Problem Formation

We need to write about the following:

- Understanding the ECG and how to calculate the dynamic model
- Create a dynamic model that displays an ECG that simulates basic properties of a human heart
- Create the same ECG, but by reading from custom inputs or files
- Extend the functions and capabilities to include parameter fitting to experimental data

Background Information

- What is an ECG and briefly how to obtain it?
- Morphology of ECG cycle (PQRST)
- Intervals
- What would a dynamic model provide? (teaching, but mostly testing platform for user uploaded data and algorithm testing)

Literature Survey

Give a summary of previous work related to your problem in chronological order.

McSharry et al.,
A Dynamic Model for Generating Synthetic Electrocardiogram Signals,
IEEE Transactions on Biomedical Engineering; 2003 Mar. 5 3:289-94
http://web.mit.edu/~gari/www/papers/ieeetbe50p289.pdf

ECGSYN
An implementation of ECGSYN in MatLab, Octave, C and Java

R Sameni, MB Shamsollahi, C Jutten, M Babaie-Zadeh,
Filtering Noisy ECG Signals Using the Kalman Filter Based on a Modified Dynamic ECG Model
Computers in Cardiology; 2005 32:1017-1020
http://www.cinc.org/Proceedings/2005/pdf/1017.pdf

https://yan-lu.github.io/pdf/lu_denoising_bibm09_final.pdf

Yan Lu, Jingyu Yan, Yeung Yam
A Generalized ECG Dynamic Model with Asymmetrical Gaussians and its Application in Model-Based ECG Denoising
BMEI; 2009 Oct 17-19

https://www.researchgate.net/publication/220715500_A_Generalized_ECG_Dynamic_Model_with_Asymmetric_Gaussians_and_its_Application_in_Model-Based_ECG_Denoising

Vega Pradana Rachim, Sung-Chul Kang, Wan-Young Chung, and Tae-Ha Kwon
Implementation of Extended Kalman Filter for Real-Time Noncontact ECG Signal Acquisition in Android Based Mobile Monitoring System
Journal of Sensor Science and Technology; 2014 23:7-14
https://pdfs.semanticscholar.org/5f10/8d21970bc2fccab0dee7ee70ba51c98609b2.pdf

Omid Sayadi, Mohammed B. Shamollahi, Gari D. Clifford
Synthetic ECG Generation and Bayesian Filtering Using a Gaussian Wave-Based Dynamical Model
Physiol Meas. 2010 Oct; 31(10): 1309-1329
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3148951/

Timeline

Term 1

Week 1 – Week 2

- Develop understanding the basic dynamic model of ECG
- Reading and consideration of potential solutions to the ECG model

Week 3 – Week 4

- Create a basic model written in MatLab for experience and proof of development.

Week 5 – Week 10

- Create a basic model that works in chosen solution
- Potential extensions to the basic simulation (baseline wander, RSA, Mayer Waves)

Term 2

Week 1 – Week 10

- Potential extensions to the basic simulation (baseline wander, RSA, Mayer Waves), cont. from Term 1
- Implement basic user input (allow user to input values in one way or another)
- GUI development
- Optimization (optional, just in case)

Term 3

Week 1 – Week 10

- Refinement/implementation of features mentioned above
- Implement parameter fitting to user uploaded data
- How to package/distribute