

Deep Learning-Based Radar Data Augmentation for People Counting

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Recently, IR-UWB (Impulse Radio-Ultra Wideband) radar has attracted attention in various applications such as security systems and rescue support in disaster situations due to its non-contact and low-power characteristics. Active research has been conducted to detect and estimate multiple targets in various environments by integrating machine learning and deep learning techniques. Research has been conducted to detect multiple people using IR-UWB radar or to estimate the number of people by recognizing various poses and performing similar estimations. However, collecting large-scale measurement data, which is essential for training machine learning and deep learning models, presents a challenge. Although appropriate and high-quality data is important for these algorithms, collecting such data in complex environments involving multiple people requires considerable time and effort. In this paper, we propose a data augmentation technique to improve the diversity and quality of IR-UWB radar reception data using a deep learning model with improved stability. The validity of the proposed augmentation technique is verified by comparing the classification accuracy of the augmented data and the actual measured data in several machine learning models.

If the training data is insufficient, the underfitting problem may occur, which significantly reduces the accuracy of the training. Therefore, we propose a data augmentation method that expands the scale of the data by adding random Gaussian noise to the radar echo signal matrix and trains using a deep learning model with improved stability to generate data similar to the actual measured data. This model is particularly suitable for scenarios where the measured data is limited and dimension of the data to be trained is low. The combined dataset of the actual data and the augmented data is used to train various machine learning classification models. The newly measured data is used as test data to compare and analyze the accuracy of the classification models. In addition, we verify the effectiveness of the proposed technique by comparing the performance with the scenario where data augmentation using deep learning is not applied.

In this study, we propose a deep learning-based data augmentation method to estimate the number of people using IR-UWB radar. The proposed method alleviates the difficulty of obtaining training data and improves the average classification accuracy of the model that identifies multiple people compared to the case without data augmentation. This shows that it can be potentially applied in various fields such as security, surveillance systems, and rescue operations in disaster environments.

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