利用循環門控單元模型進行河川水位預報

Application of Gated Recurrent Unit Model for River Stage Forecasting

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摘　要

隨著近年極端降雨事件增加而造成嚴重災害，洪水預警系統之重要性亦趨明顯。然一般物理型集水區模式因輸入資料愈模式常過於複雜，前置作業時間相當久，且模擬時間較長在即時預警時限制恐較大，因此本研究利用深度學習中之循環門控單元模型(Gated Recurrent Unit, GRU)為，建立水位預報模式並與長短期記憶模型(long short-term memory，LSTM)以及傳統遞歸神經網路(recurrent neural networks，RNN)進行比較。本研究以宜蘭河流域為研究區域，測試水位預報成果。本模式輸入因子為西門橋時水位以及宜蘭流域七處雨量站時雨量，預測因子則為西門橋未來 1-3 小時之時水位。而為探討三種模式之預測準確度與運算時間，後續則另增加未來 6 及 9 小時之預報作為測試。最後比較結果顯示，在三種模式共通之參數皆相同之情況下，可發現預報一小時而言三種方法差異不大，但若延長預報時間至九小時，則顯示 GRU 不論在預報誤差或是計算效率上都較為優異，本案例成果更可提供給防災相關單位颱風事件之預警、應變決策及減災措施之參考。

關鍵詞：深度學習、水位預報、循環門控單元

Abstract

The importance of flood warning systems has become more and more obvious with increasing of extreme rainfall events in recent years, resulting in severe serious flooding disasters. However, general physical-based hydrological models are restricted for real-time flooding warning because of the complexity in model input and the time-consuming computing time of the model. Therefore, this study uses the Gated Recurrent Unit (GRU) model in deep learning to establish a river stage forecasting model, which is compared with the Long Short-Term Memory model (LSTM) and the traditional Recurrent Neural Network model (RNN). The Yilan River basin is chosen as study area to verify the results of river stage forecasting. The input factors of this model are the hourly river stage of Ximen Bridge and the hourly rainfall of seven rainfall stations in the Yilan Basin, and the prediction factor is the river stage of

Ximen Bridge in the next 1-3 hours. The forecasts of the next 6 and 9 hours are further added to explore the prediction accuracy and calculation time of the three models. The final results show that when the common parameters of the three models are the same, it can be found that the three methods have little difference in forecasting for one hour. However, if the leading time is extended to 9 hours, it shows that the GRU is superior in both accuracy and calculation efficiency. The results also can apply to early warning, decision-making and mitigation measures for the relevant organizations of disaster prevention.

Keywords: Deep learning，River stage forecasting，Gated Recurrent Unit