

應用長短期記憶網路(LSTM)於海岸異常波浪機率預警之研究

Application of Long Short-Term Memory (LSTM) for Probabilistic Forecasting of Coastal Freak Waves.

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摘 要

海域遊憩活動已成為民眾日常休閒的常見選擇之一，然而台灣海岸地區經常發生民間俗稱為「瘋狗浪」的海岸異常波浪事件可能將岸邊人員捲入海中而帶來危害。至今仍未有理論能夠完整解釋海岸異常波浪的發生機制，預測其發生時機與位置十分困難。隨著電腦技術的進步與計算能力的提升，人工智慧(AI)擁有處理多變量、非線性及大量數據的能力，為理解複雜自然現象提供了新的契機。本研究透過岸邊攝影機記錄海岸異常波浪的發生時間，並蒐集鄰近浮標的海氣象數據。以一段連續時間內的時序列數據作為輸入，並運用具有時序列資料處理能力的長短期記憶網路(Long Short Term Memory, LSTM)，建立海岸異常波浪機率預警模型。研究結果顯示，在長浪期間和颱風警報期間，LSTM模型的預測準確性可超過八成，且誤報率較低，優於其他不具時序列資料分析能力的AI模型。顯示此類AI技術在海岸異常波浪的預測中具有高度的可行性和可靠性。

關鍵字：海岸異常波浪、長短期記憶網路、機率預警

Abstract

Coastal recreation has become a common leisure activity for the public. However, Taiwan's coastal have been experiencing frequent incidents of coastal freak waves, which potentially sweeping people away from the coast and into the sea. There is no theory that can fully explain the mechanism behind the occurrence of these coastal freak waves, and it is difficult to predict their occurrence. With advances in computer technology, Artificial Intelligence (AI) now can process multivariate, non-linear and large datasets, providing a new opportunity to understand complex natural phenomena. In this study, shore-based cameras record the time of occurrence of coastal freak waves and collect meteorological and oceanographic data from nearby buoys. We use continuous time series data as input and develop a probabilistic early warning model for coastal freak waves using Long Short-Term Memory (LSTM), which can process time series data. The results show that the LSTM model achieves an accuracy of over 80% and has a lower false alarm rate during periods of long swells and typhoon warnings compared to other AI models that lack time series analysis ability. This demonstrates the high feasibility and reliability of this AI technologies in predicting coastal freak waves.

Key words : Coastal freak waves, Long Short-Term Memory (LSTM), Probabilistic forecasting