SRTP - Project Description Form #237

PART I:

Name of Schulich faculty member who will supervise the project	Pavel Antiperovitch
Supervisor's Schulich, Western, Hospital or Lawson Email	pavel.antiperovitch@lhsc.on.ca
Schulich Department	Medicine

PART II - Project Description

Title of Project	Developing AI and Deep Learning Models for ECG Analysis

Background

Many patients with heart rhythm disorders have abnormalities in the conduction system of the heart, which manifest as prolonged QRS and QTc intervals on ECG. Certain therapies, such as cardiac resynchronization therapy, can help these patients live longer, and have improved quality of life. However, identifying patients who would benefit from this treatment is challenging without an accurate algorithm to reliably measure the QRS duration. The primary objective of this research is to create a dataset and a deep learning model that would accurately segment the QRS on ECG and identify QRS and QTc durations. This model will be used to help select patients who would benefit from treatments like cardiac resynchronization therapy.

Hypothesis

An AI/deep learning neural network will be able to segment the QRS and QT intervals on ECGs with high accuracy and precision compared to current automated methods.

Proposed Methodology

Using our current ECG library, we will create an annotated dataset of ECGs and train various deep learning neural networks to compute ECG intervals. This involves optimization of neural networks and validation of the model, which is implemented in MATLAB. Neural network outputs will be compared to intervals computed by the digital ECG systems employed at LHSC's cardiology clinics using the Bland-Altman method for assessing agreement between measurements. ECG cases that produce large discrepancies among the intervals estimated by the neural networks, the digital ECG system, and/or human observers will be analyzed to gain insight into ECG signal features that contribute to unreliable performance by the automated algorithms.

Expected Outcomes

An AI/deep learning neural network will be able to segment the QRS and QT intervals on ECGs with high accuracy and precision compared to current automated methods. This information may be used to evaluate patients who may be eligible for certain heart failure treatments like cardiac resynchronization therapy.

Research Environment – Description of the number of research personnel, primary location of research, size of lab, etc

The research student will work in a team of 2 bioengineers, 1 PhD student, and two Cardiologists specializing in heart rhythm disorders.

Names and titles of other individuals who will be involved with the research project?

Dr. Pavel Antiperovitch, MD, FRCPC, Assistant Professor, Department of Medicine, Division of Cardiology, Western University

Dr. James Lacefield, Ph.D., P.Eng., Professor and Director, School of Biomedical Engineering

Dr. Vijay Parsa, Ph.D., M.E.Sc., B.Eng. Professor, Department of Electrical & Computer Engineering
Samir Abdel Rahman, M.Sc., Ph.D. Candidate, Electrical & Computer Engineering
Dr. Anthony Tang, MD, FRCPC, Professor, Department of Medicine, Division of Cardiology, Western University

Can this project be done remotely?	Yes
Duration of Project	One Summer

Expected Objectives/Accomplishments for Student?
The student will work in a team of bioengineers and Cardiologists to develop an annotated dataset that will be used to train a neural network. The Cardiologists will train the student to interpret ECGs and annotate intervals, and bioengineers will work with the student to develop the neural network.

PART III - Certifications

Note: certification approval should be obtained prior to the start of the summer. Projects without this approval will not be a priority for funding.