# Generation of representative fibrotic patternings in the atria using Perlin noise

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The extent of fibrotic burden in the atria consistently correlates with the occurrence, and reoccurrence after ablation, of atrial fibrillation. Given the complex and unique patterning of fibrotic regions for any afflicted atria, attention has grown towards recent imaging techniques that allow non-invasive mapping of these regions, and subsequently, to techniques that might allow for the identification of arrhythmic risk or targets for ablation. Specifically, computer simulation combined with late gadolinium-enhanced magnetic resonance imaging (LGE-MRI) data allows for patient-specific determination of if and where arrhythmia-sustaining rotors are predicted to form.

These approaches are limited by the spatial resolution and subjective interpretation of LGE-MRI data, and sample sizes are inherently small. In order to enable a mechanistic understanding of how different types of fibrotic patterning can promote arrhythmia, we instead propose an approach using Perlin noise that naturally generates such patterns, quantified by easily understood parameters that are estimated by Approximate Bayesian Computation.

Our method matches directly to the imaging data in terms of a set of metrics we propose, and thus generates patterns that are known to have a realistic distribution of fibrosis. We demonstrate the use of our generated patterns to explore the impacts of different micro-fibrotic structures on cardiac excitation, and discuss how our methods also apply to macroscopic patterns of fibrosis, or indeed to problems outside of cardiac electrophysiology altogether.

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