A Data Assisted Prediction of Fatigue Life for Aluminum Alloys Using Machine Learning Approach

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April 5, 2023

Abstract

The article presents a machine learning (ML) model capable of recognizing the effect of physical and chemical parameters that contribute to fatigue failure in aluminium alloys. The traditional method of obtaining S-N curve is both expensive and time-consuming. The mechanism of fatigue is complex and influenced by a number of factors. The current study proposes a data-driven method to estimate fatigue life at different stress amplitudes that form the S-N curves. The influencing factors dominating the fatigue life can be effectively integrated using Machine Learning techniques to predict S-N curves of aluminium alloys. Dataset was prepared from industrially accepted references. MLP and GBR algorithms were employed to train the model. The prediction of fatigue life had a MSE of 0.46. It is interesting to note that the prepared model could recognize the features that most affected the fatigue life and predict the S-N curve which had close agreement with the experimental data. The current study intends to assist material scientists and design engineers to investigate the influence of different alloying element compositions on fatigue life. The model can be employed to obtain a preliminary estimate of fatigue life resulting from varying alloy mixtures.

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