Designing a Mobile Photoplethysmograph for Microwave Cardiography Ground Truth Data Comparison

Robert Gougelet
Mentor: Jim Lux

FINDER (Finding Individuals for Disaster and Emergency Response) is a microwave radar developed by Jet Propulsion Laboratory to detect victims buried in disaster rubble. FINDER uses a form of microwave cardiography (MCG) to measure cardiac and respiratory activity by detecting the phase shift of a reflected continuous microwave radar signal caused by small motions of the victim's skin surface. Performance testing of the prototype FINDER device requires ground truth data collected from human subjects acting as victims in rubble test sites. These data must be acquired in a field environment using portable, unobtrusive equipment. Photoplethysmography (PPG) detects changes in infrared and visual spectrum reflectance of tissue in response to changes in blood volume and oxygenation that are associated with cardiac and respiratory activity. PPG's simple and lightweight design implementation makes it an ideal mobile measure for FINDER's ground truth data comparison. A readily reproducible and inexpensive mobile PPG device was created for this project, using a microcontroller for time synchronization, data collection, time stamping, and storage. The newly accessible mobile PPG data permits validation and testing of FINDER life detection algorithms and source separation techniques.