Proceedings of SPIE 13865, Computational Optical Imaging and Artificial Intelligence in Biomedical Sciences III, 138650H, March 2026

Machine learning-driven analysis of surface plasmon resonance imaging for automated biomolecular binding detection

Tsebesebe, NkgapheT; Mpofu, Kelvin T; Mthunzi-Kufa, P

Abstract

Surface Plasmon Resonance Imaging (SPRI) enables label-free, real-time monitoring of biomolecular interactions across sensor surfaces, making it an essential tool for multiplexed diagnostics. However, high-dimensional SPRI image data introduces challenges for interpreting binding events, particularly in complex sample matrices. This study trains machine learning model based on Multinomial Naïve Bayes (MNB) classifier with SPRI images to automatically classify binding and non-binding events. Statistical feature analysis (mean intensity, standard deviation, entropy, gradient magnitude) revealed significant differences between the SPRI binding and non-binding images, leading to the model (with Laplace smoothing parameter α = 1.0) achieve 97.7% accuracy, 97.8% sensitivity, 97.6% specificity, and an area under the ROC curve (AUC) of 0.98. The approach holds a potential to automated and high-throughput diagnostics, reducing reliance on manual interpretation and potentially extending SPRI platforms diagnostic tools in clinical and research settings.