Abstract

Active contours (snakes) are an efficient method for segmentation of ultrasound (US) images of breast cancer. However, the method produces inaccurate results if the seeds are initialized improperly (far from the true boundaries and close to the false boundaries). Therefore, we propose a novel method to overcome drawbacks of snakes including initialization sensitivity and noise robustness based on the fusion of conventional US image with Elastography and Power Doppler images. The integrated information extracted from the three types of images provides better initialization and more tolerate to noise, consequently, leads to better segmentation. The proposed fusion method (FM) has been tested against four state-of-the-art initialization methods on 90 ultrasound images from a database collected by the Thammasat University Hospital of Thailand. The ground truth was hand-drawn by three leading radiologists of the hospital. The reference methods were center of divergence (CoD), force field segmentation (FFS), Poisson Inverse Gradient Vector Flow (PIG), and quasi-automated initialization (QAI). Using a variety of measures, the results prove the following advantages of the FM. For the raw US images the percentage of correctly initialized contours of FM is 94.2%, whereas, COD, FFS, PIG, and QAI are 0%, 0%, 26.7%, 42.2% respectively. Besides the proposed initialization method, we introduced a robust external force field applying to strong noise named fusion radial force (FRF). The combination of the fusion and radial force outperforms the Vector Field Convolution (VFC) and the Adaptive Diffusion Flow (ADF). The percentage of correctly converge to boundaries of tumors is 84.4% for FM, whereas, VFC and ADF are 56.62% and 43.30% respectively.

Keywords: breast cancer segmentation, initialization for active contours, ultrasound, Elastrography, Doppler,