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东北大学本科毕业论文

基于深度学习的台风路径预测技术
的研究与实现

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摘　要

　　家喻户晓，台风是一种破坏性极强的极端自然灾害现象，据美国海军联合台风警报中心统计，西北太平洋及中国南海海域平均每年都有好多台风生成，出现最多台风的月份是 8 月，其次是 7 月、9 月、6 月和 5 月。科学家曾计算出，一场中等强度的台风或者是高强度的台风所释放的能量相当于上百个氢弹、或 10 亿吨黄色炸药所释放能量的总和，可见其破坏力之大，危害程度之深。据世界气象组织的报告，全球每年死于热带风暴的人数约为 2000 到 3000 人。根据有关资料，西太平洋沿岸国家平均每年因台风造成的经济损失为 40 亿美元，危害巨大。我国也是一个台风灾害严重的国家，如何有效预测台风路径一直是一个重要的课题。

　　现有台风路径预测模型主要有三种，一种是 WRF 模型，该模型需要大量的人为参数的设定，并且预测误差较大；第二种方法就是利用飞机对海洋气象数据进行采样，并基于经验模型将过去的台风路径和当前的路径进行对比，并对卫星拍摄到的影像进行分析，来预测下一步的台风路径的走向；第三种预测方法主要采用统计模型。这三种模型存在着误差较大，预测精度不高的问题，为此本文提出了一种结合深度学习和多元回归技术的台风路径预测方法，该方法首先读取 Matlab 数据格式的温度,湿度比,压强的数据，并对数据进行预处理，去除掉无效数据；然后采用 LSTM 网络模型对温度,湿度比，压强进行预测，在此基础上，应用多元拟合回归技术实现了对台风路径的预测，实际数据集上的测试表明，该方法能够达到平均 20km 的精度。

　　结合本文提出的预测方法，设计实现了简单的台风路径预测系统，系统提供了数据录入，用户自定义文件输入，数据预处理，模型训练及预测，台风路径的演示等诸多功能。

关键词： 台风路径预测；机器学习；深度学习；神经网络；LSTM

ABSTRACT

Typhoon is a devastating extreme natural disaster. According to the United States Navy's Joint Typhoon Warning Center, the number and month of typhoons in the Northwest Pacific Ocean and the South China Sea are many, with the most occurring in August, followed by July and September, June and May. Scientists have estimated that a moderate or high-intensity typhoon emits energy equivalent to that of hundreds of hydrogen bombs or a billion tons of yellow explosives combined, demonstrating how devastating and dangerous it can be. According to the World Meteorological Organization, about 2,000 to 3,000 people die each year from tropical storms. According to relevant information, the average annual economic loss caused by typhoons in the western Pacific coastal countries is US $4 billion, which is extremely harmful. China is also a country with severe typhoon disasters. How to effectively forecast the track of typhoon has become an important issue.

There are mainly three kinds of typhoon track prediction models. One is WRF model, which needs a lot of artificial parameters and has a large prediction error. The second method is to use aircraft to sample the marine meteorological data, compare the past track with the current track based on the empirical model, and analyze the satellite images to predict the next track of the typhoon. The third forecasting method mainly adopts statistical model. In this paper, a method of typhoon track prediction based on depth learning and multivariate regression is proposed. Firstly, the data of temperature, humidity ratio and pressure in Matlab form are read, and then the data are preprocessed to remove the invalid data. Then the LSTM network model is used to predict the temperature, humidity ratio and pressure. On this basis, the multi-fitting regression technique is used to predict the track of typhoon. The actual test shows that the method achieves an average accuracy of 20 km.

Combined with the forecasting method proposed in this paper, a simple typhoon track forecasting system is designed and implemented. The system provides many functions such as data input, user-defined file input, data training, data prepossessing, typhoon track demonstration and so on.

Key words: Typhoon track prediction; Machine Learning; Deep Learning; Neural network; LSTM