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Artificial Intelligence for Medical Technology

Small and medium medical-technology enterprises (SME) in Baden Württemberg are set to soon use artificial intelligence (AI) methods for the improvement and new development of their products. The expertise for this has been provided by the Project Group for Automation in Medicine and Biotechnology (PAMB) at Fraunhofer IPA and the Application Center for Intelligent Machines in Medical Technology (ANIMMED) at Mannheim University Hospital. As part of „Forum Gesundheitsstandort Baden-Württemberg“, the state of Baden-Württemberg is providing ANIMMED and a further seven projects with EUR 13.9 million in funding.

AI methods enable machines to autonomously operate, carry out analyses and make decisions in complex situations. These characteristics make AI systems particularly relevant for use in medicine. In diagnostics, AI methods already make it possible to analyse vast quantities of data in practice, which a human being would be unable to handle.

Medical devices can also be automated by using AI methods. Automated devices are significantly more efficient in clinical applications, supporting doctors more effectively. For current medical applications, the automation of medical devices seems only possible using AI methods. This is due to the natural diversity of the human organism, its susceptibility to injury and its complex biology. Humans can cope with this complexity and variability. With the help of intelligent machines, humans would still make the decisions and manage the clinical process, but they could use their resources significantly more efficient. Therefore, automation using AI systems is viewed today as the technological key to the efficient precision medicine of the future.

Despite these expectations, AI only features in clinical applications on rare and limited occasions, with the exception of a few areas of diagnostics such as radiology and dermatology. Yet the potential inherent in AI for the operation of medical devices currently remains largely undeveloped in clinical practice.

A range of aspects enable AI solutions to be implemented in medical technology. There are available AI software libraries and algorithms as well as ample storage capacity and the necessary computing power. In addition, efficient measuring technology and afford-

able computer technology as well as new materials, drive concepts and clinical approaches all mean that AI can be usefully incorporated in medical devices and instruments.

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Advantages of AI in medical technology

Various projects undertaken by the Mannheim Project Group have shown that AI is of the utmost importance in hospitals for the intelligent operation of machines, i.e. instruments, devices and systems such as robots. In future, with the use of AI, machines will be able to support doctors with critical tasks and managing complex procedures in hospital, in that it would even be possible to automate processes, relieving hospital staff of certain tasks where required. As a result, the optimum in care, diagnosis and intervention tailored to the individual patient can be achieved, enhancing the efficacy of these aspects of treatment. With this, medical care will remain affordable in the future despite the additional costs incurred for the digital infrastructure required.

Training data are the key

One of the key points of AI application for medical devices is access to training data, as adaptive AI systems for intelligent devices and instruments should be trained with large volumes of valid data. This means that the data represent reality with sufficient accuracy and the calculated result corresponds to reality. Especially for medical technology applications, such large volumes of data can only be obtained in everyday clinical practice or in extremely realistic scenarios and simulations. In most cases, the development of AI systems in medicine fails to meet this requirement. The costs are too high for companies and as a result, a vicious cycle is formed: a lack of available applications means that the feasibility and benefits of AI solutions cannot be sufficiently proven by practical example. This again makes it difficult to develop new applications.

Best practice demonstrators and development methods that reflect clinical practice

Using best practice demonstrators and the range of development methods that reflect clinical practice, ANIMMED is breaking this vicious cycle: using three demonstrators for medical AI systems, it evaluates its own AI development methodology and at the same time uses the results as reference projects. The close network of partners and their location on the campus of the Mannheim Faculty of Medicine (UMM) offers an optimal ecosystem for this purpose. The medical staff and facilities at UMM, the Heinrich-Lanz Center (HLZ) as specialists for data collection from clinical sources and the Fraunhofer Project Group for Automation in Medicine and Biotechnology PAMB with its experience as an AI application developer and operator at the Mannheim Medical Transfer Center M2TC are an established networked structure that forms the basis for rapid operational project implementation.

