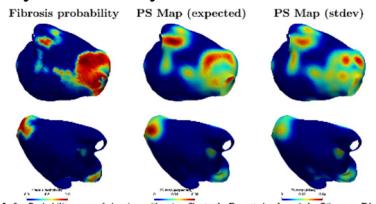


# Quantification of the impact of Atrial Shape Uncertainty on Fibrosis Burden and Atrial Tachycardia

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**Introduction:** Patient-specific models of the heart are gaining importance in the treatment of heart diseases. Quantifying how uncertainty in clinical data affects model simulations is an important step in communicating the confidence of model predictions to cardiologists. In this work, we quantify the impact of shape uncertainty on the distribution of fibrosis from Late-Gadolinium Enhancement (LGE) images and the impact of shape and fibrosis uncertainty on phase singularity (PS) maps in simulations of atrial tachycardia (AT). **Methods:** We describe the left atrium (LA) shape using a reduced-order model formed by 15 principal components (PC) that were built on a training set of 70 anatomies and explain 90% of the cumulative anatomical variance. We encode the shape uncertainty in the coefficients of the PC modes. For each new anatomy, we compute the shape posterior probability distribution using a Bayesian approach. Next, we sample from the shape posterior distribution using the unscented transform (UT). Then, we build a computational model for each sample, by projecting the LGE onto each sampled shape and then classifying the tissue as normal or fibrotic. On each sample, we simulate AT and evaluate the PS map. Finally, we compute the mean and standard deviation of the PS maps for each patient using the Monte Carlo formula. **Results:** We applied the procedure to 1 LA anatomy that was not in the training set. Using the 30 samples obtained from UT, we computed the probability map of the tissue fibrosis and the expected value and the standard deviation of the PS map. We found higher PS recurrences and larger variability of the PS map on the tissue portions with a high probability of being fibrotic. **Conclusions:** We introduced a method to evaluate the PS map uncertainty during AT when the atrial shape is affected by uncertainty.



Left: Probability map of the tissue fibrosis. Central: Standard deviation of the PS map. Right: Portions of tissue that present high recurrences and large variability of the PS map correspond to portions with a high probability of fibrosis.