A Direct Georeferencing System for the Real–Time Position and Attitude Determination of Lightweight UAVS

Christian Eling, Lasse Klingbeil and Heiner Kuhlmann (Germany)

Key words: Engineering survey; GNSS/GPS; Positioning; Remote sensing;

SUMMARY

In recent years, unmanned aerial vehicles (UAVs) have been used increasingly as mobile mapping platforms in remote sensing applications. Examples can be found in the fields of surveying, precision farming or infrastructure inspection. Generally, for these applications a georeferencing of the collected data is required. This georeferencing can be done indirectly, using ground control points, or directly, using an onboard sensor system. The advantages of a direct georeferencing over an indirect georeferencing are that it is less time-consuming and it is real-time capable. Thus, a direct georeferencing system can for example also be used for the navigation of the UAV. However, the development of a precise direct georeferencing system for UAV platforms is very challenging, since the weight and the dimensions of the system are restricted by space and the weight limitations of the UAV platform. In this contribution a direct georeferencing system for the position and attitude determination of lightweight UAVs is presented. The system has a weight of 240 g and leads to position accuracies < 5 cm and attitude accuracies < 1 deg. As the main georeferencing sensors the system includes a dual-frequency GPS board (Novatel OEM615), which is used for an RTK-GPS positioning, a single-frequency GPS board (Ublox LEA6T), which is in combination with the dual frequency GPS board used for the attitude determination via an onboard GPS baseline, an IMU (Analog Devices Adis 16488) and finally also a magnetometer. These sensors are all directly connected to a real-time processing unit (National Instruments sbRIO 9606). The RTK-GPS algorithms, the GPS baseline attitude algorithms and the Kalman filter sensor fusion algorithms, which are running on the system, are all in-house developed. The main reason for developing these own algorithms was to allow for a single epoch ambiguity resolution for both, the RTK-GPS positioning and the onboard single frequency GPS baseline. Due to the fast ambiguity resolution algorithms, the system is able to provide GPS position and attitude information as soon as possible after every loss of lock of the GPS signals. Beside the system design and an overview of the implemented algorithms also results of flight tests will be presented in this contribution to illustrate the functionality of the system.