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ABSTRACT

Monitoring water quality is an important challenge in both developed and developing countries. Remote sensing data can form a highly frequent dataset with acceptable spatial coverage that can be used to remotely monitor water quality. This dissertation's motivation is to introduce a novel automated model for remotely monitoring water quality to address the problem of insufficient samples and save the time and cost of samples collection. The proposed model estimates both optical and non-optical water quality parameters via Sentinel-2A L1C data. A bio-inspired hybrid model of a Binary Whale Optimization Algorithm (BWOA) and Artificial Neural Network (ANN) (BWOA-ANN) is applied to determine the relationship between extracted reflectance values from Sentinel-2A L1C images and analyzed samples. The novelty of this model is to solve two main problems of remote water quality monitoring: non-applicability and low non-optical parameter estimation accuracy. For the first problem, a proposed fully automated model with a band selection process that uses the BWOA to automatically select the optimal features (Sentinel-2A bands) suitable for each water quality parameter. The second problem is addressed by automatically detecting the relationship between non-optical and optical parameters. Seven datasets with different locations, seasons, and parameters were selected to test the proposed BWOA-ANN. The experimental results demonstrated good regression with a mean R^2 value of 0.916 for optical parameters and 0.890 for non-optical parameters. The proposed model was found to outperform the alternative models with an R^2 value higher by 20% and 42% for the optical and non- optical parameters, respectively.

Another model for super-resolution is proposed in this dissertation. The model performed Area-to-Point Regression Kriging (ATPRK) integrated with BWOA. BWOA-ATPRK model selects the appropriate fine bands that are more suitable for each coarse band, then downscaling the coarse band to the fine spatial resolution band. The proposed model targets to improve from the spatial resolution of Sentinel-2A bands to subsequently enhance from the final water quality prediction results. The proposed BWOA-ATPRK model achieved Correlation Coefficient (CC) and Relative Global Dimensional Synthesis Error (ERGAS) values over the Sentinel-2A L1C dataset of 0.9961, and 1.2058, respectively. The proposed BWOA-ATPRK was tested on our real in situ datasets to notice the improvement on real datasets. The results were compared between the obtained results before and after applying the super-resolution model. It was noted the improvement of the results by an average of 4% for R^2. More- over, the proposed BWOA-ATPRK succeeded in dealing with different environmental conditions images and different bands of satellite images, proving its robustness, which alternative models can not be accomplished.