Tulane Research Innovation for Arrhythmia Discovery

Machine Learning Approaches
In Digital Health

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Predict AF Recurrence?

88,000 Unlabeled ECG Strips

Uhh... Signal Quality and labels?
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Data Collection

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Part 1

Collecting Data

00. Mobile Devices
02. SNR Estimation
01. Noise Generation
Machine learning with mobile health devices

00. PPG signals from smart watch.
01. Mobile ECG monitoring devices.
02. Blood Pressure Measurements.
Data Quality Assessment

- Artificial Intelligence based Signal Quality Assessment
- Synthetic noisy signal generation and signal to noise ratio (SNR)

Clean ECG Signals + Randomized Noise = Synthetic Noisy Signal w/ SNR

Graphical representation showing the comparison of clean, noisy, and noise signals with different SNR values.
Data Quality Assessment

- Artificial Intelligence based Signal Quality Assessment
- Deep learning-based signal to noise ratio (SNR) estimation

![Graphs showing signal quality assessments](image-url)
Part 2

Data Cleaning

01. Tailored Denoising
02. Validation
Data Quality Enhancement

▷ Artificial Intelligence based Denoising
  ▷ Tailored Signal Denoising with Machine Learning
Validation of our methods

- **Comparison**: Published Paper vs our results with AliveCor 1-lead ECG Data
- **Method**: Utilize the state-of-the-art model to classify both data

**Improvement in Noisy ECG Classification**

Hsieh et al, MDPI, 2019
Part 3

Triad Projects

01. Universal Classifier
02. AF Recurrence
02. PPG Utilization
Minimizing the cost of manual labeling

Data Discrepancy
Minimizing the cost of manual labeling

- Data Discrepancy
- Domain Adaptation
Universal ECG Classifier

AUC Score Comparison

State of the Art vs Universal AF Classifier

2-lead ECG: State of the Art 83 vs Universal AF Classifier 88
AliveCor: State of the Art 82 vs Universal AF Classifier 87
Tulane Mobile ECG: State of the Art 75 vs Universal AF Classifier 97

Datta et al, CinC, 2017
Post Ablation AFib Recurrence AFib Burden with PPG

PPG Mapping to ECG & ABP Universal AF Classifier

Uncovering The Potential in Mobile Health Signals

Universal AF Classifier
PPG Mapping

- Generating ECG and Blood Pressure from PPG Signals
- Simultaneous Measurements
Calculating the AF Burden from continuous PPG signals
Continuous PPG Classification with Transfer Learning Domain Adaptation Method
Predicting AF Recurrence with AF Burden, and MRI images

Ensemble model of AF Burden calculation and image data.
Overall Research Design

Data Quality Assessment → Tailored Denoising → Universal AF Classifier → PPG Mapping → AF Burden Calculations → AF Recurrence, Stroke, Mortality
Bon Appétit