Quality assurance and calibration tasks in the scope of multi–sensor systems

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SUMMARY

The importance of kinematic multi-sensor systems (MSS) has been significantly increased within the last years. Especially in the field of mobile mapping the reachable efficiency due to the new kinematic techniques and analysis methods has opened new application fields. As well known, the acceptance of modern measurement methods, which are based on innovative techniques, are strongly related to the quality of the results and the confidence of the customers in the system. Therefore, this study will introduce and explain a general concept for the quality assurance of MSS in the field of mobile mapping. Uncertainties as well as sources of error of the used MSS are, therefore, quantified and determined. It shows on the one hand the possibility of the quality classification into aspects from individual sensors, the sensor integration, the multi sensor data fusion, and the influence of the observed object characteristics. On the other hand, the main challenges (including practical numerical examples) are discussed and some solutions with respect to existing laser scanner based MSS systems are introduced. This study focuses on laser scanner based MSS for mobile mapping tasks in the field of engineering geodesy. The minimum sensor configuration consist of a laser scanner for the acquisition of the desired object data and of a sensor for the determination of the required 6 degrees of freedom (DoF) for the position and orientation estimation. Essential for the MSS is the mutual spatial relation of each enlisted sensor and the availability of a proper time reference for the acquired sensor data. The above mentioned spatial as well as temporal reference in the MSS is usually performed within a system calibration task – one of the most important quality assurance steps of a MSS. In order to focus more on the new ideas, an individual sensor calibration is assumed to be available. The above mentioned steps will be shown in two different examples. The calibration process is introduced by means of the determination of 4 DoF, the 3D position and azimuthal orientation of a MSS, using 3D positioning sensors. Afterwards, the determination of the full 6 DoF, 3D position and 3 orientation angles, of a second MSS is discussed.