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Systematic Evaluation of Convolutional Neural Network on Land Cover Classification from Remotely Sensed Images

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Abstract : In using Convolutional Neural Network (CNN) for classification, there is a set of hyperparameters available for the configuration purpose. This study aims to evaluate the impact of a range of parameters in CNN architecture i.e. AlexNet on land cover classification based on four remotely sensed datasets. The evaluation tests the influence of a set of hyperparameters on the classification performance. The parameters concerned are epoch values, batch size, and convolutional filter size against input image size. Thus, a set of experiments were conducted to specify the effectiveness of the selected parameters using two implementing approaches, named pertained and fine-tuned. We first explore the number of epochs under several selected batch size values (32, 64, 128 and 200). The impact of kernel size of convolutional filters (1, 3, 5, 7, 10, 15, 20, 25 and 30) was evaluated against the image size under testing (64, 96, 128, 180 and 224), which gave us insight of the relationship between the size of convolutional filters and image size. To generalise the validation, four remote sensing datasets, AID, RSD, UCMerced and RSCCN, which have different land covers and are publicly available, were used in the experiments. These datasets have a wide diversity of input data, such as number of classes, amount of labelled data, and texture patterns. A specifically designed interactive deep learning GPU training platform for image classification (Nvidia Digit) was employed in the experiments. It has shown efficiency in both training and testing. The results have shown that increasing the number of epochs leads to a higher accuracy rate, as expected. However, the convergence state is highly related to datasets. For the batch size evaluation, it has shown that a larger batch size slightly decreases the classification accuracy compared to a small batch size. For example, selecting the value 32 as the batch size on the RSCCN dataset achieves the accuracy rate of 90.34 % at the 11th epoch while decreasing the epoch value to one makes the accuracy rate drop to 74%. On the other extreme, setting an increased value of batch size to 200 decreases the accuracy rate at the 11th epoch is 86.5%, and 63% when using one epoch only. On the other hand, selecting the kernel size is loosely related to data set. From a practical point of view, the filter size 20 produces 70.4286%. The last performed image size experiment shows a dependency in the accuracy improvement. However, an expensive performance gain had been noticed. The represented conclusion opens the opportunities toward a better classification performance in various applications such as planetary remote sensing.

Keywords : CNNs, hyperparamters, remote sensing, land cover, land use
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