ABSTRACT

The main objective of this thesis is to detect the human subject behind the wall using the microwave frequency. The presence of human subject is estimated using the vital sign such as respiration and heartbeat signal. A RF signal is transmitted towards the human subject, the reflected signal from the human subject contains the information about the chest movement. Due to the periodic motion of chest, the reflected signal is phase modulated and the vital sign information is present in the phase of reflected signal. Thus, using the microwave frequencies the vital sign of human subject can be estimated non-invasive. The chest movement due to respiration is more as compared to heart, so more phase change due to respiration, so, for through the wall or under debris scenario, the respiration signal is used for life sign detection.

The strength of reflected signal from the human subject changes with the frequency. To prove this concept, the RCS of human subject is measured in X-band. Also the reflected signal is stronger from the back side of human subject as compared to front side. But the chest movement due to respiration signal is more on front side.

The work for respiration estimation of human subject is started using the vector network analyser (VNA). The RF signal at a frequency is transmitted towards the subject facing the transmitting and receiving antenna. The phase of S_{21} gives the respiration signal information. Under different breathing rates viz. slow, normal and fast, the respiration signal of human subject is estimated using the VNA.

Our main focus is to build a compact portable Doppler radar system for through the wall human subject detection. The direct homodyne radar system is used at 2.4 GHz for this purpose. Using Doppler radar, respiration of human subject is estimated for real-life situation such as different breathing rates- normal, slow, fast and different medium behind the human subject. The HVD algorithm is applied to extract the respiration signal using the Doppler radar. As the respiration signal is the largest energy signal after demodulation so respiration signal

can be extracted from the noisy signal. The processing time of the HVD is very less as compared to other existing methods. The size of the system is small making it suitable for portable application.

Through the wall localization of human subject is equally important as vital sign detection. Single antenna cannot be used for localization of human subject. For this purpose multiple channel system is used to detect the angular position and respiration rate of human subject which is not possible using a single antenna system. Using two frequencies, the distance of the human subject with respect to the radar is estimated for different mediums. In complex environment between the radar and human subject, the DOA is estimated using the uniform linear array (ULA) making the system useful in real-life scenarios. The DOA estimation, range and respiration signal all can be measured simultaneously using the proposed radar. The results are repeatable under different scenarios of measurement. A low cost portable system can be made for life-sign detection and localization of the human subjects in real-life applications. It is also possible to make a reliable device for continuous monitoring of patients or in security and surveillance applications.