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AN INTELLIGENT ALLIANCE: SATELLITE-DRONE NETWORK TO ENHANCE PRECISION AGRICULTURE

Abstract

CubeSats have received a growing interest in remote sensing and monitoring during the past decades, mainly due to their lower development time and cost compared to flagship satellites. They have various applications in different industries, such as transportation, forestry, aquatics, and agriculture. Precision agriculture is a prominent field that is expanding into satellite-based remote sensing. Hyperspectral, Multispectral, and RGB Imagery via satellites are currently being used for vegetation and crop health monitoring. Satellite data is frequent, has a relatively high resolution, and is collected automatically with minimum human interaction. However, there are still a few drawbacks in using satellite collected data. The first problem is cloud coverage and shadowing over the fields. Despite the attempts for digital filtering of the data, it is sometimes near impossible to obtain the required information on time. The second problem is the file size of a high-resolution image, which corresponds to a long transmission and processing time even with powerful computation utilities. Combining satellite imaging with aerial imagery can overcome the mentioned drawbacks. Unmanned Aerial Vehicles (UAVs) offer the advantage of autonomous ad hoc deployment and flying at mid and low altitudes to provide higher-resolution data in cloudy and overcast weather conditions. In addition, instead of relying on an expensive flagship spacecraft that would not always be above the field, with a cooperative network of CubeSats and drones, low-cost CubeSats equipped with low-cost and low-resolution sensors can be used to periodically scan the area and identify anomalies. The images are sent to earth for further analysis using optical imaging techniques to narrow down area(s) of interest. Then, a drone swarm is used for a detailed, high-resolution investigation of the indicated area(s). Furthermore, the CubeSat and the drone elements can be integrated into a communication network for seamless analysis and quick response. In this research, a system-level study is presented to indicate and evaluate the requirements of each subsystem, as well as the required number of

satellite(s) and drones, their communication architecture, and interactions between the satellites, drones, and the ground station.