

PHOTOGRAMMETRIC NEWS: Doctoral Dissertation

Mr. **Anttoni Jaakkola** made his doctoral dissertation on the 5th of June 2015 at the Aalto University School of Electrical Engineering, Finland. Professor **Nicolas Paparoditis**, Institut Géographique National, Paris, France appeared as opponent. The title of the thesis was “Low-cost mobile laser scanning and its feasibility for environmental mapping”.



Abstract of the thesis

Mobile laser scanning is a measurement technology that combines accurate positioning and attitude information from navigation satellites and inertial sensors with distance measurements from a laser scanner into a point cloud that represents the geometry of the environment surrounding the measurement platform. This geometrical information can be utilized in a variety of applications ranging from 3D city modelling and infrastructure maintenance to forestry and environmental monitoring.

In this thesis, a new low-cost multi-sensor mobile laser scanning system is developed. The developed system is demonstrated on both car and UAV platforms. Also, the applicability of low-cost mobile laser scanning is evaluated in various applications. In road environment, the developed system is able to detect painted lines, zebra crossings and kerbstones with mean classification accuracies of 80.6 %, 92.3 % and 79.7 %, respectively. In tree species classification, the combination of laser scanning and spectral data is shown to improve classification accuracy from 66.9 % or 69.9 % to 83.5 %, when compared to using only laser or spectrometer data. It is also demonstrated that onboard a UAV, the developed system can measure point clouds and tree features more accurately than traditional airborne laser scanning. Finally, when using low-cost mobile laser scanning for snow depth estimation, an RMS accuracy of 5.5 cm can be achieved. The results demonstrate the feasibility of mobile laser scanning and that even a low-cost system can perform sufficiently in the selected applications.

With future advances of laser scanning and positioning technologies, it can be expected that price of these systems will further decrease. Widespread adoption of laser scanners, especially in the automotive industry, and the new global navigation satellite systems and signals will significantly reduce the cost of mobile laser scanning system components. While the laser scanners designed for automotive and industrial applications are not as accurate as survey-grade instruments, they are sufficiently accurate for a wide variety of applications.

Nowadays expensive mobile laser scanning systems are almost exclusively owned by mapping companies and, therefore, require high rates of utilization and applications with high added-value. With future cost reduction, mobile laser scanning will expand to new fields, as also other companies can afford to acquire such systems and utilize them in various applications.

Keywords: laser scanning, mobile laser scanning, IMU, GNSS, object detection, accuracy, topographic database, classification, UAV, UAS, spectrometer,

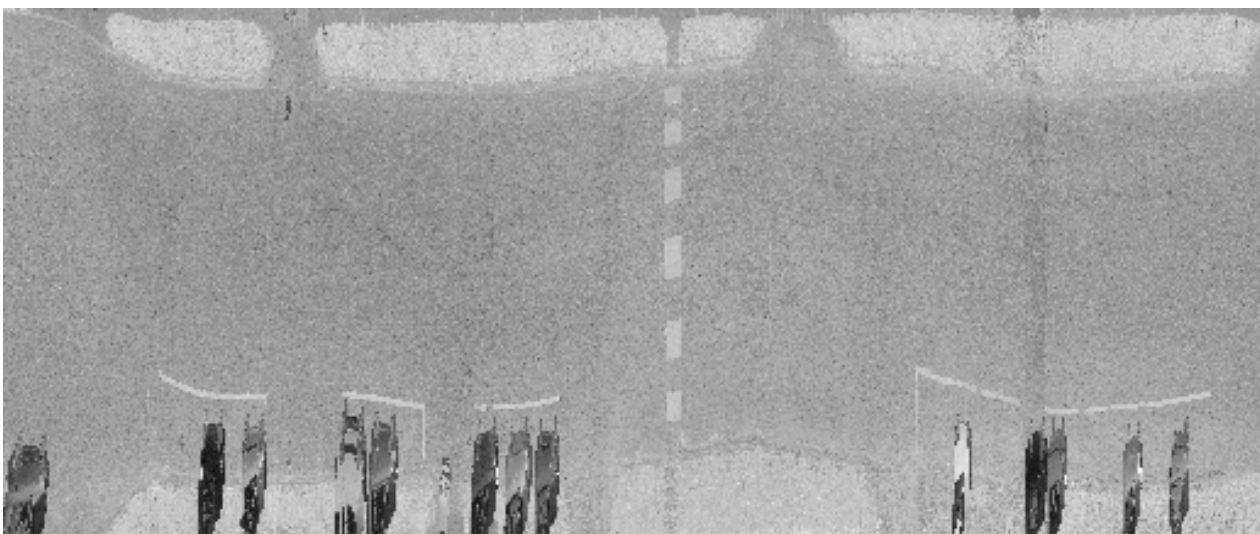
Highlighted figures from the thesis



FGI Sensei low-cost MLS system.



FGI Sensei mobile laser scanning system mounted on a mini-UAV



Intensity measurements on a road surface