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A Modification of Newton's Cooling Law with Correlation to Fractional Derivative

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Newton's cooling law provides a linear differential equation governing the rate of heat loss of a heated body using the temperature difference of the body with the environment. However, the prediction of Newton's cooling law still did not fit with the data under the laboratory framework. Previous works have modified Newton's cooling law by incorporating fractional derivatives as a basis of their models, and in particular cases of convective fluid, higher correlations with the experimental data can be observed. In this study, to model the empirical value obtained from the experiment, the conventional model is enhanced by appending a new parameter as the exponent of time in the differential equation. The comparison is shown between the conventional Newton's cooling law and the modified model, along with its adjusted R-Squared value from the regression of the experimental data, which results in a significant enhancement from the conventional model. In a numerical relationship between the two parameters, correlation of this newly proposed model is found with an established model of Newton's cooling law using Caputo type fractional derivative, thereby providing some support to the theoretical basis of the model. Moreover, the performance of this modified model is to a certain degree higher than the fractional derivative model.

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