Contactless Monitoring of Human Vital Signs Via FMCW Radar Demo
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Motivation and Contributions
- The increase in cardiopulmonary morbidity, disease transmission and burden on medical staff has led to extensive investigation of non-contact monitoring approaches.
- Remote technology such as radar do not require users to wear, carry, or interact with any additional electronic device.
- We present an extended model for non-contact vital signs monitoring of multiple people (MP-NCVSM) via FMCW radar, in a realistic noisy scenario containing multiple objects.
- Based on this model, we develop a complete methodology for human localization and estimation of their respiration rate (RR) and heart rate (HR), using only a single channel and a SISO setup.
- We propose a dedicated phantom that simulates human thoracic motion through which realistic experiments can be performed, reducing the need for human trials.

Extended FMCW Model
- Assume M different objects in the radar’s FOV. The extended FMCW signal model for this case is given by
  \[ y[n] = \sum_{m=1}^{M} s_{m} \exp\left(i 2\pi f_{m} n T_{r} \right) + v[n] \]
- \( Y_{\ell} \) models the vibration of each object.
- The set \( \{ s_{m}\} \) includes the RR and HR of each human, denoted by \( f_{r}^{m} \) and \( f_{h}^{m} \) for \( m = 1, \ldots, M \) humans in the FOV.
- Reshaping \( \{ y[n]\} \) ...

Graphical User Interface
- GUI: Parameter Setting
- Hardware: Radar
- GUI: Display
- Contactless monitoring of vital signs via FMCW radar

Sparsity Based MP-NCVSM
- Assuming that
  \[ Y_{\ell} = [v_{r}, v_{h}] \]
- Then, the RR and HR estimates of each human are given by
  \[ \hat{v}_{r} = D^{T} y_{\ell} \quad \hat{v}_{h} = D^{T} y_{\ell} \]

Results
- We perform 2 NCVSM experiments of a human located at 0.72 [m] from the radar, comparing our proposed method to other state-of-the-art techniques.
- The first experiment is based on a software simulation in which the SNR is controlled.
- The second experiment is based on a dedicated phantom that mimics the vibration source of the software simulation.
- In the following, one can observe the hardware based localization of the vibration source and its extraction, through which accurate monitoring of RR and HR is obtained, compared with other contemporary techniques.