Chapter 4
Mobile Mapping Systems: Architecture and Technologies in Smart Agriculture

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ABSTRACT

Mobile Mapping Systems (MMS) are transforming agriculture by integrating advanced sensors, geospatial technologies, and real-time data processing to enhance decision-making. These systems improve productivity, optimize resource use, and support sustainable farming. MMS enables precise mapping of agricultural landscapes, crop health monitoring, and soil analysis, providing valuable insights for smart farming. With increasing demands for sustainable agriculture due to environmental concerns and food security, MMS play a crucial role in addressing these challenges. Their

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applications range from crop yield prediction to land management and pest detection. This chapter examines MMS architecture, sensor integration, system modelling, and calibration. It also explores the impact of emerging technologies such as AI, machine learning, and cloud computing on MMS functionality. Through case studies and discussions, the chapter highlights current advancements and future trends, offering insights into the evolving role of MMS in modern agriculture.

1. INTRODUCTION TO MOBILE MAPPING SYSTEMS IN SMART AGRICULTURE

Over the last decade, geospatial data collection has undergone a transformation, driven by innovations like direct geo-referencing, low-cost digital cameras, LiDAR, and 3D modeling. These advancements have enhanced mapping accuracy, affordability, and accessibility, leading to the rise of Mobile Mapping Systems (MMS)—versatile tools now reshaping industries beyond traditional mapping.

Key breakthroughs, such as RTK GNSS and miniaturized IMUs, eliminated the need for labor-intensive ground control points, reducing costs while improving accuracy. Affordable cameras democratized aerial photogrammetry, enabling high-resolution 3D models, while LiDAR transitioned from niche to mainstream, offering sub-centimetre precision for applications in forestry, urban planning, and environmental monitoring.

As mapping tools became more accessible, demand surged across diverse fields. Agencies continued using large-area mapping for national projects, while new sectors—archaeology, engineering, and urban planning—adopted high-resolution data for 3D site documentation, infrastructure monitoring, and city modelling. This shift exposed a gap: traditional platforms lacked flexibility, mobility, and real-time capabilities.

In response, MMS emerged as a transformative solution, integrating GNSS, LiDAR, and multispectral cameras into mobile platforms—drones, vehicles, and handheld devices—bridging large-scale mapping with site-specific analysis. Agriculture, in particular, has embraced MMS for precision farming, optimizing field management through soil health monitoring, crop stress detection, and irrigation efficiency. Vineyards analyse terrain for grape quality, while rice farmers use drone-based MMS to track water usage, improving yields while reducing environmental impact.

Beyond efficiency, MMS advances sustainability by enabling targeted resource allocation, minimizing waste, cutting costs, and reducing ecological harm. In drought-prone areas, farmers use MMS-generated soil moisture maps to optimize irrigation,

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