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(Research Article)
Combining pattern recognition and deep-learning-based algorithms to automatically detect commercial quadcopters using audio signals

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Abstract

Commercial quadcopters with many private, commercial, and public sector applications are a rapidly advancing technology. Currently, there is no guarantee to facilitate the safe operation of these devices in the community. Three different automatic commercial quadcopters identification methods are presented in this paper. Among these three techniques, two are based on deep neural networks in which all the feature extraction and classification processes are performed automatically. Deep learning-based methods include the convolutional neural network (CNN), LTSM networks, and a combination of those. The third method is presented using cepstral coefficients and support vector machines. In deep learning-based algorithms, the spectral patterns extracted from the commercial quadcopters' sounds are used as input data. The spectral patterns are obtained by applying the short-time Fourier transform method to the acoustic data. Besides, the cepstral coefficients and the support vector machines are used in the third method to identify and classify the received acoustic signals. The performance of the deep learning and cepstrum coefficients-based methods are compared using the acoustic datasets recorded from the commercial quadcopters. The results show that all three presented methods have adequate performance in identifying the quadcopters. However, the LSTM-CNN method had the best performance by providing an average accuracy of 95.31%, average sensitivity of 96.24%, and average specificity of 95.61%.

Keywords: Commercial quadcopters, Deep neural networks, Cepstrum coefficients, Machine learning.

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