Application center for intelligent machines in medical technology (ANIMMED)

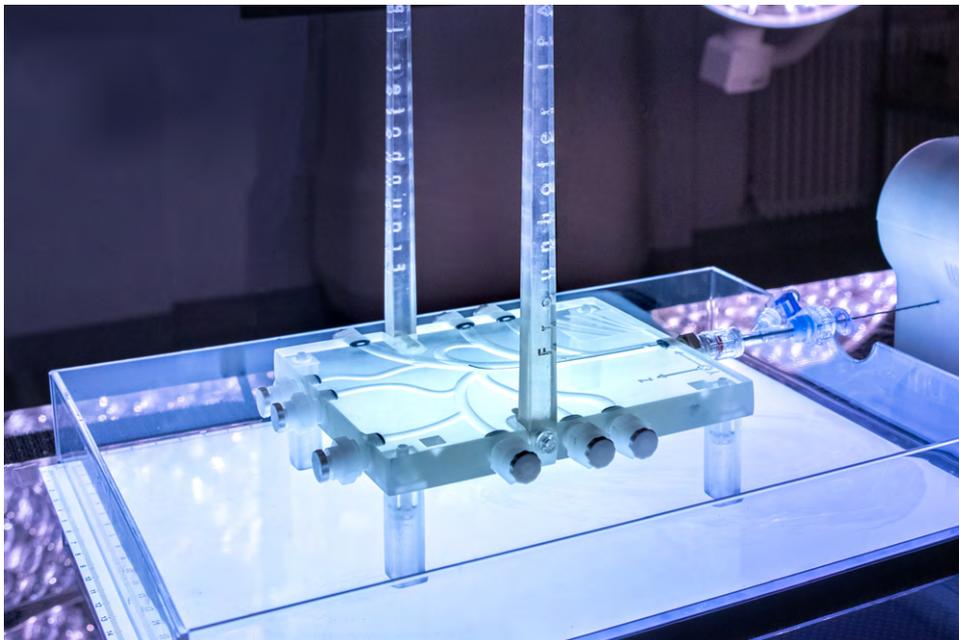
The development and application center, which is located on the site of the Fraunhofer Project Group and the HLZ facilitates the use of AI for medical technology. At Mannheim University Hospital, ANIMMED supports medical companies in the development, training and adaptation of AI solutions for intelligent medical devices and instruments.

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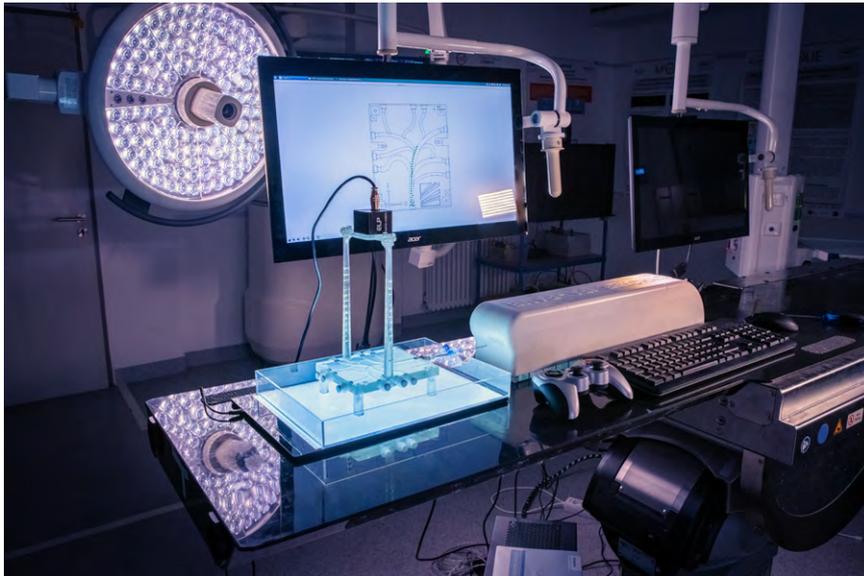
EUR 13.9 million for healthcare location Baden-Württemberg

