A DEEP SURROGATE MODEL FOR WATER QUALITY MEASUREMENT

Yi-Fan Zhang and Peter Thorburn

Surrogate Problem

Large-scale monitoring networks with various sensor probes can provide a holistic view of complex agricultural, environmental or industrial systems. However, measuring some key variables on a large scale is neither practical nor financially viable. It is possible to estimate the key variable based on other simultaneously measured variables.

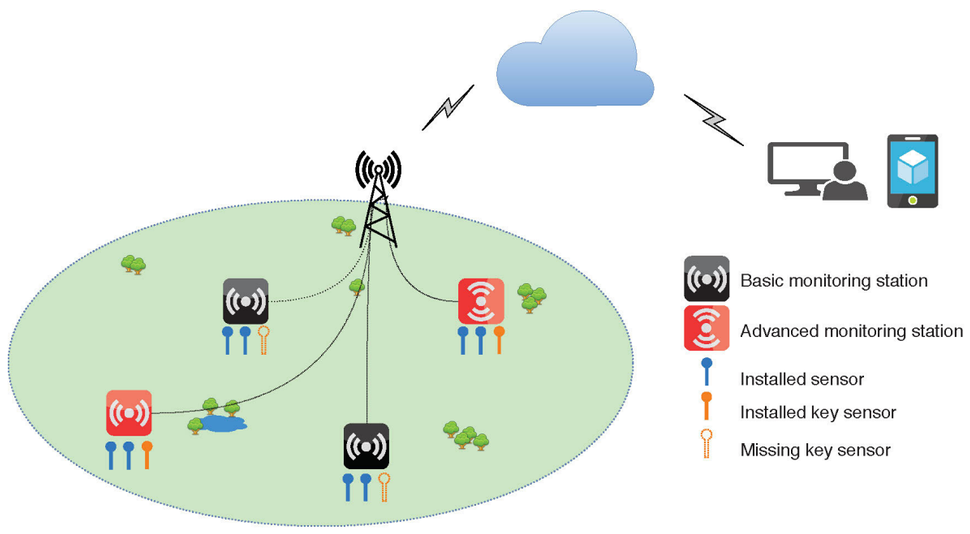

Fig. 1, A wireless sensor network with the basic and advance monitoring stations. In comparison with advance monitoring stations, basic monitoring stations lack the key sensor.

Deep Surrogate Model

We propose a deep surrogate model (DSM) for estimating water quality variables. (Fig. 2)

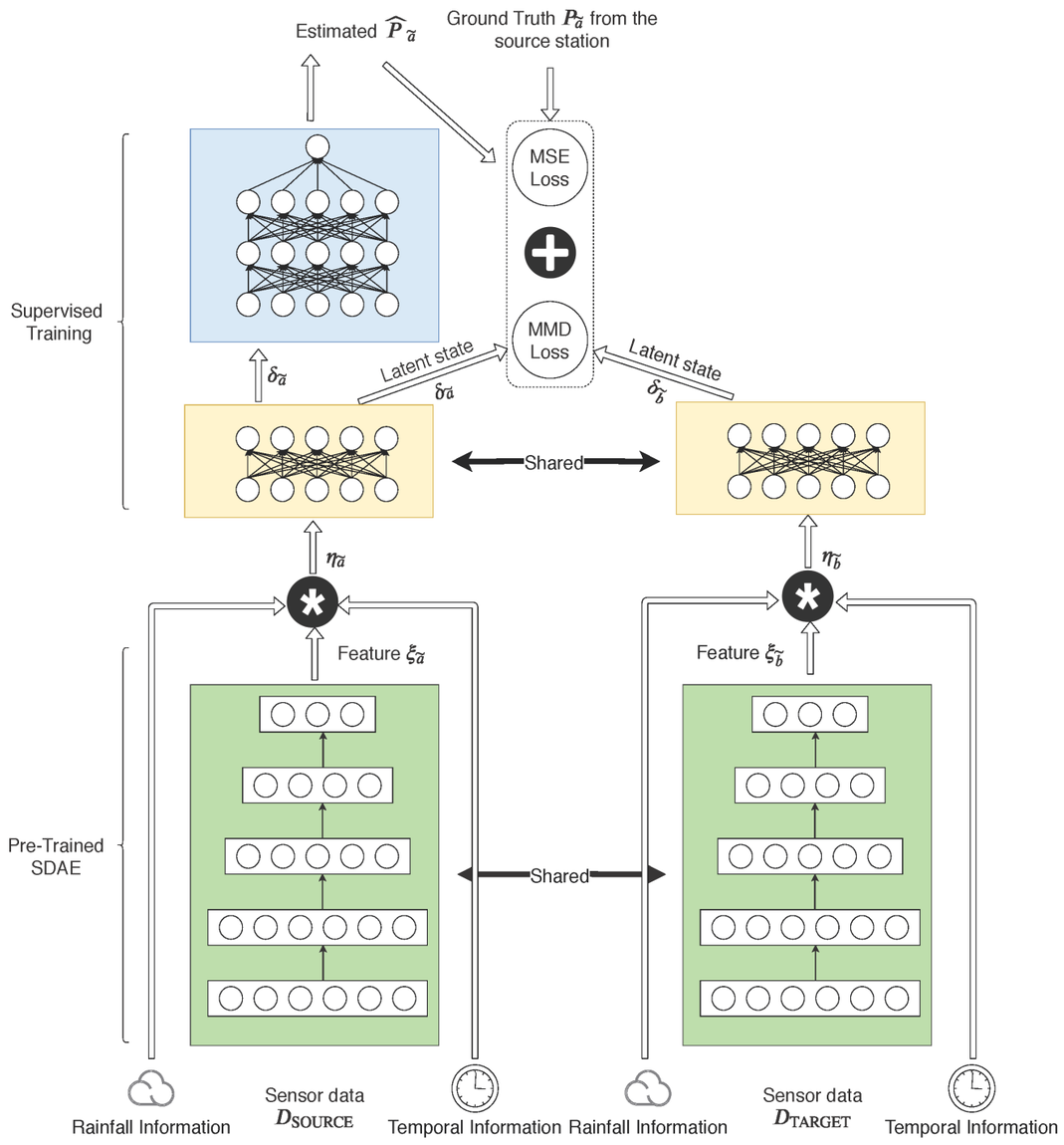

Fig. 2, Deep Surrogate Model

The DSM uses a stacked denoising autoencoder to extract the features of raw sensor data from the entire network and encodes the temporal and auxiliary information to improve the generalisation of the DSM and the surrogate accuracy.

