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Ensemble Prediction of Multiple Physicochemical Properties of Aviation Fuels Using Multiple Machine Learning Models

Coach	Supervisor(s)	Funding
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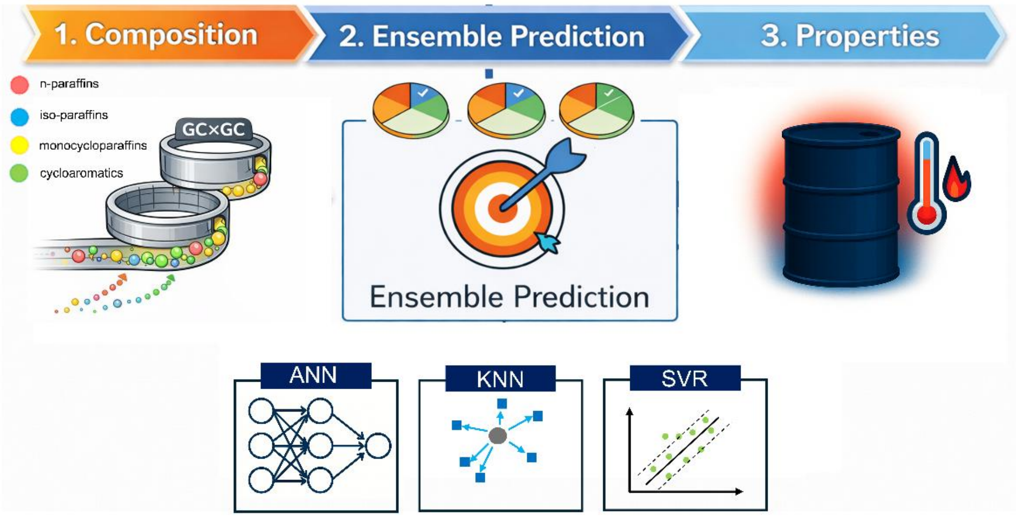

Keywords

Composition-property relationship; Artificial neural network; K-nearest neighbours; Support vector regression; Machine learning models; Ensemble learning

Aim

The aim of this research is to develop and evaluate ensemble machine learning models for predicting multiple physicochemical properties of aviation fuels based on their compositional information.

Justification

Crude oil composition is becoming more diverse, and sustainable and alternative feedstocks are increasingly introduced into fuel production. At the same time, quality requirements for aviation fuels are becoming more stringent. Understanding how composition changes impact properties has become more important than ever. Aviation fuels are complex mixtures containing hundreds or even thousands of hydrocarbons. Some important properties, such as viscosity, freezing point, and flash point, are not simple additive properties of individual components but follow non-ideal mixing rules.
Machine learning models are well suited to handle complex and non-linear problems. Several models, including artificial neural networks (ANN), k-nearest neighbours (KNN), and support vector regression (SVR), have been applied to predict fuel properties. Each method has its own advantages and limitations. Ensemble learning combines multiple models to improve prediction accuracy and robustness, providing a promising strategy for predicting aviation fuel properties from compositional information.

Program

1. Perform a literature review about Composition-property relationships of aviation fuel properties
2. Collect compositional and physicochemical property data of aviation fuels from published literature and databases, ensuring data quality quantity, and diversity for model development.
3. Build and optimize individual machine learning models, including ANN, KNN, and SVR, to predict fuel properties from compositional descriptors.
4. Systematically compare the predictive performance of different models using appropriate statistical metrics and validation strategies.
5. Develop ensemble learning models by combining predictions from multiple machine learning approaches to enhance accuracy and robustness.
6. Analyze the strengths, limitations, and applicability of individual and ensemble models.

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