A Graph-Cut Approach to Hip-Joint Segmentation

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1. Abstract

Femur fracture and hip joint physical troubles lead to people suffering severe pain, have walking difficulties and in the worst case, it could lead to death to complications. Personalized medicine tool like the subject-specific Finite Element(FE) model combined with medical imaging techniques like computed tomography(CT) and Magnetic Resonance Imaging(MRI) can help to predict femur fractures. FE methods require the localization of bony tissues and, the segmentation propagates through quantitative analyses, affecting the prediction accuracy of the whole method[1].

The standard segmentation method is the manual segmentation, which is time-consuming, subjected to operator expertise and difficult to reproduce.
These drawbacks make challenging the application of FE model in clinical practice.
Automatization of the segmentation procedure will help to make FE models suitable for applications in personalized medicine.

Femur segmentation in the hip-joint region is challenging because of the low contrast between the articulating bones, due to partial volume effect, and low Signal to Noise Ratio.
Inspired by the work of Besler[1], we have used a hessian based graph cut to achieve an automated femur segmentation. The method is based on a scale-space model of cortical bones, segmented using the graph cut. Once we have identified these bones, a filling operation allows us to include also the trabecular bones.
The method has shown to be suitable as an automated segmentation method or semi-automated one, providing an initial guess that will be refined by an expert radiologist.

2. References

[1] Bryce A. Besler et al. "Bone and joint enhancement filtering: Application to proximal femur segmentation from uncalibrated computed tomography datasets". In: *Medical image analysis* 67 (Jan 2021), p. 101887. Issn: 1361-8415. DOI: 10.1016/j.media.2020.10188