



Autonomous UAV And UGV Conductive Charging System with A Robotic Arm and An Optical Sensor Aimed at Vineyard Monitoring

Moraitis M.², Congouleris N.¹, Georgousopoulos S.³, Balafoutis A.^{1, *}

¹*Institute for Bio-Economy and Agri-Technology (iBO) of Centre for Research and Technology – Hellas (CERTH), Dimarchou Georgiadou 118, 38333, Volos, Greece*

²*Agricultural University of Athens, Iera Odos 75, 11855, Athens, Greece*

³*GIZELIS ROBOTICS, Kormatzini Area, 32009, Schimatari Viotias, Greece*

ABSTRACT

Vineyards' monitoring is significantly important and today it is mainly conducted by the farmers and their advisors on-site. Robotic solutions with multiple sensors are gaining trust for such missions allowing farmers to reduce their on-site monitoring obligations. However, the current process of charging electric unmanned aerial and ground vehicles (UAVs and UGVs) for farming use is time-consuming and lacks automation. Typically, the battery must be manually removed from the vehicle, charged separately and then reinstalled, which significantly reduces operational efficiency and requires human intervention. To address these limitations, an automated charging system for UAVs and UGVs used in agricultural monitoring was designed. The system involves modifying the existing battery-vehicle interface to integrate a universal plug that allows for easy connection to charging stations scattered with the vineyards. A robotic arm equipped with an optical sensor autonomously detects and aligns the universal plug with the charging port on the vehicle and initiates the charging sequence. This setup eliminates the need for human intervention in the charging process, significantly improving convenience, reducing downtime and thus allowing for longer periods of crop monitoring within a given time frame. The automated charging system successfully enables fast and efficient conductive charging for UAVs and UGVs, reducing the time spent on manual battery handling and directly challenging the generally slower wireless charging methods. The system's automation not only accelerates the charging process but also enhances overall productivity in agricultural operations. This solution presents a significant advancement in electric vehicle charging technology for agriculture, supporting more efficient and scalable operations in precision farming.

Keywords: UAV, UGV, crop monitoring; precision viticulture; robotized charging system; smart farming