In addition to the Application Center for Intelligent Machines in Medical Technology, the Ministry for Economic Affairs has provided a total of EUR 13.9 million to fund a further seven projects. Following approval of the funding by the Council of Ministers on April 21 as part of the „Forum Gesundheitsstandort Baden-Württemberg“, Minister for Economic Affairs Dr. Nicole Hoffmeister-Kraut explained the decision: “Innovative ideas and projects are the key to an effective healthcare sector. We should be constantly developing our skills precisely for times of crisis as well as for the future. With these first eight projects, we are significantly advancing these key technologies – for the welfare of our patients as well as for the benefit of the Baden-Württemberg economy.”



Printed vessel phantom with guide wire for a catheter.

Source: Fraunhofer IPA; photo: Vanessa Stachel



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Testbench for the training and validation of AI for autonomous navigation of a guide wire.

Source: Fraunhofer IPA; photo: Vanessa Stachel

PROFILE

ANIMMED – Anwendungszentrum für Intelligente Maschinen in der Medizintechnik (Application Centre for Intelligent Machines in Medical Technology)

Project launch: May 01, 2020

Funding amount: EUR 1,579,318

Funding as part of the Gesundheitsstandort BW healthcare location forum

Funding body: Ministry for Economic Affairs, Labor and Housing Baden-Württemberg

Project partners: Fraunhofer Project Group for Automation in Medicine and Biotechnology PAMB (LEAD), Heinrich-Lanz Center for Digital Health (HLZ)

PAMB – The Project Group for Automation in Medicine and Biotechnology at Fraunhofer IPA based at Mannheim Faculty of Medicine, Heidelberg University, was established in 2011 by the state of Baden-Württemberg and the Fraunhofer-Gesellschaft. PAMB's mission is to research and develop automatic processes and systems which will be autonomous in future, for diagnostics and intervention.

In addition, the Project Group researches intelligent diagnostic processes by using new measuring procedures and sample analysis methods to increase efficiency and improve clinical healthcare.

PAMB now has many years of experience under its belt and this, combined with its comprehensive laboratory infrastructure with an experimental intervention room and direct access to clinical establishments because of its location at Mannheim University Hospital campus, means that technologies and products can be directly applied in clinical practice.

HLZ – Heinrich-Lanz Center for digital health

A single university hospital produces around 35,000 data elements each day. HLZ's mission at Mannheim Faculty of Medicine at Heidelberg University is to unlock the mostly undiscovered wealth of data from healthcare and research using data science. Analysis of large volumes of data from biomedical research and patient care is an important basis for accurate and individually tailored prevention, diagnostics and therapy .

HLZ is part of the MIRACUM Consortium (Medical Informatics for Research and Care for University Medicine), which is funded by the medical informatics initiative of the BMF (German Ministry of Finance). Its areas of focus include better data usage to optimize patient recruitment for clinical studies, a prediction tool for asthma/COPD and neuro-oncology, as well as the establishment of a molecular tumor board that is closely linked to clinical care.

Further information

www.forum-gesundheitsstandort-bw.de

<https://www.umm.uni-heidelberg.de/heinrich-lanz-zentrum/>

<http://pamb.ipa.fraunhofer.de>

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With nearly 1000 employees, the **Fraunhofer Institute for Manufacturing Engineering and Automation IPA**, Fraunhofer IPA, is one of the largest institutes in the Fraunhofer-Gesellschaft. The total budget amounts to € 76 million. The institute's research focus is on organizational and technological aspects of production. We develop, test and implement not only components, devices and methods, but also entire machines and manufacturing plants. Our 15 departments are coordinated via six business units, which together conduct interdisciplinary work with the following industries: automotive, machinery and equipment industry, electronics and microsystems, energy, medical engineering and biotechnology as well as process industry. The research activities of Fraunhofer IPA aim at the economic production of sustainable and personalized products