Machine Learning for Analyzing MRIs to Guide Atrial Fibrillation Diagnosis and Treatment

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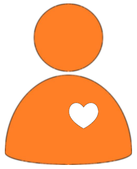
Atrial Fibrillation

33.5 Million Global Prevalence

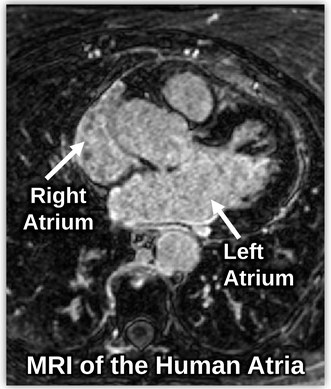
Projected to Double in the Next 10-20 Years

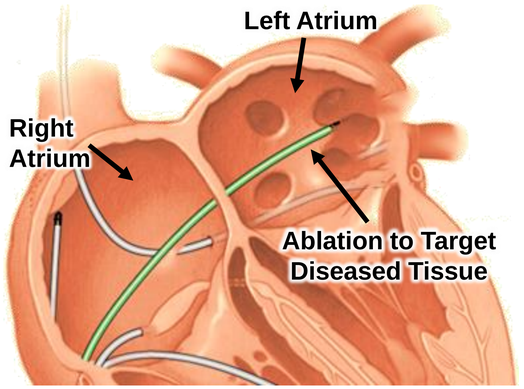


Increases Risk of Stroke by 5 Times

- Atrial fibrillation is the most common form of abnormal heart rhythm.
- Characterized by the irregular beating of the atria, the upper chambers of the heart.
- Impacts 2% of the general population, and is projected to increase in the near future.
- Increases risk of stroke by **5-times**, heart failure by **3-times**, and mortality by **2-times**.
- Becoming an increasing economic burden of the health care system.

Magnetic Resonance Imaging (MRI)

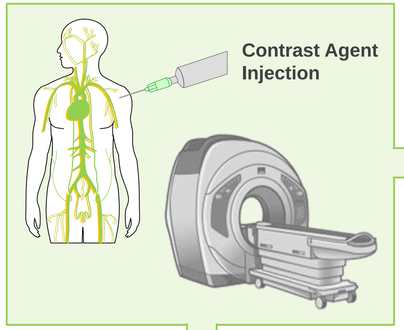




- MRIs are widely used for atrial fibrillation diagnosis and treatment (*figure left*).
- MRIs, when performed with contrast agents, can be used to non-invasively assess diseased tissue in the atria, allowing doctors to target them during surgery (*figure right*).
- However, current manual protocols for assessing MRIs are labor intensive.
- There is an urgent need for an automated method to accurately analyze MRIs.

Methods: Automatic Analysis of the Atria Using Machine Learning

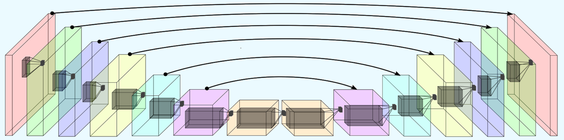
MRI Scanning



Machine Learning Algorithm Prototyping

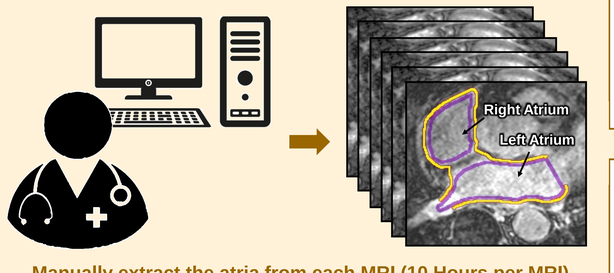
2018 International Atrial Segmentation Competition

- Raised global awareness for developing intelligent methods to analyze atrial MRIs.
- Attracted >100 teams from 11 countries worldwide.
- 27 cutting-edge algorithms submitted to the competition.
- Sponsored by: Nvidia, MedTech CoRE, Arterys (Cloud AI).



- A convolutional neural network (*figure above*), a type of advanced machine learning algorithm, was developed through further research after the competition.
- Performed fully automatic analysis of the atria from MRIs.
- Generates a model of the atria in 2 seconds for each MRI.

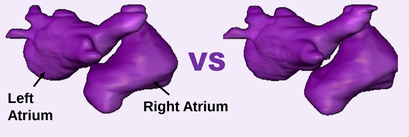
Cardiologist Expert Assessment



Manually extract the atria from each MRI (10 Hours per MRI)

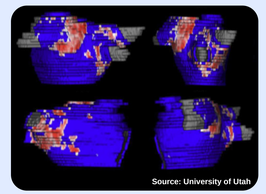
Method Validation

Expert Extracted Model of the Atria | Machine Learning Generated Model of the Atria



- Validate the outputs from the proposed machine learning algorithm with the expert assessment.

Clinical Treatment



- Accurate 3D models of the diseased tissue.
- Allows targeted atrial fibrillation treatment.

Results

- The algorithm improves the speed of MRI analysis from **10 hours** (manual expert assessment) to **2 seconds**.
- Machine learning generates a model of the atria with an accuracy of **94%** and accurate within **<1 millimeter** of the expert assessment.

Future Work

- Acquire more MRI data from different clinical centers to enhance the robustness of the method.
- Perform clinical validation by testing the method on current patients undergoing atrial fibrillation treatment.
- Develop more advanced machine learning methods to improve accuracy.