typical piezoelectric bimorph by its shape. While the top surface electrode of a piezoelectric bimorph maintains the same side along the top surface, the s-drive's top surface electrode switches sides halfway along the top surface. Thus, when voltage is applied, the typical piezoelectric bimorph forms a u -shape, while the s-drive forms an s-shape. This s-shape not only increases the deflection of the s-drive, it also enables the s-drive to be connectable. It can be formed into 2D or 3D arrays, allowing the muscle cell-sized s-drive to form the building blocks of piezomuscle, a novel type of artificial muscle that would be able to mimic human muscle movements.

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Status:

- Full US (20200075838) and EPO patent applications filed
- This technology is available for exclusive or non-exclusive licensing.
- Simulations have successfully demonstrated the usability and practicality of the technology.

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