Skysong Innovations
Advancing the Arizona State University Knowledge Enterprise

1475 N. Scottsdale Road, Suite 200
Scottsdale, AZ 85287-3538
Phone: 480 884 1996 Fax: 480 884 1984

Case ID:M19-161L
Published: 4/18/2023

Inventors

Hamidreza Marvi
Mahdi Ilami
Reza James Ahmed

Contact

Jovan Heusser
jovan.heusser@skysonginnovations.com

Steerable Surgical Needles & Other Assemblies

Surgical needles are commonly used in diagnostic and therapeutic procedures, as well as minimally invasive surgeries. Precise navigation of a needle during any procedure is vital for accurate target placement and minimization of tissue damage. Needle steering encompasses techniques that guide the tip of a flexible needle shaft to a target that is located behind obstacles of some kind. The most common needle steering method involves applying force and torque at the base of a flexible needle with an asymmetrical tip. This method results in compression and torsion effects in the needle shaft, tissue damage during tip rotations, and restricted reachable work space from the limited radius of curvature.

Researchers at Arizona State University have developed a novel steerable assembly system for active needle steering in soft tissue. This system does not require mechanical actuation so it eliminates compression and torsion effects as well as tissue damage. A smaller radius of curvature can be achieved with this system to allow for more complex surgical operations. Prototypes have been developed and tested in multiple different phantom tissue models. Although tested with needles, this system can utilize other steerable surgical tools as well.

By using active but non-mechanical navigation of surgical needles, this system increases target placement accuracy, minimizes tissue damage, and subsequently improves clinical outcomes.

Potential Applications

- Needle or other medical device steering
  - Percutaneous diagnostic and therapeutic procedures
    - Biopsies, brachytherapy, thermal ablations, targeted drug delivery, interventional radiology & more
  - Minimally invasive surgeries

Benefits and Advantages

- More precise control and navigation of the needle/surgical tool

- Radius of curvature down to 10.16 mm in tested phantoms
- Reduced tissue damage - no need for duty cycled rotation of needle tip to redirect asymmetric forces at tip during insertion
- Utilizes a non-load bearing needle shaft to eliminate issues associated with compression and torsion effects (including buckling and limited curvature)
- Existing imaging machines can be used to facilitate active steering and tracking
- Can be adapted to any steerable surgical tool
- Reduced deflection - the needle is able to correct its trajectory and follow the desired path after puncturing a tissue interface

For more information about this opportunity, please see

Ilami et al - Sci Rep - 2020

For more information about the inventor(s) and their research, please see

Dr. Marvi's departmental webpage