

Application of deep convolutional neural network for short-term precipitation forecasting using weather radar-based images

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Abstract

In this study, a deep convolutional neural network (DCNN) model is proposed for short-term precipitation forecasting using weather radar-based images. The DCNN model is a combination of convolutional neural networks, autoencoder neural networks, and U-net architecture. The weather radar-based image data used here are retrieved from competition for rainfall forecasting in Korea (AI Contest for Rainfall Prediction of Hydroelectric Dam Using Public Data), organized by Dacon under the sponsorship of the Korean Water Resources Association in October 2020. This data is collected from rainy events during the rainy season (April - October) from 2010 to 2017. These images have undergone a preprocessing step to convert from weather radar data to grayscale image data before they are exploited for the competition. Accordingly, each of these gray images covers a spatial dimension of 120×120 pixels and has a corresponding temporal resolution of 10 minutes. Here, each pixel corresponds to a grid of size 4km×4km. The DCNN model is designed in this study to provide 10-minute predictive images in advance. Then, precipitation information can be obtained from these forecast images through empirical conversion formulas. Model performance is assessed by comparing the Score index, which is defined based on the ratio of MAE (mean absolute error) to CSI (critical success index) values. The competition results have demonstrated the impressive performance of the DCNN model, where the Score value is 0.530 compared to the best value from the competition of 0.500, ranking 16th out of 463 participating teams. This study's findings exhibit the potential of applying the DCNN model to short-term rainfall prediction using weather radar-based images. As a result, this model can be applied to other areas with different spatiotemporal resolutions.

Keywords: AI Contest, convolutional neural network (CNN), radar image, precipitation forecasting, weather radar.

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