

Interactive Exploration of Left Atrium Population-Level Morphology in Atrial Fibrillation Patients

Tim Sodergren, Anupama Goparaju, Alan Morris, Evgueni Kholmovski, Nassir Marrouche, Joshua Cates, Shireen Elhabian

Scientific Computing and Imaging Institute, University of Utah
Salt Lake City, Utah, USA

Aims: It has been hypothesized that the shape of the left atrium (LA) may be an indicator of atrial fibrillation (AF) pathology and to play a role in thrombus formation. Recent research has suggested that it is possible to gain more detailed insights into the role of shape in AF through the application of computational image analysis tools. The objective of this study is to develop computational methods for interactive visualization of 3D LA shapes utilizing outputs from shape-driven statistical models to allow a clinician to make inferences about a patient in reference to an entire population. **Methods:** We analyze the LA shape through a shape-learning algorithm termed as particle-based modeling (PBM), in which we extract surface contours from a population of images and then parameterize population-level shape statistics through the automatic placement of a dense set of homologous landmark positions (aka correspondences) using an optimization on information content. We then generate a 2-D embedding of the resulting high-dimensional dataset which allows us to visualize the data on a scatter plot, with each data point representing a single sample. This parameterization of the shape characteristics of samples collapsed onto a single plot gives us a visual representation of the population-level morphology of the data. **Results:** Cardiac MR angiography data from 207 AF patients was collected retrospectively from a database of AF patients at the University of Utah. From the 2-D scatter plot, we were able to interactively select individual samples, view their shapes, and see associated clinical data. We can also map new patients to infer their relations to other patients in the population via querying nearby samples and viewing their clinical data.

Conclusions: Through PBM and dimensionality reduction, we were able to represent the population-level LA shape characteristics, make comparisons within a population, and make comparisons of new shapes to an existing population, which may allow a clinician to make inferences about clinical outcomes, reveal population-level trends, and facilitate shape-driven hypothesis generation.

