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FRAUNHOFER INSTITUTE FOR MEDICAL IMAGE COMPUTING

PRESS RELEASE

Simulated procedures on virtual hearts

Fraunhofer MEVIS presents a new method for planning minimally invasive heart valve surgery at an international conference in Berlin

One of the world's most important conferences in the field of computer assisted radiology and surgery, CARS 2018, will take place from June 20 to 23 in Berlin. The Fraunhofer Institute for Medical Image Computing MEVIS in Bremen will make an essential contribution to one of the conference's key topics: How can minimally invasive heart procedures be performed more effectively and patient-friendly with the help of modern data and image processing algorithms?

"We work on new technological approaches that support diagnosis and therapy planning of cardiovascular diseases," says MEVIS researcher Anja Hennemuth. Since May 1, 2017, she has been a professor at the Institute for Imaging Science and Computational Modeling in Cardiovascular Medicine (ICM), a new joint institute of Charité and the German Heart Center in Berlin. At the institute, an interdisciplinary team of experts in cardiovascular medicine led by Prof. Titus Kühne and experts in biofluid mechanics under Associate Prof. Dr. Leonid Goubergrits works together with researchers in image-based therapy support towards new solutions for clinical decision support systems. Since 2009, Hennemuth has been the head of cardiovascular research and development at Fraunhofer MEVIS. She has accomplished groundbreaking work in the development of solutions for cardiovascular image analysis and image-based modeling that have been transferred into medical devices. In 2017, she was appointed to a joint professorship at the ICM and the Technical University of Berlin.

Her team developed a software system that supports surgeons in planning minimally invasive heart valve operations. One common procedure is to sew in a special ring to reduce the area that closes the heart valve. The goal is to stop the valve from leaking and to reduce the amount of blood that flows back into the atrium.

The new software should help clinicians estimate the chances of success and plan the type and course of the procedure more precisely. The experts can create a dynamic heart model based on the patient's MRI, CT, or ultrasound image data. As a result, they can observe the heart valve during different phases of the heartbeat on their monitors. In April, Hennemuth's colleague Lennart Tautz received a Karl-Heinz-Höhne prize, given for innovative developments in medical visualization, for programming the software module.

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In a second stage, the software simulates a procedure during which a ring is sewn into a virtual heart, thus correcting or reducing heart valve insufficiency. "Subsequently, the system simulates the procedure's effect on the heart function," explains Anja Hennemuth. "We can assess how much easier the heart pumps now that the blood flows differently after inserting the ring." The surgeons can simulate different variations of the procedure to identify the most effective option.

A prototype of the software is currently being validated and results are being compared to actual patient outcome information. The researchers use image data acquired before and after a procedure. Afterwards, they simulate the procedure and examine to what extent the simulation matches the real data.

"So far, the results have been very good and the surgeons are satisfied," says Hennemuth. She hopes to implement the new method into a medical device within a few years. "The foundation of our success is the close interdisciplinary collaboration between Fraunhofer MEVIS, Charité, and the team of Prof. Volkmar Falk at the German Heart Center in Berlin." In the future, the team aims to transfer the method to other types of heart procedures.

Another promising project to be discussed at CARS 2018 in Berlin is the new navigation method for vessel catheters, presented by MEVIS Institute Director Horst Hahn. Such catheter procedures are minimally invasive, thus making them gentle and cost-effective. However, in order to navigate the catheter tip through the blood vessels to the heart in a controlled and safe manner, the repeated administration of contrast agent and X-ray fluoroscopy have been necessary. This leads to excessive radiation exposure for patients.

The new 'shape sensing' method presents an alternative. The distal part of the catheter is equipped with sensors that can capture the particular bending of the tubular instrument. These measurements are fed into the software. The software contains a detailed model of the vessel systems reconstructed from prior image data of the patient. The adjustment of model and measurement data enables precisely calculating the current location of the catheter tip. Doing so, the necessity of costly and burdening imaging would hopefully drastically diminish and simplify navigation.

Since the 1980s, the international CARS (Computer Assisted Radiology and Surgery) conference has taken place every year in various locations worldwide. This year, Berlin hosts the 32nd conference. Around 700 participants are expected to attend the four-day event.

Embedded in a worldwide network of clinical and academic partners, **Fraunhofer MEVIS** develops real-world software solutions for image-supported early detection, diagnosis, and therapy. A strong focus is placed on cancer as well as diseases of the circulatory system, brain, breast, liver, and lung. The goal is to detect diseases earlier and more reliably, tailor treatments to each individual, and make therapeutic success more measurable. In addition, the institute develops software systems for industrial partners to undertake image-based studies to determine the effectiveness of medicine and contrast agents. To reach its goals, Fraunhofer MEVIS works closely with medical technology and pharmaceutical companies, providing solutions for the entire chain of development from applied research to certified medical products. www.mevis.fraunhofer.de/en

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