A POINT-CORRESPONDENCE APPROACH TO DESCRIBING THE DISTRIBUTION OF IMAGE FEATURES ON ANATOMICAL SURFACES, WITH APPLICATION TO ATRIAL FIBRILLATION

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Introduction

Conventional image-based registration techniques have proven unreliable for aligning patient images and comparing local features because MRI suffers from inconsistent quality and appearance across subjects and time.\textsuperscript{1} The current approach uses a point-based correspondence model to establish a mapping among surface positions, even for variable cardiac anatomy.\textsuperscript{2,3}

Our motivating application is an analysis of the distribution of fibrosis, or diseased tissue, in the left atrial (LA) walls of atrial fibrillation (AF) patient populations. Anatomical variations and the lack of consistent anatomical features across the LA surface make the comparison of features on the LA wall difficult.

Methods

Figure 1. Workflow overview. Contrast-MRI (Ao denotes aorta) must be segmented and processed to align the surfaces before establishing correspondence across patients.

Results

Figure 2. Correspondence across patients. Correspondence points are used to tally the occurrence of fibrosis (green patches) at each point on a representative shape from the population.

Figure 3. Spatial distribution of fibrosis across AF patients. AF patients showed more intense and wide-spread fibrosis on the posterior and anterior surfaces of the LA in patients with failed procedures. Colors reflect the percent of patients exhibiting fibrosis at each correspondence point.

Discussion

This work provides a pipeline for examining the distribution of interesting local image features at discrete points across a population of shapes or images. The correspondence model allows interesting features to be tabulated on a representative shape revealing spatial distributions of local features across populations.

Additionally, the application of this approach to a cohort or AF patients revealed a higher and more expansive spatial distribution of fibrosis in patients with poor procedural outcomes.

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References