Joint Department of Biomedical Engineering
Marquette University / Medical College of Wisconsin

Announcement of Public Dissertation Defense

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ABSTRACT

MOTION ARTIFACT EVALUATION OF CORONARY CT ANGIOGRAPHY IMAGES

The objective of this dissertation was to develop and validate an automated algorithm to quantify motion artifact level on coronary CT angiography (CCTA) images. Unlike existing motion artifact reduction techniques that evaluate the relative level of motion artifacts within one exam, this dissertation aims to quantify the absolute level of motion artifacts across exams from varying patients. The ability to quantify absolute motion artifact level enables several potential applications, for example, assessing and comparing two motion artifact reduction techniques.

This dissertation includes three specific aims. Aim 1 investigated the absolute motion artifact quantification effectiveness of six motion artifact metrics using phantom and clinical images. The six metrics included four existing metrics and two novel metrics: Fold Overlap Rate (FOR) and Low-Intensity Region Score (LIRS). Ground-truth motion artifact level was obtained by pairwise-comparison observer studies. The FOR and LIRS metrics demonstrated good agreement and linearity to the ground-truth observer scores. A compound metric of Motion Artifact Score (MAS), defined as the product of FOR and LIRS, further improved performance.

In Aim 1, vessel and artifact regions were identified by thresholding for the phantom images and by manual segmentation for the clinical images. Aim 2 developed an automated Motion Artifact Quantification algorithm for clinical images. The algorithm included identification of right coronary artery (RCA) regions of interest (ROIs) and segmentation of vessel and shading artifacts, followed by calculation of the motion artifact metrics. Each step was validated against ground-truth results obtained by manually reader studies. Results shown that MAS calculated using the algorithm is within 10% of the values obtained using ground-truth segmentations.

Aim 3 investigated one application of the Motion Artifact Quantification algorithm. The Motion Image Quality Decision algorithm was developed to automatically identify whether a CCTA dataset is of sufficient image quality or requires further correction. An observer study on 30 clinical datasets was performed to obtain the ground truth decisions. Fifteen of the datasets were used to identify algorithm thresholds for aggregating the MAS across slices. The remaining datasets were used to evaluate the algorithm. Results demonstrated algorithm sensitivity of 100%, specificity of 83.3% and total correctness of 93.3%.

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