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GROUND CLUTTER MODEL FOR FORWARD SCATTER RADAR (FSR) WITH VERY HIGH FREQUENCY (VHF) AND ULTRA HIGH FREQUENCY (UHF) BANDS IN TROPICAL REGION

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ABSTRACT

The lack of traditional radar system during this era is the inefficient to detect targets that occupied with radar absorbing material (RAM) coating. Forward scatter radar (FSR) was introduced to overcome the problem by operating via shadowing concept. The target is detected when it crosses the baseline of the transmitter and receiver of the sensor where it creates a Doppler signal to the transmitted electromagnetic wave. Equipped with omnidirectional antennas, FSR is able to form a fencing system that is useful for situational awareness not only for normal targets, but also for stealth targets. However, as the system utilized omnidirectional antennas, positioned on the ground as well as the lack of range resolution due to its configuration, the captured signal from desired target also collect the unwanted signal from the surrounding. This unwanted signal is one of the interference signal known as clutter. Clutter signal will cause false alarm during the operation. Subsequently, it is necessary for the user to indentify the characteristics of the clutter occurred in order to differentiate the signal between the target and the clutter signal. From the characteristics analysis, a clutter model can be developed to generate a simulated clutter signal as a reference signal during the operation. This thesis presents a clutter model for four (4) types of profiles in tropical region, which are seaside, forest, two-profile and free space area. The operating frequencies used to measure the clutter signals are 64, 151 and 434 MHz. There are four (4) levels of clutter strength; low, medium, strong and very strong that are divided based on the wind speed occurred during the measurements. The measured clutter signals are conformed to distribution models, such as Log-Normal, Log-Logistic, Gamma and Weibull distribution using curve fitting approach. This is to ensure the best fitted model which is validated by using goodness-of-fit (GOF) test namely root mean square error (RMSE), where the smallest error indicates the best model. At the end of the analysis, the simulated signals are compared with the measured signals in terms of its Doppler signal with the error below than 10%. The type of model obtained for the simulated signal with its shape factor is also compared to the model obtained from the measured signal. As for this thesis, only measured clutter signal for very strong seaside clutter is discussed due to number of results. It is found that 64 MHz clutter signal fits best to Weibull distribution and the error between the measured and simulated signal is 0.42%, 151 MHz clutter signal fits best to Gamma distribution with 3.42% error and Log-Logistic distribution suits best to 434 MHz clutter signal and the error is 7.69%. It is also found that there is a big difference between clutter model from United Kingdom and clutter model from this research. Lastly, a graphic user interface (GUI) is developed to generate the simulated signal by choosing the operating frequency, type of clutter strength and type of profile.

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