

Automatic 3D reconstruction of electrophysiology catheters from two-view monoplane C-arm image sequences

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Abstract *Purpose:* Catheter guidance is a vital issue for the success of electrophysiology interventions. It is usually provided through fluoroscopic images that are taken intra-operatively. The cardiologists, who are typically equipped with C-arm systems, scan the patient from multiple views rotating the fluoroscope around one of its axes. The resulting sequences allow the cardiologists to build a mental model of the 3D position of the catheters and interest points from both views.

Methods: We describe and compare different 3D catheters reconstruction strategies and ultimately propose a novel and robust method for automatic reconstruction of 3D catheters in non-synchronized fluoroscopic sequences. This approach does not purely rely on triangulation but incorporates prior knowledge about the catheters. In conjunction with an automatic detection method, we demonstrate the performance of our method by evaluating on the complete surgical workflow.

Results: In our experiments that include 20 biplane datasets, we achieve an average re-projection error of 0.43mm and an average reconstruction error of 0.67mm compared to gold standard annotation.

Conclusions: In clinical practice, catheters suffer from complex motion due to the combined effect of heart beat and respiratory motion. As a result, any 3D reconstruction algorithm via triangulation is imprecise. We have proposed a new method that is fully automatic and highly accurate to reconstruct catheters in three dimensions.

Keywords fluoroscopy · catheter 3D reconstruction · electrophysiology · probabilistic graphical model · arrhythmia

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Electrophysiology Lab Procedure Manual

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