Unifying the seeds auto-generation (SAGE) with knee cartilage segmentation framework: data from the osteoarthritis initiative.

Author

Gan HS, Sayuti KA, Ramlee MH, Lee YS, Wan Mahmud WMH, Abdul Karim AH

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Abstract

PURPOSE:

Manual segmentation is sensitive to operator bias, while semiautomatic random walks segmentation offers an intuitive approach to understand the user knowledge at the expense of large amount of user input. In this paper, we propose a novel random walks seed auto-generation (SAGE) hybrid model that is robust to interobserver error and intensive user intervention.

METHODS:

Knee image is first oversegmented to produce homogeneous superpixels. Then, a ranking model is developed to rank the superpixels according to their affinities to standard priors, wherein background superpixels would have lower ranking values. Finally, seed labels are generated on the background superpixel using Fuzzy C-Means method.

RESULTS:

SAGE has achieved better interobserver DSCs of 0.94 ± 0.029 and 0.93 ± 0.035 in healthy and OA knee segmentation, respectively. Good segmentation performance has been reported in femoral (Healthy: 0.94 ± 0.036 and OA: 0.93 ± 0.034), tibial (Healthy: 0.91 ± 0.079 and OA: 0.88 ± 0.095) and patellar (Healthy: 0.88 ± 0.10 and OA: 0.84 ± 0.094) cartilage segmentation. Besides, SAGE has demonstrated greater mean readers' time of 80 ± 19 s and 80 ± 27 s in healthy and OA knee segmentation, respectively.

CONCLUSIONS:

SAGE enhances the efficiency of segmentation process and attains satisfactory segmentation performance compared to manual and random walks segmentation. Future works should validate SAGE on progressive image data cohort using OA biomarkers.