

# Mechanocardiograms: At the Limits of Seismocardiography and Ballistocardiography

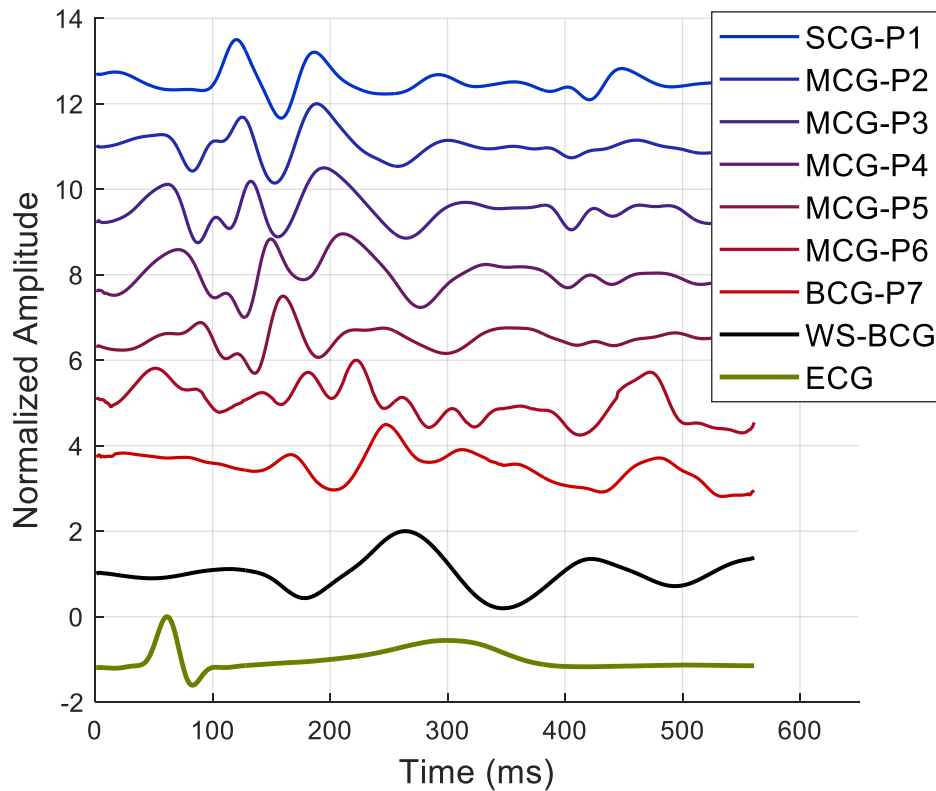
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Ballistocardiogram (BCG) and seismocardiogram (SCG) are cardiac signals of mechanical origin that have gained increasing relevance as non-invasive tools for cardiovascular monitoring. SCG is regarded as the measurement of thoracic vibrations due to cardiac contraction and blood ejection, typically recorded at the xiphoid process, whereas BCG is interpreted as whole-body recoil forces associated with blood flow along the vascular tree, measured near the body's center of mass at the lower back or via sensors integrated into weighing scales or beds.

In this work, to investigate the limits between SCG and BCG, sequential measurements were obtained using an accelerometer placed at seven anatomical locations (P1 to P7) spanning from the xiphoid process to the lower back: P1 at the xiphoid process, P2 to P5 along the left anterior-to-lateral thoracic wall, P6 on the posterior midline (thoracic spine), and P7 on the lumbar spine. Each position was recorded for one minute at rest. Accelerometer signals, together with a weighing-scale BCG (WS-BCG) and ECG, were acquired. Data from three healthy subjects showed consistent results. Woody-averaged beats were computed using ECG R-peak alignment, and representative results from one subject (31-year-old male) are shown in the figure. The signal at P1 is named SCG and that at P7, BCG, according to current conventions, while intermediate signals are here named mechanocardiograms (MCG).



From the figure, it can be observed what appears to be a continuous transformation from SCG to BCG across consecutive recordings. This suggests that, although SCG and BCG terms may still be used at P1 and P7, a unified nomenclature is needed for intermediate signals between SCG and BCG, which may not be appropriately termed wearable BCG as is currently done in the field. Finally, these results also suggest that new modeling approaches seeking a common explanation of SCG and BCG could be explored.