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AN INTEGRATED CLUSTERING ALGORITHM AND ITS APPLICATION IN SURGICAL NAVIGATION

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Abstract

Objective: Fluoroscopic image distortion correction and C-arm camera calibration plays a crucial role in a C-arm-based surgical navigation system. In order to fulfill the two functions, several fluoroscopic images with certain landmarks must be acquired at different C-arm orientations. Hereafter, these images must be processed to extract geometric parameters of these landmarks. The geometric parameters of landmarks will then be used for image distortion correction and C-arm camera calibration. This research is to design an algorithm to extract these geometric parameters in fluoroscopic images with high accuracy and reliability.

Method: This paper proposes an integrated clustering algorithm for landmark geometric parameters extraction. The proposed algorithm integrates an adaptive thresholding method and a connected components(CC) analysis method, it needs only one pass to process a grayscale image and outcomes landmarks parameters directly. The original gray scale image will be binarized with the adaptive thresholding method. The binarized image will then undergo the CCs analysis for extracting landmark geometric parameters(landmark areas and center coordinates). The CCs analysis consists of two interrelated parts: Fast Quasi CCs Labeling and partial CCs updating and merging.

Results: Experiments have been carried out on two groups of images: 10 real fluoroscopic images with landmarks acquired with a GE8800 C-arm unit and 31 computer synthesized single-landmark images. The results demonstrate that the proposed integrated algorithm possesses better robustness, higher landmark detection accuracy, higher running efficiency and higher landmark classification reliability than the conventional algorithms.

Conclusion: The integrated clustering algorithm of adaptive thresholding and connected components(CC) analysis could be used for extracting landmark geometric parameters in fluoroscopic images with high accuracy and reliability.

Keywords: surgical navigation; thresholding; connected components analysis; parameters extraction