Cardiovascular diseases are the top natural death cause in the United States. Proactive diagnosis and treatments can significantly reduce patient risk for cardiovascular diseases. Arterial stiffness and blood pressure is recognized as independent predictor of patients’ cardiovascular events. They are probably the most commonly measured indicators of cardiovascular diseases. Arterial stiffness and blood pressure measured in a convenient and accurate manner can provide independent diagnosis information for better patient treatment.

Blood pressures measurements have been deployed heavily in the area of hypertensive patient stratification. On the other hand, people use pulse wave velocity as a surrogate measurement of arterial stiffness due to unavailability of arterial stiffness measurement technique. In the past decades, arterial stiffness and pulse wave velocity have been proved to be an independent predictor of cardiovascular events. However, the measurements of blood pressure and arterial stiffness are still inadequate in accuracy, convenience and clinical relevance.

This dissertation reported four studies concerning improved methods for monitoring arterial stiffness and blood pressure. The first study proposed an improved technique to monitor arterial stiffness or evaluating Pulse Wave Velocity using arterial tube-load model for robust and accurate arterial stiffness estimation. The second study covers the technique of estimating pulse transit time as a function of blood pressure. This technique can potentially be employed to build calibration curve between pulse transit time and blood pressure using only baseline measure for continuous and cuffless blood pressure monitoring; meanwhile this technique gives a rise of extra pulse transit time correlating with systolic blood pressure which can be potentially useful for patient stratification. The third study investigates two non-invasively pulse transit time measurement techniques as cuffless blood pressure trackers and compare them against invasively measured pulse transit time as reference. The fourth study discusses an evolved technique to
build adaptive transform function to estimate central pressure waveform from peripheral blood pressure waveforms. This technique is to improve more clinical significant central blood pressure monitoring based on more accessible peripheral blood pressure waveform. In the end the summary and future work are given for future improvement in arterial stiffness and blood pressure monitoring.

**Refereed Patents Pending**
- M Gao, R Mukkamala, Methods and Apparatus for Determining Central Blood Pressure
- M Gao, R Mukkamala, Methods and apparatus for determining pulse transit time as a function of blood pressure
- M Gao, R Mukkamala, D Xu, G Zhang, M Moslehpour, Methods and apparatus for determining arterial pulse wave velocity

**Refereed Journal Publications**
- G Zhang, M Gao, D Xu, NB Olivier, R Mukkamala, “Pulse Arrival Time is Not an Adequate Surrogate for Pulse Transit Time As a Marker of Blood Pressure”, Journal of Applied Physiology 111 (6), 1681-1686
- M Gao, B Olivier and R Mukkamala “Assessment of Two Simple, Non-Invasive Estimates of Pulse Transit Time as Markers of Blood Pressure”, accepted by Physiological Report
- M Gao, W Rose, B Fetics, H Cheng, C Chen, D Kass, R Mukkamala, “An adaptive transfer function for deriving the central blood pressure waveform from a peripheral blood pressure waveform: validation in patients”, Submitted to Hypertension
- M Gao, G Zhang, NB Olivier, R Mukkamala, “Cuffless, Noninvasive and Probation-free Blood Monitor Using Nonlinear FEM Arterial Tube-Load Mode, To be submitted to IEEE Biomedical Transaction

**Related Conference Publications**
- R Mukkamala, M Gao, W Rose, B Fetics, H Cheng, C Chen, D Kass, , “An adaptive transfer function for deriving the central blood pressure waveform from a peripheral
blood pressure waveform: validation in patients”, Journal of the American Society of Hypertension 2014 8 (4), e46-e46


