The Determined Navigator

Medical information scientist Lena Maier-Hein, a Heinz Maier-Leibnitz prizewinner, seeks to optimise assistance systems for minimally invasive procedures in cancer diagnosis and treatment. But the biggest challenge is transferring the technology to clinical practice.

In sports, Lena Maier-Hein has always been a team player. In 2009 she was a member of Germany’s champion beach basketball team. And when it comes to her specialist field of medical informatics, the 34-year-old is also an achiever: ambitious, full of ideas and extremely successful. Her greatest success was winning the 2013 Heinz Maier-Leibnitz Prize, the most important award for early-career researchers in Germany, presented by the DFG, and a 2015 ERC Starting Grant.

Team spirit and personal ambition – which many would have difficulty reconciling – are perfectly united in Dr.-Ing. Lena Maier-Hein. The leader of the junior research group “Computer-Assisted Interventions” at the German Cancer Research Center (DKFZ) in Heidelberg, has been held up on the way to our interview due to the cancellation of her flight from London, where she was visiting a collaboration partner. So it’s up to the other members of her 10-strong group to talk about their projects.

We finally meet up with Maier-Hein later in the foyer café at the DKFZ: a young woman bursting with energy, with the look of an athlete, sporting a red pullover, black jeans and red ankle boots. She expresses herself clearly and precisely, but modestly and without frills. You can’t help wondering whether she uses her bright red smartphone to make those top-level calls. You can certainly imagine it, but also that she knows how to motivate her team and get the best from them. “I believe in working as a team and the value of collaboration,” she says succinctly.

Lena Maier-Hein works at the interface between informatics, medical technology and surgery. The basic question she addresses is: How can patient data be consolidated and made available so as to provide the surgeon with meaningful support and benefit the patient? She develops new techniques, methods and algorithms to enable surgeons to better plan and perform minimally invasive procedures, for example in the diagnosis of cancer (punctures) and its treatment (ablation).

She began by working with conventional assistance systems based on preoperative images (for example an MRT scan of the cranium). Now she has her sights set on intraoperative images of internal organs taken, which are taken during a procedure. Navigating with a needle in soft tissue pre-
In front of the DKFZ: Lena Maier-Hein (centre) with members of her junior research group “Computer-Assisted Interventions”. New computer-based assistance systems (below) could help surgeons plan and carry out minimally invasive procedures more effectively.

sents particular challenges to surgeons because organs can change shape or move, for example due to breathing.

This is the focus of Lena Maier-Hein’s work. As a doctoral researcher she was a DFG fellow in the Research Training Group “Intelligent Surgery”, whose purpose was to develop new computer-based methods for soft tissue surgery. As part of a project entitled “Planning and Navigated Use of Thermal Therapy Methods”, she developed a new computer-based needle control system described by experts as being both precise and effective.

Looking back, she praises the tandem system whereby information scientists worked alongside medical scientists, which meant that “the technology was developed alongside surgical considerations”. This practical focus cannot be taken for granted; all too often, innovative software concepts fail to make the jump to clinical practice “because they aren’t simple enough or they don’t save enough time or money”. For this reason, she regards the transfer to practice as the greatest challenge.

In another DFG project, she collaborated with colleagues in Erlangen to utilise time-of-flight (ToF) camera technology in open and minimally invasive surgery. The key outcome was the discovery that a ToF camera can be used to measure a three-dimensional surface quickly, accurately and without contact. Using a combination of high-resolution 2D colour images and corresponding 3D distance data, a new data layer can be generated during the operation.

Maier-Hein first came into contact with informatics in her final years at school, and was inspired by its numerous applications. She studied the “dynamic subject” in Karlsruhe and at Imperial College London. As a doctoral researcher and fellow in the Research Training Group “Intelligent Surgery”, she moved to Heidelberg and the DKFZ, where Professor Hans-Peter Meinzer, head of biological and medical informatics, became her mentor. In 2009 she obtained her doctorate from TH Karlsruhe and was awarded the DKFZ’s Waltraud Lewenz Prize. In 2012 she became the leader of the new junior research group on “Computer-Assisted Interventions”. Just three years later, at the age of 33, she completed her habilitation.

In spite of this rapid climb up the career ladder, she describes the job situation for young researchers in Germany as simply dire and extremely difficult for the individual. Herself the mother of a two-year-old daughter and married to medical information scientist Dr. Klaus Maier-Hein, she doesn’t mince her words: the demands of an academic career, parenthood and family – and in her case a dual career – are all but impossible to balance. Without the certainty that enables people to plan their futures, careers can simply fizzle out. She believes that a proper tenure track model as in the English-speaking world could help.

In terms of her work, Maier-Hein’s vision is that “computer assistance will cover and support the entire medical process from the choice of treatment strategy through the planning and implementation of the intervention to clinical follow-up”. She believes that this can be best achieved through cooperation. She invests a lot of time and energy in networking (“She’s a master of cooperation,” says one colleague) and cooperates with institutions of excellence such as Imperial College London, Vanderbilt University and University College London. “To come up with outstanding solutions you need complementary expertise,” she says. Full stop.

You don’t need to be a technical expert to understand the value of innovations, she argues: the technology that helps motorists to navigate should be cheaply available to surgeons in the operating theatre. She believes that assistance systems will be part of the future in minimally invasive surgery – and through her research, she wants to help make this happen.

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