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INSTITUTION

Matematikcentrum. Matematisk statistik, Lunds universitet, Box 118, 221 00 LUND

FÖRFATTARE

Ludvig Hassbring och Jessica Nilsson

DOKUMENTTITEL OCH UNDERTITEL

Machine Learning for FMCW Radar Interference Mitigation

Frequency Modulated Continuous Wave radar is used for object detection and localization, e.g., for surveillance purposes or for automotive systems. The amount of radars is increasing, which leads to an increasing amount of radar interference. The radar signals from different devices are uncoordinated and therefore difficult to estimate beforehand. If several radars operate on the same frequency band, mutual disruptions will occur. Interference can lead to false detections, i.e., ghost objects, or missed detections. If identical radars are interfering with each other, a specific type of interference, so called coherent interference, is present. This type of interference together with a phenomena called clock drift is simulated in this project, as well as semi-coherent and non-coherent interference. Several mitigation algorithms are used to reduce/eliminate the different types of interference. Convolutional Neural Networks (CNNs) are commonly used to find structure and patterns in data. By providing the network with clean data and data containing interference, the network can be trained to detect where interference is occurring and re-create the clean data set. Since the data containing interference has different attributes than clean data, interference can be detected and mitigation can be performed to reduce the interference. Two CNN architectures, one shallow and one deep, are trained and evaluated using simulated data and the performance of the models are compared with conventional signal processing algorithms. The Signal-to-Interference-plus-Noise Ratio (SINR) and Error Vector Magnitude (EVM) of the different algorithms are compared. Training the CNNs to minimize SINR generates models useful for object detection, even when subject to a substantial amount of interference. By using Mean Square Error (MSE) as the objective function, the trained models are useful for interference mitigation, but ghost objects are occasionally classified as true objects. Generally, CNNs can be used as an alternative to common signal processing algorithms, especially when a majority of the data points are affected by interference. The complex networks are able to identify the data containing information about the objects, even when the data is hidden in a considerable amount of interference.

NYCKELORD

FMCW radar, interference mitigation, convolutional neural network

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Maskininlärning för att begränsa radarinterferens

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