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Productivity modelling of an inclined stepped solar still for seawater desalination using boosting algorithms based on experimental data

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ABSTRACT

Solar energy has recently become a viable option for desalinating seawater, primarily in arid regions. However, increasing the productivity of solar still by integrating experimental base and modelling methods is still subject to prediction errors; therefore, the main objective of this research is to postulate and test boosting algorithms for predicting the efficiency and productivity of the system. Five boosting regressors were deployed and evaluated: categorical boosting, adaptive boosting, extreme gradient boosting, gradient boosting machine, and gradient boosting machine (LightGBM). The proposed regressors are implemented based on the system's actual recorded dataset (consisting of 720 observations). The dataset consists of input variables, which are the wind speed (V), cloud cover, humidity, ambient temperature (T), solar radiation (SR), (T_{io}), (T_w), (T_v), and (T_i). Also, the output variable is represented by the productivity of the system. The dataset was separated into training (70%) and testing (30%) sets. In order to decrease regressors

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errors, hyperparameter optimization was employed. GradientBoosting approach provided the best prediction, with 95% R^2 accuracy and 39.57 root mean square error (RMSE) error. The LightGBM technique achieved 94% R^2 accuracy and 40.07 RMSE error in the testing dataset. The results reveal that GradientBoosting outperforms the cascaded forward neural network in predicting system productivity (CFNN).

Keywords: Solar desalination; Meteorological data; Boosting algorithms; Modelling; Productivity evaluation