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Segmentation of embryonic and fetal 3D ultrasound images based on pixel intensity distributions and shape priors

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Abstract

This paper presents a novel variational segmentation framework combining shape priors and parametric intensity distribution modeling for extracting the fetal envelope on 3D obstetric ultrasound images. To overcome issues related to poor image quality and missing boundaries, we inject three types of information in the segmentation process: tissue-specific parametric modeling of pixel intensities, a shape prior for the fetal envelope and a shape model of the fetus' back. The shape prior is encoded with Legendre moments and used to constraint the evolution of a level-set function. The back model is used to post-process the segmented fetal envelope. Results are presented on 3D ultrasound data and compared to a set of manual segmentations. The robustness of the algorithm is studied, and both visual and quantitative comparisons show satisfactory results obtained by the proposed method on the tested dataset.

Keywords: 3D ultrasound, obstetric imaging, multi-phase level-set segmentation, Legendre moments, shape prior, anatomical models, statistical shape priors

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