Feasibility of Visualizing Higher Regions of Shannon Entropy in Atrial Fibrillation Patients
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Background & Motivation
Atrial Fibrillation (AF) is the most common kind of sustained cardiac arrhythmia which is mostly maintained by rotors that are located outside of pulmonary veins (PV) region, a known prognostic marker for stroke, heart failure and even death1,2,3. Catheter ablation is associated with limited success rates in patients with persistent AF. Currently available mapping systems cannot accurately predict rotors outside PV regions.

Objectives
Develop and test the feasibility of a novel entropy based mapping technology to accurately identify the rotor pivot zones for faithful ablation of arrhythmogenic substrates that causes AF in a patient-specific manner.

Novel Mapping Approach
Entropy is the measure of the expected value of a signal that uses symbolic dynamic approach to fully capture the intrinsic dynamics of the intra-atrial electrogram to identify rotor pivot points. Shannon Entropy (SE) can be calculated for the intra-atrial electrograms as below:

\[ SE = - \sum_{i=0}^{N-1} p_i \log_2 p_i \]  

N – number of amplitude bins; 
p – probability of any sample falling within a particular amplitude bin;

Methods
- Collaboration with Mayo Clinic, Division of Cardiovascular Diseases to obtain raw intra-atrial electrograms from a persistent AF patient
- Optical mapping data from induced VF/VT in isolated rabbit heart with known pivot point to validate entropy technique
- Custom software in MATLAB to compute entropy maps to identify rotor pivot points.
- 3D SE map for the human data was obtained by superimposing the SE values (multiplied by 10) on the anatomical map for visualization.

Human persistent AF data

Conclusions & Future Work
- Optical mapping data with known pivot point demonstrate the feasibility of using entropy to identify rotor pivot point.
- Persistent AF data demonstrated the feasibility of this approach to visualize higher regions of entropy using current catheter mapping system to generate 3D SE map.
- Future study to distinguish paroxysmal and persistent AF.

References