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Machine Learning Application of Dissolved Oxygen Prediction in River Water Quality

Eda Göz[1], Mehmet Yüceer[2], Erdal Karadurmuş[3]
[1]Ankara University, Chemical Engineering Department
Ankara, Turkey
esemizer@eng.ankara.edu.tr
[2]Inönü University, Chemical Engineering Department
Malatya, Turkey
mehmet.yuceer@inonu.edu.tr
[2]Hitit University, Chemical Engineering Department
Çorum, Turkey
erdalkaradurmus@hitit.edu.tr

Extended Abstract

Dissolved oxygen is the total of molecular oxygen in water and it effects many water quality parameters. Moreover, survival of the aerobic aquatic organisms is influenced by dissolved oxygen level. Surface waters have the most important role not only source of drinking water but also irrigation in agricultural activities. In recent years, water resources have been consumed increasingly via anthropogenic and environmental effects. In order to prevent this problem, monitoring of surface water quality has become inevitable. For this purpose, on-line monitoring stations have been built in the last years. However, building of stations and measuring of pollution parameters are quite expensive and laborious. In order to decrease this cost or facilitate certain parameters can be estimated from other parameters. Actually parametric, statistical and deterministic approaches can be used for modelling of river water quality. These models can be called as traditional approaches. However, these methods need a lot of information that related to hydrological process to obtain the results [1]. Moreover, due to the fact that several factors affecting water quality parameters and nonlinear dynamics, traditional modelling techniques are inadequate for modelling river water dynamics. In order to overcome this problem artificial intelligence techniques have been proposed. In literature artificial neural network modelling was proposed for dissolved oxygen prediction [2, 3]. However, there are some problems with modeling with ANN. Because of the fact that conventional feed forward neural network use gradient descent methods to train network, it might get to algorithm stuck at local optimum. Moreover, all parameters of network were tuned iteratively for this reason its learning speed is very slow. Another artificial intelligence method that extreme learning machine was developed by Huang [4]. In ELM learning algorithms hidden nodes weights and biases randomly assigned and need not to be tuned, output weights are calculated with simple inverse operation. Due to these properties and less human intervention, ELM is extremely fast learning speed and better generalization capability than traditional learning algorithms.

In this study two types of artificial intelligence techniques that ELM and KELM were proposed to predict of dissolved oxygen (DO) concentration from relatively easy measured that water temperature, pH and conductivity. Within this context in ELM part of this study hardlimited (*'hardlim'*), sigmoid, sinusoidal (*'sine'*), radial basis (*'radbas'*) and triangular basis (*'tribas'*) functions were tried. Additionally, in Kernel ELM studies, linear kernel (*'linkernel'*) and radial basis function kernel (*'RBF kernel'*) were used. The successful of the developed models were tested with some indices that regression coefficient (R), mean absolute percentage error (MAPE%), and root mean square error (RMSE). Test results of extreme learning machine with *tribas* were obtained as R-test: 0.9481, MAPE-test: 7.1997 and RMSE-test: 0.7261. Test results of kernel extreme learning machine with *RBF kernel* were R-test: 0.9855, MAPE-test: 2.8471 and RMSE-test: 0.3807. According to results kernel extreme learning machine is successful to predict dissolved oxygen concentration.

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