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Zero-shot transfer learning driven aerosol prediction at spatially correlated sensor deficient subway stations

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Keywords : Fine particulate matter, Subway station, Zero-shot Transfer learning, air quality prediction

Within the context of indoor aerosol pollution, particulate matter with an aerodynamic diameter less than 2.5 μm (PM2.5) has attracted considerable attention from both the government and the academic community, especially in closed indoor environments, such as the subway stations. To ensure sustainable indoor air quality (IAQ) levels, future air quality information is essential to develop early warning systems for effective countermeasures. Such as by the regulation of ventilation control systems. However, the availability of monitoring data is not reality at all subway stations due to sensor absence, hostile monitoring environments, or expensive equipment. The data unavailability problem relates a branch of machine learning known as zero-shot transfer learning that leverages the knowledge learned from a source domain to facilitate predictions on the target domain. Therefore, the present study introduces a zero-shot transfer learning-driven recurrent neural network framework (ZTL-RNN) for future air quality prediction on subway stations that lack the PM2.5 sensors. The proposed methodology is divided into 4 main parts. First, the dependency of external factors such as the outdoor air quality (OAQ) conditions is analyzed on the indoor environment to select significant variables. Second, a similarity function is considered to evaluate the similarity between the source and target subway stations by utilizing the indoor environment's inherent characteristics. Here, the source station is referred to as the station where PM2.5 data is available, and the target subway lacks the monitoring data. Third, several RNN structures' performance is evaluated on the source subway station to select an appropriate forecasting algorithm. Finally, after selecting the best RNN framework, PM2.5 is forecasted on target subway stations utilizing zero-shot transfer learning substructure at various time-resolutions. Our results show that transfer learning methods can help identify future hazardous environments at spatially correlated subway stations that lack monitoring equipment, and even help in IAQ control to provide sustainable air quality levels.

감사의 글

This work was supported by a grant from the Subway Fine Dust Reduction Technology Development Project of the Ministry of Land Infrastructure and Transport (20QPPW-B152306-02).

참고문헌

Park, S., Kim, M., Kim, M., Namgung, H. G., Kim, K. T., Cho, K. H., & Kwon, S. B. (2018). Predicting PM10 concentration in Seoul metropolitan subway stations using artificial neural network (ANN). Journal of hazardous materials, 341, 75-82.