Abstract

The dissertation presents the application of convolutional neural networks in radar technology. The primary aim is to demonstrate the potential of artificial intelligence methods in radar domains where traditional approaches have previously been employed. The aim of the study is to develop a method for detecting and recognizing selected objects using a frequency modulated continuous-wave radar, short-time Fourier transform, and a dedicated convolutional neural network structure. The dissertation includes a theoretical description of the convolutional neural network structure, the properties of frequency modulated continuous-wave radar, short-time Fourier transform, and a range of methods leading to a comprehensive object detection approach. Special attention is given to the creative use of the micro-Doppler phenomenon. The proposed solution is based on processing the echo signal emitted by the frequency modulated continuous-wave radar and reflected from an object using the short-time Fourier transform to generate representations that serve as input data for the convolutional neural network. The effectiveness of the proposed solution has been validated through a series of simulations and practical studies on identical input data sets. The practical aspect analyzed in the study addresses the socially significant issue of improving the safety of road users moving through roads, parking lots, airports, and other critical public spaces, where ensuring the security and identification of detected objects is essential. The conducted experiments, along with the presented results and analyses, have effectively demonstrated the feasibility of using convolutional neural networks for object recognition in radar applications.

Keywords: convolutional neural networks, frequency modulated continuous-wave radar, short-time Fourier transform, micro-Doppler phenomenon.