Motion Compensation for EM Catheter Tracking in Pre-operative MR/CT Images

Project Management and Software Development
for Medical Applications

General Info

Contact Person: Ardit Ramadani

Contact Email: ardit.ramadani@tum.de

Project Abstract

In this project we focus to develop a tool for tracking catheters intraoperatively through electromagnetic tracking and compensating for any motions based on the input of external sensors. The electromagnetic tracking system we currently own is a system from NDI called Aurora EM Tracker [1] which is fully integrated in the ImFusion Suite framework through a plugin [2]. The goal of the project is to implement a motion compensation algorithm to capture external movements.

Background and Motivation

Due to the Heart's complexity sometimes is very hard for surgeons to localize the tip of the catheter in fluoroscopic images during a cardiac procedure. Furthermore, it is especially difficult in cases where the branching of the vasculature is vast, and their diameter is very small. Fluoroscopic views of such anatomies do not give much depth perception; therefore, surgeons have to inject contrast agent and map all 2D fluoroscopic intra-operative views to anatomical structures from pre-operative 3D images.

Therefore, it is of significant importance that this mapping happens in a natural way. Hence, in this project, we aim to develop a solution that makes use of pre-operative high-quality 3D MRI/CT volumes and provides real-time catheter location using an electromagnetic tracking system. The electromagnetically tracked location of the catheter is displayed in real-time in the 3D MRI/CT pre-operative images without a need for further imaging modalities. This solution would ease the process of catheter tracking during minimally invasive cardiac procedures

Student's Tasks Description

The tasks that the student should fulfill during the timeframe of the project are:

o Implement an ImFusion Suite tool that visualizes a catheter shape within the 3D volume.
o Track EM catheter tip position and store pointcloud data points at mouse click (optional).
o Display (link) current pose of the EM sensor to the closest centerline point.
o Implement a motion compensation algorithm that takes into account more than one sensor, and compensates for external movements.
o Implement a virtual MRI/CT volume exploration tool using the EM sensor (this will allow the user to scroll through volume slices while moving the EM sensor) (optional if time allows).

Working arrangements

Since the project requires interaction with hardware components, the student should be in Munich during the timeframe of the project. We will provide a working space at the German Heart Center in a very friendly office environment.

Technical Prerequisites

o Knowledge in Medical Image Processing
o Good programming language skills in C++
o Knowledge in object tracking is preferable

References

[1] Aurora NDI Tracking system [Online] Available: https://www.ndigital.com/products/aurora/

[2] ImFusion Suite [Online] Available: https://www.imfusion.com/
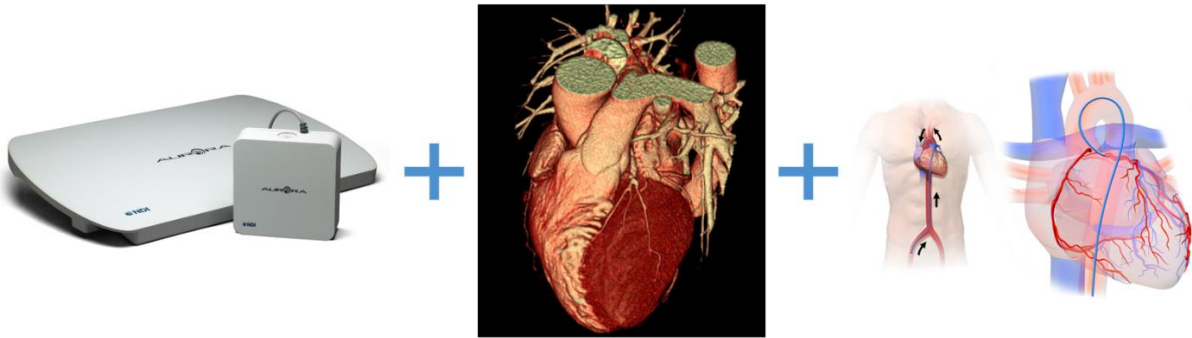
Images

*Figure 1. Aurora EM Tracking System (left), Heart's complex
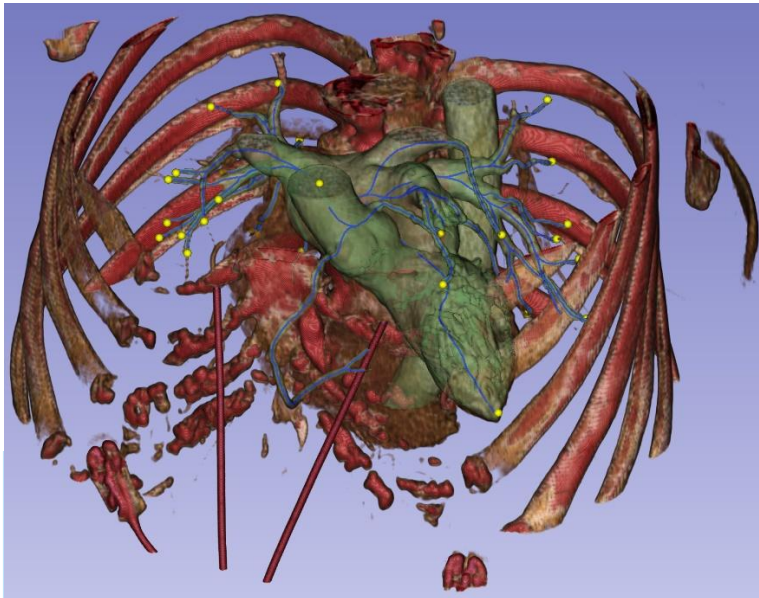vascularisation (center), Catheter tracking (right)*

Figure 2. Heart's catheter movement roadmap (centerlines)