

A REVIEW OF ARTIFICIAL INTELLIGENCE METHODS COMBINED WITH SURFACE-ENHANCED RAMAN SPECTROSCOPY TO IDENTIFY THE COMPOSITION OF SUBSTANCES

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Abstract

Surface-enhanced Raman spectroscopy (SERS), widely recognized as a sensitive and precise analytical technique, has demonstrated significant application value in fields such as biomedicine, environmental protection, and food safety. In pursuit of enhanced sensitivity, robustness, and comprehensive sensing, continuous advancements are being made across the entire SERS pipeline, from substrate design and synthetic route planning to data preprocessing, analysis, and instrumentation. Artificial intelligence (AI), with its ability to learn complex patterns and representations, has emerged as a powerful tool to handle the increasing intricacies and vast data associated with SERS. The integration of AI has accelerated systematic optimization and deepened the understanding of fundamental physics and spectral data, surpassing conventional methods in speed and accuracy. In particular, the combination of SERS and AI has achieved breakthroughs in the noninvasive identification of mixture compositions, a traditionally challenging task. Machine learning and deep learning tools i.e., Principal Component Analysis (PCA) Partial least Square Regression Analysis (PLSR) and Partial Least Square Discriminant Analysis for them qualitative and quantitative analysis, applied to Raman spectroscopy data, offer efficient analytical tools capable of recognizing and quantifying components in mixtures beyond the capabilities of traditional chemical analysis. This review presents recent progress in AI-enhanced SERS, summarizes preprocessing and AI-driven analysis methods for identifying complex substance compositions, and provides a detailed discussion on the challenges, advantages, and prospects of Raman spectroscopy in combination with AI.

Keywords: SERS; Artificial Intelligence; Chemometric tools

WHEAT YIELD PREDICTION BY USING AI MODELS

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Abstract

Wheat is one of the major constituents of human food and its consumption day by day is increasing. Accurate prediction of wheat yield is essential for ensuring global food security and optimizing agricultural practices. Traditional techniques just fail to attain the desired precision because the relationship between environmental variables such as climate variability, soil conditions, and crop management is intricate recent developments in artificial intelligence (AI) provide a groundbreaking perspective to predicting wheat yields with greater precision. AI approaches, such as machine learning and deep learning, can process large and heterogeneous datasets, such as satellite imagery, meteorological data, and soil properties, to make accurate predictions. Key algorithms like Random Forest and Support Vector Machines have demonstrated significant potential in yield prediction by uncovering intricate patterns in these datasets. Moreover, advanced models such as Convolutional Neural Networks can effectively capture both spatial and temporal relationships, making them highly efficient for analyzing remote sensing data over time. The application of AI to wheat yield prediction enhances decision-making for farmers, policymakers, and stakeholders, enabling timely interventions and better resource management. As AI models