Development of a Small UAV-Based Measurement System for Rice Plant Monitoring Using a Line Laser-Scanner

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Abstract: Rice growth monitoring at specific times and frequency is important to control the growth of rice for high quality rice production. Monitoring using laser-scanner measurements which observes the change in the volume of plants is more effective than monitoring based on measurements of the leaf color or stems color using an optical sensor, such as a camera. An Unmanned Aerial Vehicle (UAV), which can fly autonomously using Global Positioning System (GPS) and Inertial Measurement Unit (IMU) may be used to make timely and frequent observations of a small-scale observation area. This paper introduces the development of a small and light UAV based measurement system to monitor rice plant growth using a line laser-scanner at low altitudes (below 10 meters). A DJI S800 flight platform and a Wookong-M flight control system were used. The S800 is a HEXA rotor helicopter and the WooKong-M includes GPS and IMU. This UAV system has an ability to fly stably and smoothly and its payload is about 2 kg (excluding batteries to drive the rotors). A line laser scanner, HOKUYO UTM30LX , weighing about 400 g, is on-board the platform to obtain 3D cloud point data of rice plants. Although its measurable range depends on the target, it is usually about 10 meters in the daytime. A single frequency GPS receiver and a six-axis accelerometer are also installed to record platform position and attitude. The GPS receiver uses a u-blox module which can output the raw GPS data, so its positioning error (only horizontal coordinates) is reduced to about 1 meter Post-Processed Kinematic procedures. A control system to control the onboard sensors and to record data from the sensors was developed based on the Arduino system. Arduino is a low cost, open-source physical computing platform based on a simple micro controller board. The flight time of this measurement system is expected to be about 8 to 12 minutes. It also has potential to obtain 3D cloud point data of rice plants in a small-scale observation area at a low cost.

Keyword: UAV, GPS, Laser Scanner, Agriculture