Application of AI Technology for Tsunami Prediction by Oceanographic Radar

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At Hamaoka Nuclear Power Station, oceanographic radar (HF radar) is installed to detect the tsunami early.We can observe sea surface velocity distribution up to offshore of about 40 km approximately every minute.When a tsunami occurs, it is expected to capture the situation which the tsunami approaches and to predict the arriving tsunami.

Oceanographic radar observation captures a wide range of flow velocity distribution at once and obtains numerical result.By using the distribution situation of the change of the flow velocity on sea surface by the tsunami, we investigated the tsunami prediction by the image recognition method using AI technology.AlexNet (convolution neural network) was used for the image recognition method.

For the prediction of the tsunami, the tsunami height (first wave) and the arrival time are important, the tsunami height was classified into 1 m interval (tsunami height 10 m or less) or 2 m interval (tsunami height 10 m to 22 m), and the arrival time was classified as one minute interval (1 min to 22 min). The total was classified into 374 categories.Using the image recognition method, we examined the accuracy of the classification based on the observation situation.

In this study, the result of the tsunami simulation exceeding 5000 tsunami caused by the Nankai Trough earthquake which will have the most influence on Hamaoka Nuclear Power Station.Since the number of large-scale tsunami cases is small, we devised such as using data in seconds.Also, since AlexNet can handle color images (RGB), the current flow time change (current time, 1 minute before the current time, 2 minutes before the current time) of three steps in the learning data was applied to R, G, B.As a result, regularity such as time series of flow velocity and position information can be reflected, and the feature of image change (change in flow velocity distribution) became easier to capture.

Although the scale of the tsunami varies, it is important to predict a large-scale tsunami (tsunami height 10 m or more) at Hamaoka Nuclear Power Station, so the result of "Tsunami height 10 m or more" is described here.As for the verification of the AI prediction, the data (verification data) not used for learning data in simulation data was used.The ratio between learning data and verification data was set at about 80% and about 20%.The accuracy rate was about 77%.Regarding time, if one category (arrival time ±1 minute) is permitted, the accuracy rate improves to about 94%.So, it can be said that the error of the tsunami height is smaller than the arrival time with this image recognition method.

Keywords: tsunami prediction, oceanographic radar, AI, AlexNet

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