New algorithm for classification of skin lesions

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PD Dr. Tobias Lasser (left) and Dr. Krammer work on the new algorithm FusionM4Net for the classification of skin lesions. Credit: LMU Klinikum München

Dermatologists typically classify skin lesions based on multiple data sources. Algorithms that fuse the information together can support this classification. An international research team has now developed an algorithm that classifies skin lesions more accurately than previous algorithms by using an improved data fusion process.

Many people worldwide suffer from skin diseases. For diagnosis,

physicians often combine multiple information sources. These include, for instance, clinical images, microscopic images and meta-data such as the age and gender of the patient. Deep learning algorithms can support the classification of skin lesions by fusing all the information together and evaluating it. Several such algorithms are already being developed. However, to apply these learning algorithms in the clinic, they need to be further improved to achieve higher diagnostic accuracy.

New data fusion method improves diagnostic accuracy

A research team led by PD Dr. Tobias Lasser from the Munich Institute of Biomedical Engineering (MIBE) at the Technical University of Munich (TUM) has now developed a new learning algorithm—FusionM4Net—that displays higher average diagnostic accuracy than previous algorithms. The code for FusionM4Net is freely available (ciip.in.tum.de/software.html). The new algorithm uses a so-called multi-modal multi-stage data fusion process for multi-label skin lesion classification.

- Multi-modal: The learning algorithm includes three different types of data: Clinical images, microscopic images of the suspicious skin lesion, and patient metadata.
- Multi-label: The researchers trained the algorithm for multi-label skin classification, i.e. it can differentiate between five different categories of skin lesions.
- Multi-stage: The new algorithm first fuses together the available image data and then the patient's metadata. This two-stage process allows image data and metadata to be weighted in the algorithm's decision-making process. This distinguishes FusionM4Net considerably from previous algorithms in this field, which merge all data at once.

To evaluate the diagnostic accuracy of an algorithm, it can be compared

to the best existing classification for the used dataset, for which the value 100 percent is assigned. The average diagnostic accuracy of FusionM4Net improved to 78.5 percent through the multi-stage fusion process, outperforming all other state-of-the-art algorithms with which it was compared.

Working towards clinical application

To foster reproducibility, a publicly available dataset was used to train the algorithm. However, in dermatology, datasets are not standardized everywhere. Depending on the clinic, different types of images and patient information may be available. Thus, for actual clinical deployment, the algorithm must be able to handle the type of data that is available at each specific clinic.

Together with the Department of Dermatology and Allergology at the University Hospital of LMU Munich, the research team is working intensely on making the algorithm operational for future clinical routine. To this end, the team is currently integrating numerous datasets that have been standardized for this clinic.

"Future routine clinical use of algorithms with high diagnostic accuracy might help ensure that rare diseases are also detected by less experienced physicians and it might mitigate decisions affected by stress or fatigue," says PD Dr. Tobias Lasser. Thus, learning algorithms could help improve the overall level of medical care.

More information: Peng Tang et al, FusionM4Net: A multi-stage multi-modal learning algorithm for multi-label skin lesion classification, *Medical Image Analysis* (2021). DOI: 10.1016/j.media.2021.102307