

## **Enhanced long short-term memory with fireworks algorithm and mutation operator**

### **ABSTRACT**

Prediction models are used to prevent and prepare for corresponding events according to various types of data generated in production. Aiming at the problems of lower predictive accuracy and slower convergent speed of the existing prediction models, a prediction model based on fireworks algorithm (FWA) and long short-term memory (LSTM) is proposed to predict time-related data. Firstly, we establish the interconnection structure model of the hidden layer nodes in the LSTM. Then, considering the diversity and concurrency of the group, we optimize the hyperparameters combination of LSTM. Finally, we improve FWA by adding three mutation operators (Gaussian mutation operator, Cauchy mutation operator, and discrete mutation operator). Based on the enhanced FWA, we achieve a better optimization effect by increasing the diversity of hyperparameters combination. The experimental results show that the performance of the proposed LSTM-enhanced FWA model has been significantly improved by comparing to the existing LSTM and LSTM-GS models. The mean absolute error (MAE) is reduced by 38.49% and 17.79%, respectively; the root mean squared error (RMSE) is reduced by 29.47% and 19.28%, respectively; and the mean absolute percentage error (MAPE) is reduced by 36.67% and 26.92%, respectively. MAE and MAPE represent the degree of deviation between the predicted value and actual value, and RMSE well reflects the precision. This means that the proposed LSTM-enhanced FWA model is better than existing LSTM and LSTM-GS models because all three types of error are reduced, meanwhile three kinds of error better reflect accuracy and precision of error.