



Special Issue Reprint

## The Application of Spectral Techniques in Agriculture and Forestry

www.mdpi.com/books/reprint/10723

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ISBN 978-3-7258-3669-7 (Hardback) ISBN 978-3-7258-3670-3 (PDF)

This Special Issue compiles 12 groundbreaking studies that advance spectral analysis technologies through interdisciplinary integration with machine learning. By synergizing remote sensing data and intelligent algorithms, the featured research establishes multidimensional monitoring frameworks spanning crop phenotyping to ecosystem assessment. Key advances include (1) novel vegetation indices derived from multi-angle hyperspectral data, resolving angular dependencies in leaf area index estimation, and enhanced convolutional neural networks, achieving 98.4% accuracy in maize disease detection under complex backgrounds; (2) L-band synthetic aperture radar innovations for vertical forest parameter retrieval and genetic-algorithm-optimized spectral models quantifying soil heavy-metal contamination via rice leaf signatures; and (3) spatiotemporal coupling of thermal infrared and multispectral techniques elucidating canopy temperature hysteresis mechanisms, enabling XGBoost-based crop water diagnostics for precision irrigation in arid regions. The studies, covering diverse agroforestry systems across European and Asian climates, validate spectral technology's universal applicability to stress response monitoring, nutrient dynamics analysis, and sustainable farming practices. These innovations collectively construct an integrated "air-space-ground" intelligent sensing network, offering scalable solutions for food security under climate change. The findings mark spectral analysis's transition into a data-driven decision-making era, establishing critical frameworks for real-time ecosystem monitoring and resource management.



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