Pt-ELECTRODE IMPEDANCE MEASUREMENT SYSTEM

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Abstract
Since early 1900’s, efforts have been made to characterize the electrode-electrolyte interface impedance behavior in order to design better electrode systems. These systems are widely deployed in biomedical applications such as cochlear and retinal implants, and the improvement of these systems rests on the development of an accurate model of the interface impedance behavior. The purpose of this thesis is two-fold: to design and implement an arbitrary waveform generator using FPGA, and to validate a model of the I-V relationships of platinum electrode immersed in saline solution. Experiments were conducted on platinum ball electrodes and their impedance were calculated and plotted on graphs. Mathematical and circuit models were constructed, with the latter successfully predicting the behavior observed in the experiments.

FPGA Waveform Generation System
The FPGA Waveform Generation System consists of software and hardware. Icons to the left are softwares used - HDL Designer, ModelSim, Project Navigator, iMPACT, and PACE. The FPGA board and its block diagram are shown below.

Experiment Setup
Below is a conceptual representation of the experiment setup. Pictured left is the actual setup.

Results
Measurements taken were analyzed and plotted on graphs as shown below.

Programing
VHDL was used to program the FPGA. Below is a block diagram of the code. To the right is a ModelSim simulation screenshot.

Conclusion
Although the circuit model simulation results are yet imperfect, similarities between Fig 1 and 2 is easily observed. It is believed a back-to-back parallel connected diode in series with ohmic resistance could be the model for Pt-electrode in saline.