Tumor segmentation in breast cancer ultrasound examinations using neural network and combined RF, Nakagami and B-mode modalities

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Accurate segmentation of tumors in breast image analysis have crucial importance in the process of diagnosis and treatment of breast cancer. Computer-aided diagnosis (CAD) systems have been developed in the field to assist medical professionals and improve the outcomes. In the recent years, advanced deep-learning models have demonstrated improvement in many medical imaging applications, including ultrasound image segmentation. However, due to specific characteristics of B-mode images, such as speckle noises, low contrast and shadows, the segmentation task has always presented challenges, as most publicly available ultrasound datasets provide only B-mode modality data. In this paper, we propose a different approach, in which the selected model is fine-tuned on images that integrate structural and statistical information. The model was trained and validated on composite images generated from raw RF signals obtained during ultrasound examinations of patients during neoadjuvant breast cancer therapy. The composite ultrasound images combine radiofrequency (RF) signals, Nakagami parametric maps and B-mode modality. A pre-trained transformer-based neural network was fine-tuned and validated on a dataset of 994 images. The study highlights the possible advantages of combining various modalities of ultrasound imaging data for improved automated breast tumor segmentation. Experimental results are analyzed in the article and compared to baselines for models using B-mode modality.