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# Utilizing different machine learning methods to accurately predict density, temperature, velocity, and thermal conductivity of hydrophilic, hydrophobic, and compound materials

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## Highlights

- Different machine learning regression techniques were used to predict the $k_{nf}$.
- Gaussian regression method is produced the best results based on research comparing these methods.
- Best results in the velocity field through LSBoost regression.
- All of the trained models have a strong correlation with real-world values.


## Abstract

A learning algorithm is a set of instructions used in machine learning that enables a computer program to imitate how humans improve at describing specific types of data. As programming is exposed to more data, math and logic that support a learning algorithm can be updated (without human intervention) over time. In this study, different machine learning regression methods were used to predict the thermal conductivity ($k_{nf}$) -related physical properties of tested samples. Different parameters were considered such as density, temperature, rate, velocity, and $k_{nf}$ is the most significant to improve heat transfer. Gaussian regression, linear regression, support vector regression, generalized linear regression, regression tree, artificial neural network (ANN), LSBoost Ensemble, and bag Ensemble were used. Gaussian regression method was produced the best results based on research comparing these methods. This method produced more accurate results in four fields (density, temperature, rate, and $k_{nf}$) than other methods. However, the best results in velocity field via LSBoost regression, which entails calculating the RMSE and PLCT. After selecting the optimal regression, the results of this regression should be validated. All of trained models had a strong correlation with real-world values, based on the findings of study, which are positive. Finally, it was determined that the covariance function was the only parameter that affected the RMSE results in Gaussian regression. This study illustrates the effect of using distinct covariance functions for each RMSE physical properties. Density is expressed over exponential function, and velocity and rate are expressed in matern32. The temperature was expressed due to the exponential square, and $k_{nf}$ was expressed in terms of exponential.