Research Overview

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CICS Review
Nov 2, 2022
Important to jointly determine intracranial pressure (ICP) and intracranial compliance (ICC) to characterize operating point.
Point-of-care intracranial pressure and compliance measurement

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Sponsor MEDRC Analog Devices

Ongoing:
Arterial blood pressure waveform estimation from arterial diameter
ICP prediction using compliance/resistance estimates
Force-coupled Ultrasound Application to a Generalized Venous Computational Model

Alex Jaffe, Aaron Aguirre, Charles Sodini, Brian Anthony

Sponsor: MEDRC-Philips
Machine Learning based Algorithm to estimate Absolute Blood Pressure Waveform from Ultrasound signals

Hanrui Wang (Ph.D. student, EECS MIT), Anand Chandrasekhar (Post Doc EECS MIT), Joohyun Seo (ADI), Aaron Aguirre (Clinical collaborator, Massachusetts General Hospital), Faculty Supervisors from MIT: Song Han, H. S. Lee, C. G. Sodini
Sponsor – MEDRC- Analog Devices

Goal: Predict MAP from BP shape and blood flow velocity waveforms.

Trained an Attention based Machine Learning model to regress MAP from patient data.

Trained the model on #37, validated on #6 and tested on #12 subjects.

Results from a single subject

Testing results on 12 subjects:
MAP error = 3 +/- 10.6 mmHg (Bias +/- std)
Phantom Based Analysis to Estimate Critical Closing Pressure

Anand Chandrasekhar (Post Doc. in EECS), Jeanne Harabedian (M. Eng. student in EECS) Hae- seung Lee and Charles Sodini (Faculty supervisors)

Sponsor – MEDRC - Philips

Simplified Physiological Model
Blood Circulatory System

Circuit Model of Arterial System

Data Recorded from the Phantom

Critical Closing Pressure (Pcrit) is modelled as the pressure exerted by the smooth muscles on the collapsible arterioles.

At the state of partial collapse, transmural pressure is ~0 mmHg.

Results

Pressure in collapsible tube [mmHg]

~Pcrit

BP

Resistive drop in pressure

BP [mmHg]

Pump Frequency = 0.5 Hz

Pump Frequency = 1 Hz

Pump Frequency = 1.5 Hz

Estimated Pcrit [mmHg]

True Pcrit [mmHg]