III. ULTRASOUND IN DERMATOLOGY

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GROUP OVERVIEW

The working group is a joint venture between the Ultrasound Bionic Technologies laboratory of the Jedlik Laboratories (see pp. 51) and the Department of Dermatology at Semmelweis University. The group enables an interdisciplinary collaboration between clinical dermatologists with well-established experience in ultrasound-based diagnosis and bionic engineers with the knowledge of ultrasound biophysics. The aim of the group is to help develop an ultrasound imaging platform that can be used by dermatologists and other doctors to help them perform differential diagnosis on skin lesions. Such work has two main aspects, namely the research of appropriate differential diagnosis algorithms and the development of a suitable medical device on which these algorithms may run. These activities are considered in the corresponding sections below.

DIFFERENTIAL DIAGNOSIS

Skin lesions come in many forms, from benign nevi to malignant (but rarely fatal) basal cell carcinoma (BCC) to malignant melanoma (MM) – even between these diagnoses, many subtypes and stages of disease progression present themselves, which ultrasound imaging, given suitable expertise, can distinguish between [1]. The aim of our research is to try and represent the knowledge of an expert radiologist in a form that can be algorithmicised to enable computer-aided diagnosis (CAD). Our previous research has shown that quantitative descriptors such as the Nakagami parameter may potentially be used to perform differential diagnosis between MM and BCC melanoma and basal cell carcinoma. However, the performance of the differential diagnosis algorithms is very sensitive to choosing the correct region of interest (ROI) and to low signal to noise ratio (SNR), therefore research is ongoing to find ways to create robust Nakagami estimators.

In finding suitable algorithms to help differential diagnosis, the group took a step back and started looking at semi-quantitative scores of different ultrasound features, as provided by radiologists and medical practitioners of various levels of experience. The question is how these scores correlate with gold standard histology diagnoses. Based on these results, candidate scores may be selected that could be used by medical practitioners without radiology qualifications. Furthermore, the questions arise how the semi-quantitative scores can be translated into fully quantitative parameters (such as the Nakagami parameter) that can be calculated by (semi-)automatically using a computer, potentially enabling use of the differential diagnosis algorithms by non-professionals.

MEDICAL DEVICE DEVELOPMENT

Although diagnostic ultrasound devices are abundant on the market and are often cost-effective compared to diagnostic imaging modalities, relatively few have the capability to transmit and receive at frequencies high enough (over 15 MHz) for dermatological applications. Moreover, even ultrasound systems or transducers specifically designed for dermatological investigation lack cost-effectiveness, portability and non-expert usability. For this reason, the Ultrasonic Bionic Technologies group of the Jedlik Laboratories (see pp. 51) has undertaken to develop a user-friendly ultrasound device specifically aimed for
dermatological applications, with the aim of evaluating its effectiveness within the currently discussed working group. In order to enable a manually scanned transducer to create pictures from a series of so-called A-lines whose spatial location is unknown, we developed an algorithm based on the decorrelation of A-lines during manual scanning [5].

![Ultrasound images of a nevus. Left: imaged using our own UltraDerm device. Right: imaged using a competitor (Draminski/Interson). Work with Gergely Csány and Helga Feiszthuber.](image)

**PUBLICATIONS**