Moreover, the domain adaptation layer is designed to learn the spatial differences between monitoring stations in disparate locations.

Experiment

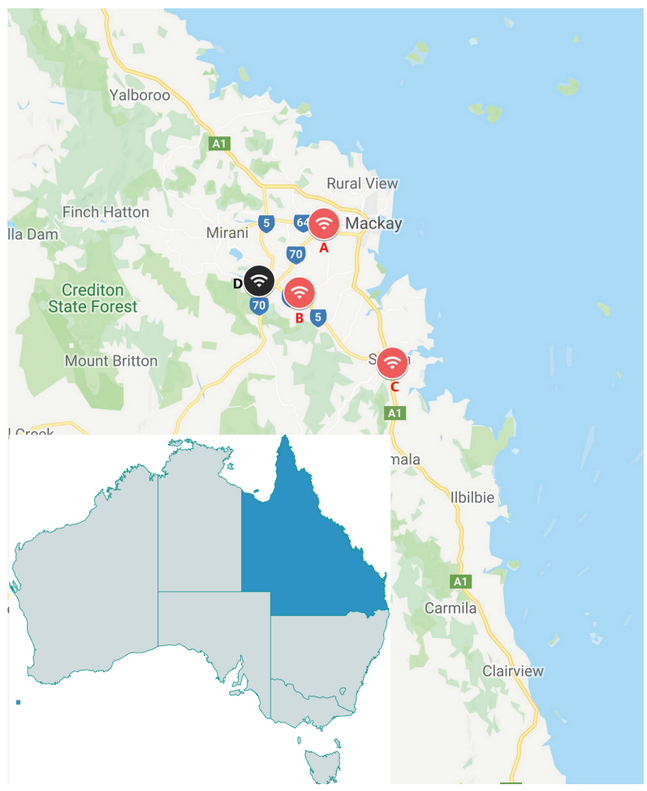

Fig. 3, Queensland Government's water quality monitoring network in the Great Barrier Reef region (part). The black and red icon represents the basic and advanced water quality monitoring station.

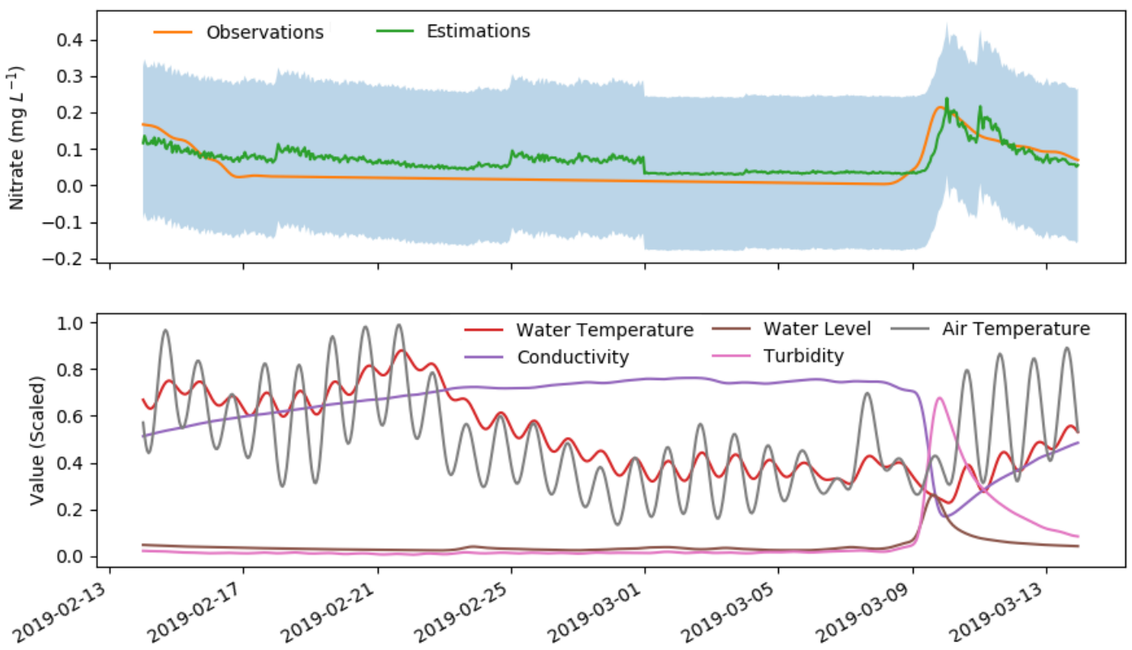

Fig. 4, Estimating the concentration of nitrate between 13/2/2019 and 13/3/2019 in station C. The upper and lower figures represents the changing of nitrate concentration and other water quality variables, respectively.

Yi-Fan Zhang and Peter Thorburn, A Transfer Learning based Surrogate Model with Spatio-Temporal Awareness for Water Quality Measurement, IEEE Internet of Things Journal. Submitted.