# Prediction Method for Transformer State Based on GRU Network

## Introduction

Dissolved gases content in power transformer oil can provide important information for transformer condition assessment. The recurrent neural network (RNN) has always performed well in the data labeled in the form of sequence but it has long term dependency and vanishing gradient problem. Gated Recurrent Unit (GRU) is an improved version of RNN which deal with problems in RNN. This paper proposed a new forecasting model based on GRU network. The studies show that the model can effectively predict the change state of oil gas in power transformer. Compared with the Long Short Term Memory (LSTM) networks which is also improved recurrent neural network, the accuracy rate is comparable, and the training time is shorter and the universality is better. When the interval and fluctuation of data are greater, the prediction of the GRU network is also more stable.

The GRU network structure is more novel and has better performance. The prediction model established by the GRU network has high accuracy in predicting the state of the transformer and the training time is shorter. Based on the characteristic gas data of a power transformer, this paper proposed a state prediction model of power transformer based on GRU network, analyze the effect of GRU network to predict transformer status.

## GRU Neural Network

The GRU network improves the structure of the network on the basis of RNN, it adds a gating mechanism to control the transmission of information in the neural network. The gating mechanism can choose how much information in the memory unit needs to be retained or discarded, and what new state information needs to be saved in the memory unit. This allows the gate-controlled recurrent neural network to learn the dependencies with a relatively long time span without the problems of gradient disappearance and gradient explosion. In RNN networks, there is a non-linear relationship between the state of the network and the parameters are shared at each time step, which is the root cause of gradient explosion and gradient disappearance. gated neural network add a linear dependency between states, to avoid the problem of gradient disappearance and gradient explosion.

Compared with LSTM network, the GRU network structure is simpler. It combines the input gate and the forget gate which in the LSTM and called update gate. In the GRU network, there is no

division between the internal state and the external state of the traditional network structure, but by adding a linear dependency between the current network state and the previous moment network state, to solve the gradient disappearance and gradient explosion. Its function is to memorize and transfer data information, like the cell state in LSTM. For example, in transformer oil gas prediction, it can save important information such as the prominent state of individual gases and the correlation of multiple gases.

## Realization of gas content prediction in oil

The entire state prediction process is divided into three stages. In the first stage, the data is preprocessed, and the data is processed into a sequence that can be used for model training. In the second stage, the processed oil chromatography time series data are sent to the GRU model for training to generate a prediction model. The prediction model consists of a layer of GRU network. In terms of network structure setting, we adapt Adam as optimization algorithm, set batch-size to 20, the number of hidden layers is set to 60, set sigmoid as the activation function. At the last stage, predict the date of the validation set, and evaluated the prediction results through various aspects.

## Conclusion

In oil chromatography prediction, there are problems such as low prediction accuracy, poor generalization performance, and long model training time. To solve these problems, this paper proposed a prediction model based on GRU network. and compares it with other traditional prediction methods through simulation. The conclusions can be drawn as follows:

1) Based on the actual case analysis the oil chromatography state prediction established by GRU network has the better generalization ability compared with the traditional prediction method and avoids the introduction of the error due to subjective threshold selection.

2) Compared with the LSTM network, it has the same accuracy rate, but the training time is shorter, which is suitable for scenarios that require training time.

3) Because of its own network structure, the prediction accuracy of the GRU network when the data size is small or the data interval is long is better than the LSTM network.