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Crop row detection through RPAS surveys to optimise on-farm irrigation management

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In the context of Precision Agriculture (PA), particular attention is given to the optimization of on-farm irrigation management, since water resources for agricultural use has become scarcer in recent decades due to the combined effect of climate change and increased competition between different water uses. Additionally, in many areas, the increased crop water requirement and the reduction of rainfall during the cropping season led to the need to irrigate crops traditionally not irrigated. In fact, due to the increase in extreme weather events, irrigation is becoming an important tool to guarantee adequate quality standards to agricultural products.
NUTRIPRECISO (RDP-EU, measure 1.2.01, Lombardy Region) is a two-year project aimed at designing, realising and managing variable rate drip irrigation systems in vineyards, orchards and horticultural crops, based on the spatial variability of soil and crop properties. Remotely Piloted Aircraft Systems (RPAS) imagery is used in PA to monitor this variability and produce crop maps. When a row crop is the object of investigation, RPAS imagery must be post-processed to identify and extract crop row from soil background and weeds.
The research presented hereby focuses on the crop row detection and extraction by analysing and post-processing images acquired through RPAS. Different methodologies were tested and compared: multirotor and fixed wings vehicles, RGB cameras, fisheye lenses camera and multispectral sensors. Furthermore, several types of segmentation methods were compared, such as supervised classifications, Bayesian segmentation and an algorithm developed ad hoc for this purpose. Extraction algorithms were applied both on geometric products (Digital Elevation Models, DEM) and vegetation indices (NDVI, ARVI, SAVI, 2G_RBi). All the different crops investigated in the project (grapevine, pear and tomato) were considered, and different outcomes were obtained according to the specific type of crop. Obtained results are promising, with Overall Accuracies (OA) greater than 90% in all cases, and User's Accuracies (UA) over 85% for the class 'crop row'. In addition to presenting the most significant results obtained, the best methodologies to be adopted for practical applications are discussed.