College of Engineering Chengannur
Department of Computer Engineering
M. Tech. Computer Science (Image Processing)
03CS6901 Seminar I
Abstract of Proposed Seminar Topic

Weakly Supervised Estimation of Shadow Confidence in Fetal Ultrasound Imaging

204314 Gowri B Nair

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Abstract

Detecting acoustic shadows in ultrasound images is important in many clinical and engineering applications. Real-time feedback of acoustic shadows can guide sonographers to a standardized diagnostic viewing plane with minimal artifacts and can provide additional information for other automatic image analysis algorithms. However, automatically detecting shadow regions using learning-based algorithms is challenging because pixel-wise ground truth annotation of acoustic shadows is subjective and time consuming. In this paper we propose a weakly supervised method for automatic confidence estimation of acoustic shadow regions. Our method is able to generate a dense shadow-focused confidence map. In our method, a shadow segmentation module is built to learn general shadow features for shadow segmentation, based on global image-level annotations as well as a small number of coarse pixel-wise shadow annotations. A transfer function is introduced to extend the obtained binary shadow segmentation to a reference confidence map. Additionally, a confidence estimation network is proposed to learn the mapping between input images and the reference confidence maps. This network is able to predict shadow confidence maps directly from input images during inference. We use evaluation metrics such as DICE, inter-class correlation and etc. to verify the effectiveness of our method. Our method is more consistent than human annotation, and outperforms the state-of-the-art quantitatively in shadow segmentation and qualitatively in confidence estimation of shadow regions. We further demonstrate the applicability of our method by integrating shadow confidence maps into tasks such as ultrasound image classification, multi-view image fusion and automated bio-metric measurements.

Ultrasound (US) imaging is a medical imaging technique based on reflection and scattering of high frequency sound in tissues. Compared with other imaging techniques (e.g. Magnetic Resonance Imaging (MRI) and Computed Tomography (CT)), US imaging has various advantages including portability, low cost, high temporal resolution and real-time imaging capability. With these advantages, US is an important medical imaging modality that is utilized to examine a range of anatomical structures in both adults and fetuses. In most countries, US imaging is an essential part of clinical routine for pregnancy health screening between 11 and 22 weeks of gestation

In our proposed method, a shadow-seg module is first trained to produce a semantic segmentation of shadow regions. In this module, shadow features are initialized by training a shadow/shadow-free classification network and generalized by training a shadow segmentation network. After obtaining the shadow segmentation, a transfer function is used to extend the predicted binary shadow segmentation confidence map based on the intensity distribution within suspected shadow regions. This confidence map is regarded as a reference confidence map for the next confidence estimation network. Lastly, a confidence estimation network is trained to learn the mapping between the input shadow-containing US images and the corresponding reference confidence maps. The outline for the training process. During inference, we use the confidence estimation network to predict a dense, shadow confidence map directly from the input image. Additionally, we integrate attention mechanisms into our method to enhance the shadow features extracted by the networks

To verify the practical benefits of our method, we integrate the shadow confidence maps into different applications such as 2D US standard plane classification, multi-view image fusion and automated biometric measurements.

References

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