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Phase-based probabilistic active contour for nerve detection in ultrasound images for regional anesthesia (Article), Hafiane, A., Vieyres, P., Delbos, A.

Abstract

Ultrasound guided regional anesthesia (UGRA) is steadily growing in popularity, owing to advances in ultrasound imaging technology and the advantages that this technique presents for safety and efficiency. The aim of this work is to assist anaesthetists during the UGRA procedure by automatically detecting the nerve blocks in the ultrasound images. The main disadvantage of ultrasound images is the poor quality of the images, which are also affected by the speckle noise. Moreover, the nerve structure is not salient amid the other tissues, which makes its detection a challenging problem. In this paper we propose a new method to tackle the problem of nerve zone detection in ultrasound images. The method consists in a combination of three approaches: probabilistic, edge phase information and active contours. The gradient vector flow (GVF) is adopted as an edge-based active contour. The phase analysis of the monogenic signal is used to provide reliable edges for the GVF. Then, a learned probabilistic model reduces the false positives and increases the likelihood energy term of the target region. It yields a new external force field that attracts the active contour toward the desired region of interest. The proposed scheme has been applied to sciatic nerve regions. The qualitative and quantitative evaluations show a high accuracy and a significant improvement in performance.