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Imaging Diagnostics and Treatment

How malignant lymph nodes can be diagnosed with ultrasound

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Medical ultrasound is a crucially important imaging procedure, even in diagnosing cancer. Researchers from the Fraunhofer Institute for Computer Graphics Research IGD are developing a digital platform for detecting malignant lymph nodes in the head and neck area from ultrasound images, making biopsies redundant in the process. For the Echomics software, developers are currently examining the informative value of numerous image markers and biomarkers. The software is slated for release in mid-2021.

(Darmstadt) The medicine of the future is on the hunt for technology that makes fast, safe diagnostics possible without delays. Soon, doctors will be able to use ultrasound to detect malignant lymph nodes that spread throughout the head and neck in squamous cell carcinoma. This would make a biopsy superfluous. "The informative value of our application will be so good that the right treatment can be determined immediately, without additional examinations," said Matthias Noll, deputy head of the Visual Healthcare Technologies Competence Center at Fraunhofer IGD. Ideally, the software would use the data to suggest the best treatment that would make sense for this particular patient.

Automated imaging data analysis

Ultrasound is already routinely used in the diagnosis of these tumors, however, the imaging itself is insufficient for a fully confirmed diagnosis. The Echomics software by Fraunhofer IGD looks to be the first to change that. It uses biomarkers or image markers established in the automated analysis of tumors in radiological imaging data, called radiomics. Additional ultrasound-specific markers help improve detection, making possible an objective analysis of the imaging data. In its current phase of development, up to 4,000 different markers are being tested. Aside from appearance and size, the software looks at other as-

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pects, such as the firmness of the lymph node, its contour quality, or the structure of the tissue. “We’re currently verifying the informative value of each individual marker and finding the best ones,” explained Noll.

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Squamous cell carcinoma’s signature makes diagnosis possible

In addition to the 3D imaging data itself, the application also factors in the patient’s clinical information, such as gender, age, and lifestyle, allowing individual risks to be included in the diagnosis. The end result is a kind of signature for the squamous cell carcinoma metastasized in the lymph nodes that allows for an exact diagnosis and flows into the selection of a personalized, ideal treatment. With each additional patient anonymized and added to the database, the results become more accurate. The software can be used just as good for an initial diagnosis as for a follow-up.

Analytical environment for clinical research

To better comprehend the generated patient data, it is rendered explorable with the help of visual analytics methods. To achieve this, the researchers at Fraunhofer IGD are developing a dashboard—a user interface for displaying the data. “With this analytical environment for clinical researchers, various scientific issues can be studied,” said Jörn Kohlhammer, head of the Information Visualization and Visual Analytics Competence Center. The huge amount of data can be used to derive hypotheses while also validating them. Healthcare professionals can look for similar patients and use patient cohorts to test their suppositions. This will result in new knowledge about diagnostics and treatment.

Swift progression demands swift diagnosis

Every year, around 17,000 people get tumors in the head and neck area, such as the tongue, base of the mouth and larynx. Three quarters of them are men. Nine out of ten tumors are classified as squamous cell carcinoma, i.e., they emanate from the mucous membrane. The lymph nodes in the neck are a part of the diagnostics and follow-up care for these kinds of tumors. One important examination tool is ultrasound. It is inexpensive, does not generate any X-ray radiation, and is available everywhere. However, the results depend on the examiner and the device. In uncertain cases, abnormal lymph nodes need to be biop-

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sied, however, with squamous cell carcinoma in particular, time is of the essence. For patients, biopsies mean a potentially superfluous surgical procedure rife with uncertainty and anxiety.

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From the visual computing experts

ECHOMICS, the detection of malignant lymph nodes in the head and neck area using echographic biomarkers, is an innovation by Fraunhofer IGD. Since the start of the 2000s, the institute has been developing new ultrasound applications. Visual analytics and information visualization—the optimal visualization of data and information—are other Fraunhofer IGD competences in the medical field. ECHOMICS is a project funded by German’s Federal Ministry for Education and Research as part of the SME medical technology innovation project “KMU-innovativ: Medizintechnik”.

More information:

More about the ECHOMICS project: igd.fraunhofer.de/en/projects/echomics-echographic-biomarkers-analyzing-lymph-nodes-throat

More about automated ultrasound imaging data analysis:
<https://www.igd.fraunhofer.de/en/projects/automatic-analysis-ultrasound-imaging-data>

More about our individual health solutions: <https://www.igd.fraunhofer.de/en/institute/mission-vision/vision/individual-health>

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Photo (M): Fraunhofer IGD is developing software to detect malignant lymph nodes in ultrasound images.
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Information about Fraunhofer IGD:

The Fraunhofer Institute for Computer Graphics Research IGD was founded in 1987. It is the internationally leading organization for applied research in visual computing. We convert information into graphics and graphics into information. We focus on human-machine interaction, virtual and augmented reality, artificial intelligence, interactive simulation, modelling, 3D printing and 3D acquisition. Approximately 220 researchers at the five sites in Darmstadt, Rostock, Kiel, Graz and Singapore are developing new technological solutions and prototypes for industry 4.0, digital healthcare and the "Smart City Experience". With our annual research volume of EUR 21 million, we offer applied research to support the strategic development of the industry and economy.