Model-Based Blood Pressure Wave Reflection Analysis Using Peripheral Blood Pressure Waveforms

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Background
- Cardiovascular disease (CVD) remains a major source of morbidity and mortality, responsible for approximately 1 death in 3 in the world.
- Healthcare cost attributable to CVD is higher than the cost associated with any other diagnostic groups (cost for stroke and the related conditions was approximately $300 billion in 2008).
- Systematic methods that are able to easily assess CV health must be developed to closely monitor the onset and progression of CVD.
- Diagnostic Factors of CVD
  1. Routine diagnostic factors: systolic pressure (SP), diastolic pressure (DP), pulse pressure (PP), heart rate (HR)
  2. More related factors: PWV, PTT, RM, RI, central aortic blood pressure (BP)

Goal
- To develop a minimally invasive method to derive CV risk factors by quantifying BP wave reflection in the arterial tree
- To enable minimally invasive prediction of CV risk factors by quantifying wave reflection with peripheral blood pressure waveforms

Significance
- An increase in wave reflection ultimately results in elevated central aortic BP thereby increasing the cardiac afterload.
- Quantification of BP wave reflection can lead to high-fidelity prediction of CV risk factors.

Current Limitations
- Central aortic BP and blood flow measurement is required and/or must be approximated.
- Extreme perturbation is required (e.g., occlusion of distal artery).
- Susceptible to errors in characteristic impedance computation or approximation of central aortic flow to a triangle.

Approach: Multiple Measurement Information Fusion

Experimental Data: Human and Animal Subjects

Results

Wave Decomposition Results

Wave Reflection Quantification

Future Work
- Improve accuracy and robustness
- Extend and adapt the method to low-cost and non-invasive measurement settings
- Evaluate the method in clinical settings