Safety-related transmitter drift trend analysis and improvement plan study related to Kori Units 3&4

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1. Introduction

Transmitters play an important role in monitoring the status of various systems and devices in nuclear power plants. Since the accuracy of these transmitters is directly related to the safety of the system, drift can be a big problem. Drift is a phenomenon in which the measured value of the transmitter deviates from the original value over time. If these drifts are large, incorrect information can be passed to the system, which can cause problems with the safety of the power plant.

This study analyzes the trend of safety-related transmitter drift in Kori Units 3&4, and proposes a method for predicting future drift values based on this trend. In particular, we want to predict drift values based on historical data by utilizing an ANN (Artificial Neural Network) methodology based on Keras and Python.

2. Methods and Results

2.1 Analysis of drift results

Calibration result data collected for 10 years of Kori Units 3&4 safety-related transmitters was acquired, and data quality was improved by reviewing missing values, errors and noise. Table 1 is the result of analyzing the calibration result data as a drift value.

Table 1: Drift Analysis Result

	Drift @0%	Drift @25%	Drift @50%	Drift @75%	Drift @100%
Mean	-0.006%	-0.003%	-0.002%	-0.002%	0.003%
Upper	0.379%	0.488%	0.344%	0.344%	0.383%
Lower	-0.438%	-0.481%	-0.487%	-0.400%	-0.364%
Standard Deviation	0.087%	0.099%	0.104%	0.105%	0.111%
Median	0.000%	0.000%	0.006%	0.006%	0.000%

2.2 Drift model training and prediction

Based on the analysis of drift results, the neural network structure is built after processing data for model learning and dividing the data into training and validation sets. The results of model learning and training with MAE (Mean Absolute Error) set as a loss function are shown in Fig. 1.

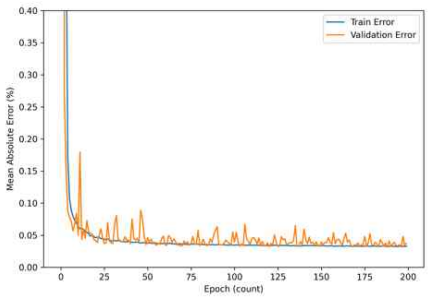
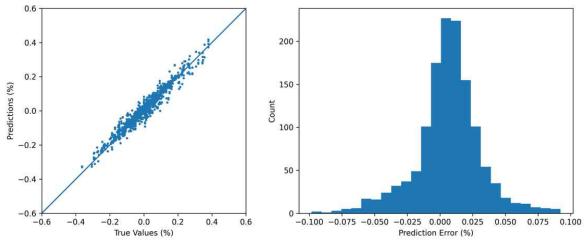


Fig. 1. Visualize the model's training progress

The result of evaluating the predicted future value and the actual measured value with the trained model is shown in Fig. 2.



(a) (b)

Fig. 2. Result of model predicts: (a) Scatter graph for predictions, (b) Prediction error distribution

3. Conclusions

As a result of the drift analysis of the safety-related transmitters of Kori Units 3&4, they were managed within a good range of ±0.5%.

As a result of drift model training and prediction, the MAE (Mean Absolute Error) was 0.04%, showing good performance.

Accurately identifying the drift trend of transmitters and predicting future drift based on this is important for enhancing the safety of nuclear power plants. If this study using Keras and Python-based ANN (Artificial Neural Network) methodology is applied to the actual plants, it will contribute to the safe operation of nuclear power plants.