

On the accuracy of a mobile mapping system for land surveying

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Abstract

Mobile mapping technologies have become increasingly interesting in the context of land surveying. As opposed to traditional surveying techniques, the data acquisition is clearly separated of the measurement process. Irrespective of the kind of object that must be measured and/or mapped, the process of data interpretation is normally not carried out on-site. This makes it possible to achieve a much more flexible management of the resources. Furthermore, since the data acquisition process is generic, such a system can be used to serve different applications, from traditional surveying to three-dimensional scene modelling.

The typical setup of such a mobile mapping system comprises an image acquisition sub-system, usually including cameras mounted according to a stereo configuration, and a real-time positioning sub-system. The latter normally consists of a GPS-enabled device as well as an inertial navigation system (INS) that together provide a measurement of both geographic location and orientation at a given moment in time. This data acquisition process yields image sequences for which the position and orientation of the camera(s) at the moment of acquisition, can be determined within a given accuracy. High positional accuracy naturally means more expensive equipments but depending on the applications served, the relatively large one-off investment in the acquisition equipment may be compensated in the long run by the low operating costs.

Cameras mounted in a stereo configuration, ie. capturing a scene from different viewing positions, make it possible to determine the location of any point within that scene, with respect to a referential defined by those cameras. Through adequate camera calibration and stereo triangulation, it is thus possible to perform three-dimensional scene reconstruction. As mentioned earlier, the measured points in space are referred to a local coordinate system defined by the stereo configuration itself. Given the acquired data for geographic position and orientation of the mobile mapping platform at moment of image capture, it is possible to place these measurements in a world coordinate system.

This paper focus on the possible hardware configurations and presents results regarding the achievable relative and absolute accuracy of measurements carried out with such a system. This analysis considers multiple factors influencing the accuracy of the measurements such as the characteristics of the equipment used, namely the size and resolution of

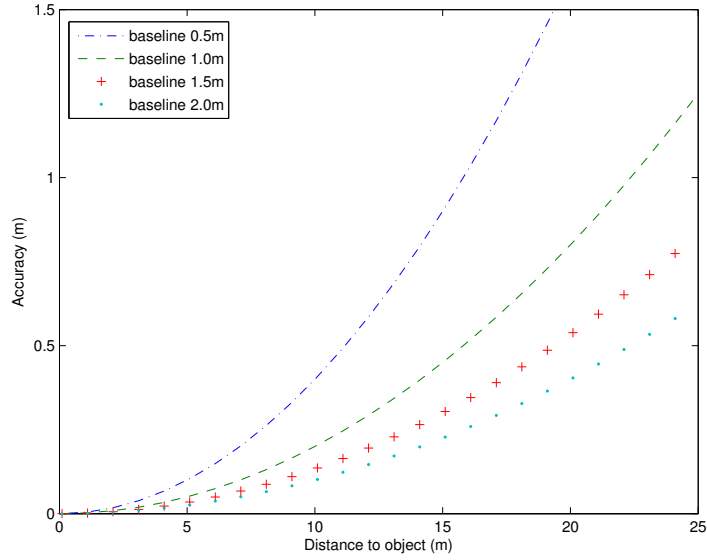


Figure 1: Accuracy of measured position as a function of depth.

the sensors, the viewing angle and baseline (distance between cameras mounted in a stereo configuration) among others, and photogrammetric errors due camera misalignments and incorrect calibration. Figure 1 illustrates the achievable accuracy in the estimation of depth as a function of the distance to the object point, for different baseline distances and forcing other parameters fixed (such as image resolution and sensor physical size). Furthermore the errors introduced by incorrect position and orientation data are also considered in these analyses.