Cardiovascular diseases are one of the major causes of mortality in the United States. Early detection and intervention would be of great significance to engineering and medicine in disease management. Modern clinical techniques of evaluating cardiac function most frequently involve history and physical examination (including stethoscope auscultation), electrocardiograms (ECG), echocardiogram imaging, and various blood tests. Seismocardiographic signals (SCG) which associate with the cardiomechanical activity can be used for monitoring and predicting cardiac health. SCG signals are recorded on the chest surface, typically using an accelerometer. SCG's high potential utility in cardiac health monitoring may be impeded by its spatial, postural, and longitudinal variability. In this dissertation, SCG signals have been recorded from several healthy human subjects. The factors involving SCG's variability including its spatial, postural, and longitudinal variability is documented. Furthermore, optimum posture and sensor placement have been suggested by analyzing several SCG features. The understanding SCG variability in spatial, postural, and over time in healthy subjects may help identify prominent SCG features and improve predicting cardiac health. In addition, monitoring respiration is critical for patients and can be performed via direct measurement of airflow utilizing a mouthpiece or other access to breathing airflow stream. In some instances, this may be impractical or undesirable especially in an ambulatory setting and less-invasive approaches are needed. The respiration signal can be extracted noninvasively from physiological signals such as ECG or SCG. The current study extracted respiration noninvasively from several physiological signals from healthy subjects and compared that with direct respiration measurement. In addition, the respiratory phase from SCG signals of HF patients was also extracted using traditional signal processing techniques and compared with the respiratory phase extracted from machine learning. Noninvasive respiration would help monitor patient breathing including patients with heart failure.

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The public is welcome to attend.