Digital Twins and Low-Cost Sensors to Improve Pistachio Management

Raquel Martínez-Peña[1], Sergio Vélez[2]

[1] Regional Institute of Agri-Food and Forestry Research and Development of Castilla-La Mancha (IRIAF),Woody Crops Department, Ctra. Toledo - Albacete, s/n, 13700 Tomelloso (Ciudad Real), Spain.

[2] JRU Drone Technology, Department of Architectural Constructions and I.C.T., University of Burgos, Burgos, 09001, Spain.

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Abstract

This study evaluates a technique for creating digital twin models of pistachio trees using various configurations of smartphone cameras as low-cost sensors, applied to a pistachio orchard in Ciudad Real (Castilla-La Mancha, Spain). The goal is to provide farmers with accessible and affordable tools to monitor and optimize pistachio production by focusing on key agronomic and harvest factors. Photogrammetric methods were applied to generate digital twins, enabling detailed analysis of tree structure and growth. These models were then correlated with several important agronomic and harvest parameters, revealing strong correlations with key agricultural factors. The use of smartphone cameras as low-cost sensors proves to be particularly practical due to their widespread availability among farmers. The system, integrated into a real-time monitoring platform, offers valuable insights into tree performance and crop development, allowing for optimized management practices tailored to each cultivar. The affordability and accessibility of this technology make it a valuable tool for improving productivity, sustainability, and overall management in pistachio cultivation.