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# Machine learning in optics: Comparative analysis using ANN, SVM, and decision trees

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**Abstract**

The integration of machine learning (ML) and deep learning (DL) into optical science is rapidly transforming the design, optimization, and interpretation of optical systems. Traditional optical analysis relies on complex mathematical modelling and labour-intensive calibration, which can be time consuming and error prone. This study demonstrates the application of ML and DL algorithms to three optical domains: computational imaging, spectral analysis, and diffraction pattern interpretation. Convolutional neural networks (CNNs) enable efficient denoising and reconstruction of optical images, while support vector machines (SVMs) and random forests (RFs) enhance the classification of spectral signals. Artificial neural networks (ANNs) facilitate rapid interpretation of diffraction patterns. Quantitative evaluation demonstrates that ML/DL methods improve accuracy, processing speed, and robustness compared to conventional approaches, highlighting the potential for next-generation optical systems in Biophotonics and quantum optics.