Optik - International Journal for Light and Electron Optics 257 (2022) 168813

Contents lists available at ScienceDirect

Optik

journal homepage: www.elsevier.com/locate/ijleo

Towards a NIR Spectroscopy ensemble learning technique competing with the standard ASTM-CFR: An optimal boosting and bagging extreme learning machine algorithms for gasoline octane number prediction

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ARTICLE INFO

Keywords:
Extreme learning machine (ELM)
Bagging
Boosting
Gasoline Octane number
Near-Infrared Spectra. Ensemble learning.
ASTM-CFR

ABSTRACT

The determination of the octane number plays a major role in quantifying the quality of gasoline. The standard method, the international standard ASTM-CFR internal combustion engine, used for this purpose suffers from its high cost and time. Many algorithms have been developed to address the limitations of this method, taking advantage of infrared spectroscopy, which provides easily measurable parameters that can be used to predict the octane number. This paper proposes two methods to compete with three existing algorithms (ELM, IELM, and SaDE-ELM) and also aims at achieving high accuracy results compared to the engine-based measurement method. The proposed methods used ensemble learning strategy combined with ELM instead of single ELM learner, used in the aforementioned algorithms, to achieve better predictions of the octane number. The findings indicate our algorithms outperformed the existing algorithms and the predictions are very close to that of the standard method. This can be considered an important achievement in the field of octane number prediction that can eventually replace the standard method. Also, contrary to the common belief that Boosting algorithms are superior to Bagging algorithms, in this paper, we demonstrated that our Bagging algorithm performed almost identically compared with the Boosting algorithm. Despite these promising results, further research should be undertaken to investigate the Hughes effect phenomenon that the gasoline data set, used in this work, suffer from.

1. Introduction

The transportation sector has seen tremendous advancement but is undergoing significant changes that are mainly driven by legislative requirements. The legislation aims to lower greenhouse emissions, improve performance, better drivability, and affordable

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https://doi.org/10.1016/j.ijleo.2022.168813
Received 23 October 2021; Accepted 3 March 2022
Available online 13 March 2022