ABSTRACT

Detecting small displacements in the order of millimeters requires a large bandwidth according to the range resolution perspective. Continuous Wave (CW) radar shows very small bandwidth requirements in detecting small displacements but improvements are needed to overcome limitations in detecting target distances from the radar. Multi Frequency Continuous Wave (MFCW) radar system has been proposed previously as new configuration of radar system for small displacement detection. However, the further study of the noise effect is required. Therefore, the contribution of the thesis is providing the performance analysis result of the MFCW radar in detection small displacement under noise. In first midterm defence, a simulation modeling of the Multi Frequency Continuous Wave (MFCW) radar system has been developed and the study on each MFCW parameter was carried out and reported. The results prove that the proposed radar system can detect small displacements and detect the target's distance from the radar. However, the detection capability under the influence of amplitude and phase noise needs to be investigated to determine the MFCW performance, especially considering the potential for phase noise arising from the use of multi-frequency generator circuits. Therefore, in the second midterm defence, the radar performance under noise influence is reported. The results of the proposed radar system show that the radar system can detect small displacements on a millimeter scale with good detection capabilities at SNR greater than 13 dB. Amplitude and phase noise have a less significant effect on distance detection results. However, phase noise has a more significant effect on the detection results of small displacements than amplitude noise. At SNR greater than 13 dB the error in detection of small displacements begins to converge at a constant value. Phase noise with a variance greater than 1 rad^2 could potentially indicate an error in detection of small displacements greater than 1 mm.

Keywords: MFCW, *small displacement,* SDR, VNA, performance, noise