Multiple Degree-of-Freedom Micro-Scale Guidewire (#7532)

A robotically actuated 2 degree-of-freedom guidewire

Georgia Tech inventors have developed a robotically actuated 2 degree-of-freedom guidewire with an outer diameter of 0.78mm. The design involves rectangular notches on two sides of a Nitinol superelastic tube of 0.78mm diameter, which act as joints. These joints are oriented at 90 degrees to each other to allow the 2 degree-of-freedom motion. Their most recent prototype demonstrates bi-directional motion capability. Furthermore, by adding these degrees-of-freedom along the length of a guidewire, and at specific locations, customized bending can be enabled at those locations based on the task requirement. As an example, passive springs may be used to enable back and forth motion for a specific joint. This will reduce by half, the number of actuators required to move the guidewire/device for each degree-of-freedom. Therefore, only one actuator is needed to move the joint back and forth. It is envisioned that the device could be fabricated using 3-D printing technology, whereby the inventors can print the channels to route the tendons internal to the guidewire/device to facilitate joint motion.

Benefits/Advantages

- Lays the foundation for developing the world’s smallest bidirectional motion capable, multi-DOF, mechanically actuated guidewire
- Achieves individual control of each degree-of-freedom
- Enables greater range of motion and steer ability at anywhere along the length of the guidewire compared to traditional active guidewires
- Allows tendon driven actuation to enable multiple degree-of-freedom motion capability with a potential compact footprint

Potential Commercial Applications

- Interventional and minimally invasive devices and guidewire
- Use for physicians or teleoperatively
- MRI, ultrasound, CT, Fluoroscopy, etc
- Vascular surgery, interventional cardiology, cardiothoracic surgery, neurosurgery, etc.

Background/Context for This Invention

In most cases of peripheral arterial disease (PAD), the operating surgeon must use a variety of catheters riding on a thin wire known as a ‘guidewire’. This guidewire must be manually navigated through a tortuous pathway of arteries to arrive at the diseased area. Automation of the guidewire therefore reduces surgeon effort and minimizes the time required for a PAD procedure. Adding multiple degree-of-freedom (DOF) capabilities in a guidewire is critical for effective navigation, but is restricted by the size constraints of a standard guidewire.

Jaydev P. Desai
Director, RoboMed Laboratory and Professor - Georgia Tech Wallace H. Coulter Department of Biomedical Engineering

Yash Chetan Chitalia
Graduate student – Georgia Tech School of Mechanical Engineering

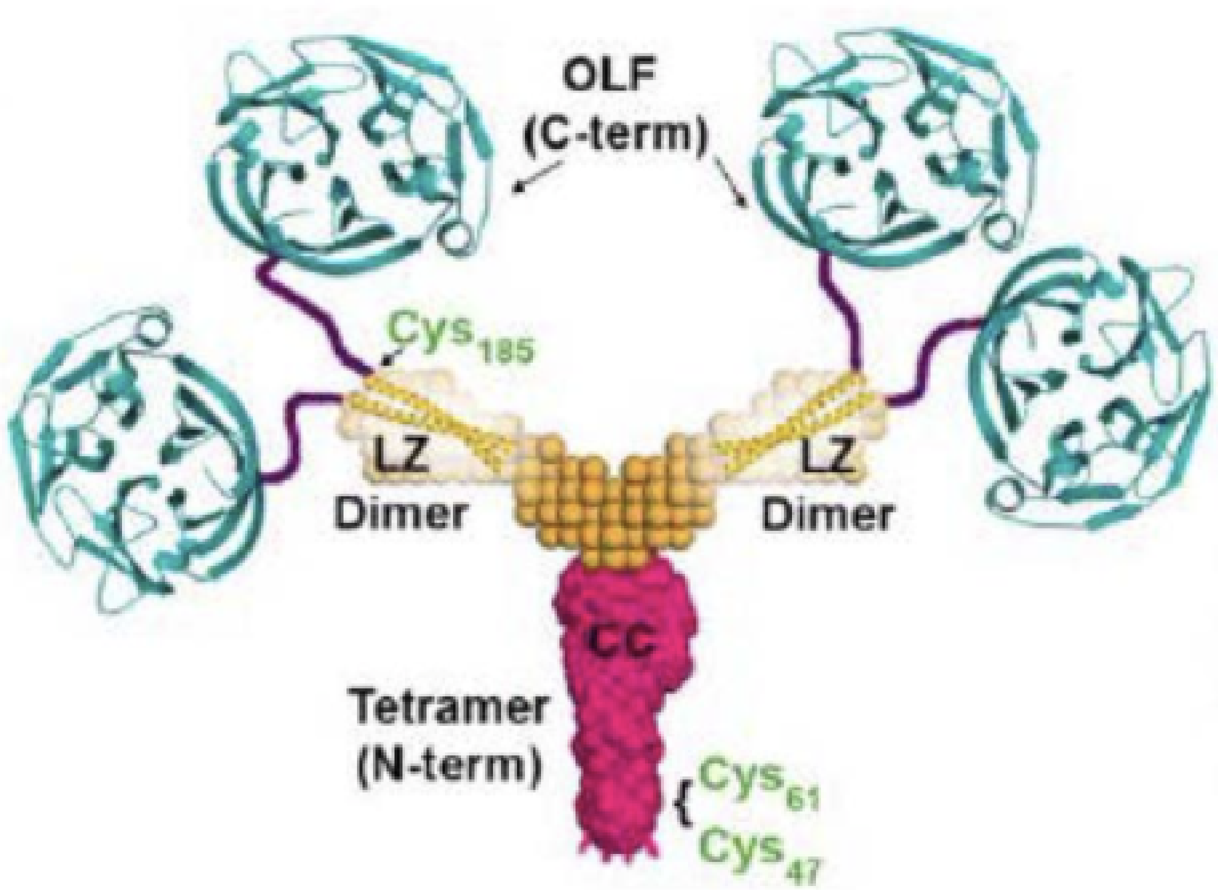
More Information

Publications

For more information about this technology, please visit:
https://licensing.research.gatech.edu/technology/multiple-degree-freedom-micro-scale-guidewire

Images:

The gene structure depicting the domains of myocilin, including signal peptide, location of key cysteine residues, and its coiled-coil, leucine zipper, and olfactomedin domains.



The myocilin quaternary structure based on solution X-ray scattering, X-ray crystallography, and chemical cross-linking experiments.