# 1. Introduction

This report analyzes a MATLAB script designed for processing and analyzing an ECG signal. The script loads data from a file 100m.mat, from the MIT-BIH Arrhythmia database, performs a frequency domain analysis using Discrete Fourier Transform (DFT), applies filters to remove artifacts (60 Hz interference), reconstructs the signal in the time domain using Inverse Fourier Transform (IDFT), identifies the R peak instances, calculates the RR intervals and some basic heart rate variability (HRV) metrics, and finally visualizes the results

# 2. Methodology Analysis

The script is logically divided into several sections:

## 2.1. Data Loading and Parameter Definition:

The signal is loaded from 100m.mat.

A conversion to physical units (mV) is applied using the formula (val-1024)/200, typical for PhysioNet data.

Fundamental parameters such as the sampling frequency (fs = 360 Hz), the sampling interval (deltat), and the time vector (t) are defined. A specific signal duration (probably 60s, N=21600) is implicitly assumed based on the indices used subsequently.

The frequency resolution (deltaf) is calculated.

## 2.2. DFT Calculation and Periodogram:

A frequency vector (f) centered around zero is defined.

The DFT is manually calculated using a for loop.

The Periodogram (P) is calculated and visualized as an estimate of the power spectral density.

Graphs of the signal in time, the DFT magnitude, and the unwrapped phase of the DFT are generated.

## 2.3. Noise Filtering:

A high-pass filter is implemented in the frequency domain by zeroing the DFT components for abs(f) <= 0.5 Hz to remove baseline wander.

A notch filter at 60 Hz is implemented by zeroing the DFT components corresponding to +60 Hz and -60 Hz.

## 2.4. Return to Time Domain (IDFT):

The Inverse Fourier Transform (IDFT) is manually calculated using a for loop.

## 2.5. Peak Instance Identification:

The filtered signal (normalized real part) is used to identify the R peaks.

A threshold-based method (threshold=0.5) is employed. The peak instance (t_RR) is estimated as the midpoint between the last upward crossing and the current downward crossing of the threshold.

The RR intervals (diff_RR) are calculated as differences between consecutive peak instances.

## 2.6. Calculation of Cardiac Signal Characteristics:

Basic HRV metrics are calculated: mean of RR intervals (mean), standard deviation of RR intervals (standard_dev, SDNN), and average heart rate (bpm).

An RR interval scatter plot (RR(n+1) vs RR(n)) is generated, useful for visual HRV analysis.