

Novel Contactless and AI-Based Method Can Determine Heart Rate and Cardiac-Induced Vibrations of Chest

Introduction: Seismocardiography (SCG) - measurements of cardiovascular-induced vibrations on the chest - has shown potential for providing clinically relevant information for cardiac conditions. SCG is conventionally recorded by attaching an accelerometer to a single point on chest. However, prior research suggests that multichannel SCG (mSCG) - measurements from multiple chest locations - can provide extra and more accurate clinical information. Current mSCG methods are limited to accelerometer arrays, laser Doppler vibrometry, and airborne ultrasound. These methods are either costly, difficult for inexperienced users, or need bulky equipment, thereby impeding their use beyond research or clinical settings.

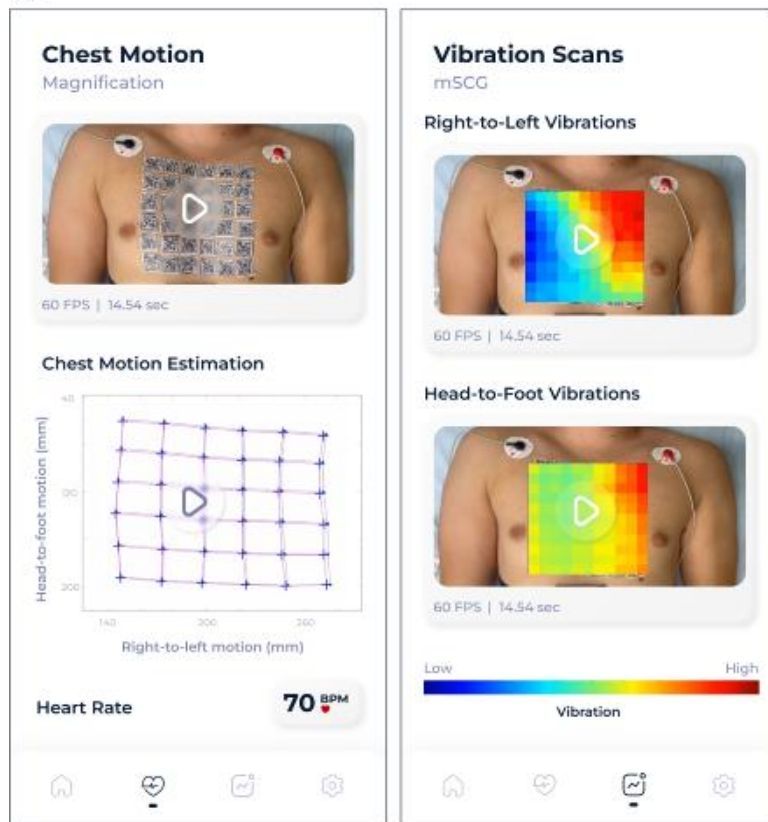
Hypothesis: mSCG signals can be accurately estimated from tiny chest movements in chest videos recorded using normal cameras (e.g., those in smartphones).

Methods: We enrolled 10 subjects (sbjs) with no history of cardiovascular diseases (21.7 ± 1.7 years, 40% women). ECG and chest video of sbjs were recorded at rest for 15 sec during breath hold at the end of inhalation followed by another 15 sec recording during breath hold at the end of exhalation. We developed an AI-powered mobile app to record the chest videos and convert them to 0-30 Hz mSCG in right-to-left (RL) and head-to-foot (HF) directions (Fig 1a). Heart rate (HR) based on ECG RR interval and mSCG were measured and compared.

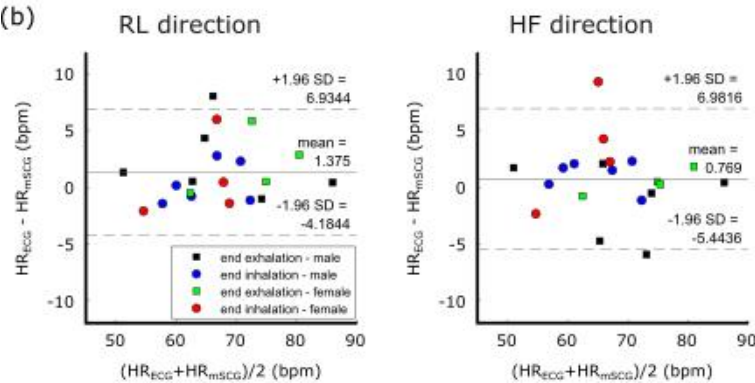
Results: HR estimated from mSCG in both RL and HF directions had a good agreement with ECG-based HR using Bland-Altman analysis [RL: bias = 1.4 bpm, 95% CI = 5.6 bpm; HF: bias = 0.8 bpm, 95% CI = 6.2 bpm (Fig 1b)]. High quality mSCG and ECG measurements were obtained for all sbjs.

Conclusion: Clinically relevant information can be accurately extracted from chest videos using our novel contactless and AI-based method. Given that the vast majority of Americans have access to a camera phone, future developments of this method may provide new means of remote and accessible cardiac monitoring.

(a)



(b)



Abstract Graphic/Image Description: (a) Screenshots of the mobile app that records and analyzes chest videos to extract cardiovascular-induced chest vibrations and cardiac metrics including heart rate (HR), (b) Bland-Altman plots of HRs estimated from chest videos vs. gold-standard HR measured from ECG.