Bio-impedance Simulation Platform using 3D Time-Varying Impedance Grid for Arterial Pulse Wave Modeling



Bassem Ibrahim*, Drew A. Hall[†], and Roozbeh Jafari*

*Embedded Signal Processing (ESP) Lab, Texas A&M University, TX, USA [†]BioSensors and BioElectronics Group, University of California, San Diego, CA, USA E-mail: bassem@tamu.edu, drewhall@ucsd.edu, rjafari@tamu.edu



Introduction

Significance: Continuous monitoring of hemodynamic parameters relies on accurate sensing of the arterial pulse wave. Bioimpedance (Bio-Z) is a non-invasive method to measure the arterial pulse wave by sensing the change in blood volume in the artery with deep penetration in the tissue.





- Challenge: The measured pulse signal is significantly affected electrode by the configuration and position relative to the artery.
- **Objective:** A simulation tool is needed to model the tissue and arterial pulse wave to guide design decisions for rapid evaluation of Bio-Z sensing circuits and algorithms.

Arterial Pulse Wave



• Using small 3D voxels of time-varying bio-impedance equivalent circuits connected together in a 3D SPICE impedance grid to model the tissue and arteries that can be simulated with the sensing circuit and electrode models.

Methods

Artery's Model

• The model includes the impedance properties of the tissue and dynamic regions such as arteries, the heart, and the lungs defined by their size, location, and depth.

Bio-Z 3D Model

location, and the current injection frequency.





