Safe and precise surgical catheter guiding by robots

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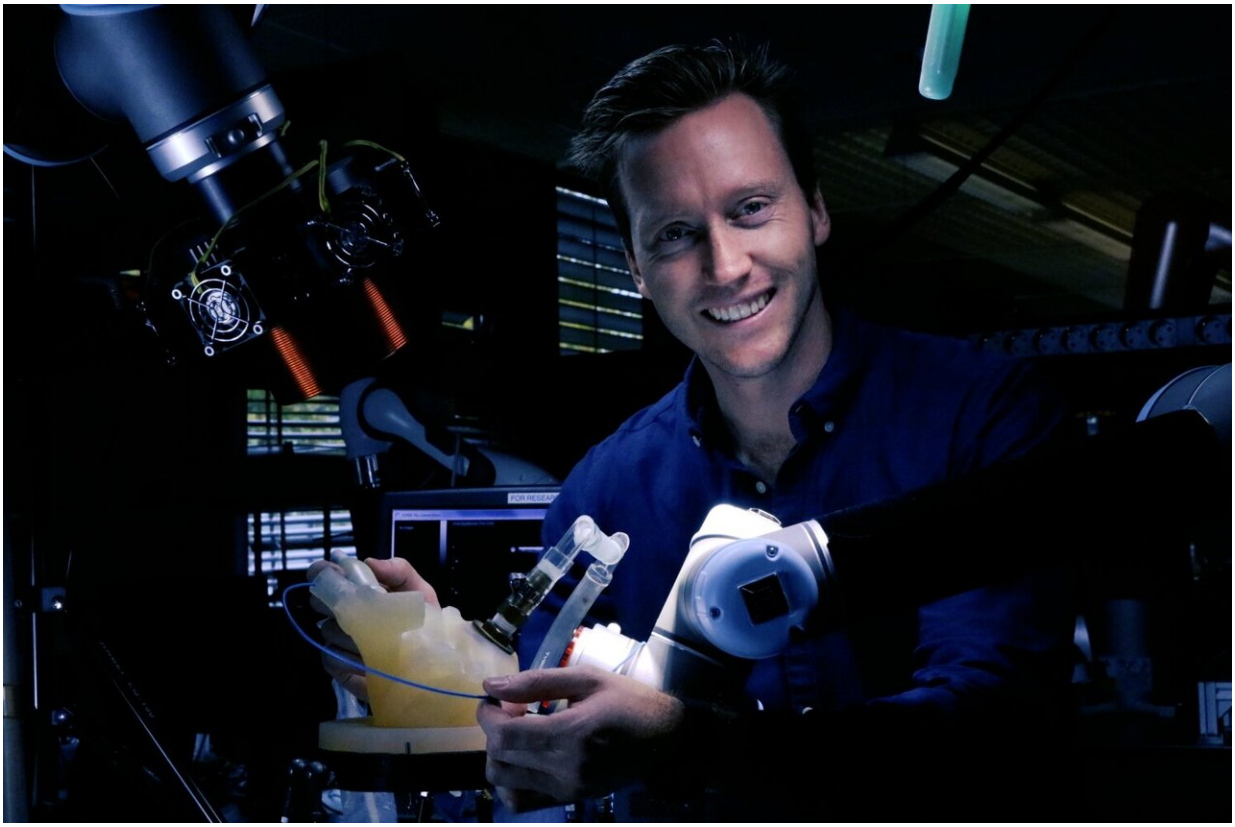

Credit: University of Twente

Traditionally, the success of a minimally-invasive surgical (MIS) procedure is dependent on the clinician's capabilities. Prominent MIS procedures include vascular surgeries, during which catheters are

inserted into the body, steered to a target location, and used to treat a vascular disease. A particular challenge in vascular surgeries is the accurate positioning of the catheter tip. Researcher Christoff Heunis of the University of Twente came with a solution. He designed the ARMM system, a robotic surgical platform that steers surgical catheters through externally-generated electromagnetic fields. Heunis envisions it to be a safe and precise alternative to manual steering and hope to provide surgeons with the dexterity required to complete an intervention faster. Today Heunis will defend his Ph.D. work on this topic.

By utilizing a single collaborative robot arm, this ARMM platform (Advanced Robotics for Magnetic Manipulation) could potentially fit easily into the OR while ensuring a small footprint. So far, in the Surgical Robotics Laboratory of the University of Twente, he has shown that catheters can be magnetically steered inside phantom arteries, and animal tissue, with submillimeter precision.

Unnecessary trauma

Vascular diseases (those that affect the arteries, heart, etc.) have been well documented. Organs affected by these diseases are delicate and remote, and the vasculature to reach them is, in some cases, torturous. Standard interventions for endovascular repair involve high-risk complications, leading to unnecessary trauma during catheterizations (when a surgeon inserts and steers a catheter in the arteries). Moreover, the accuracy of catheter steering is highly dependent on the abilities of a clinician.

Heunis graduated as a master in biomedical engineering in South Africa before moving abroad in 2017, which led him to the Netherlands. In Enschede, his doctoral position started as a researcher in the Biomechanical Department, University of Twente under the supervision of Prof. dr. Sarthak Misra. He has collaborated with vascular surgeons,

technical medicine researchers, and worked with clinical institutions, including the Technical Medicine Centre, Medisch Spectrum Twente, UMCG, and Meander Medisch Centrum Amersfoort. In his four years as Ph.D. candidate, he has also devoted substantial time to the mentoring and supervision of bachelor and master students—20 in total, to which he regularly conveyed the same message:

"Regardless of your past or your origin and irrespective of the hardships that come your way: be empowered by your motives. As an academic, you often come across individuals that are unsupportive or situations that you would rather avoid. Just take the chance—eventually, the only manner someone can truly influence you is to give you their opinion, and that does not have to be your reality. You might be surprised at how easy it is to do what is best for you—so go out (figuratively) and do it!"

Novel-T startup competition

Currently, Christoff Heunis is working closely with Novel-T to investigate the feasibility of this system in hospitals around the Netherlands and Germany. "The highlight of my research was when I joined the Novel-T startup competition, which I did out of pure curiosity. What I did not expect was the potential that my project had in the clinical world. It turns out that the ARMM system could potentially be the next Da Vinci. My motto is: One day or day one—you decide. This became the foundation on which I based my decisions—especially those that influence my future, and even more importantly decisions I had to make in 2020 during the pandemic. I transformed from an academic to an entrepreneur in just a few months and realized what impact my work could have—as a potential medical system, ARMM could help patients recover as swiftly and completely as possible."

"My team and I have made some active contributions towards starting a start-up company (Flux Robotics), and I am currently participating in the

UT Challenge, within which I am through to the next round. I am also shortlisted at the startup competition Digital Euregio Summit 2021 (DSE) where I will represent the startup in May.

Provided by University of Twente