Laser sensor and its applications in 3D modeling and pedestrian tracking

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Abstract

This research concerns with laser sensors and its two applications on 3D object reconstruction of urban outdoor environment and pedestrian tracking.

3D modeling

A vehicle-borne system is developed as well as a framework for the reconstruction of textured CAD model of out-door urban environment. In data measurement, three single-row laser range scanners and six line cameras are mounted on a measurement vehicle, which has been equipped with a GPS/INS/Odometer based navigation system. Laser range and line images are measured as the vehicle moves ahead. They are synchronized with the navigation system, so that can be geo-referenced to a world coordinate system. Generation of CAD model is conducted in two steps. A geometric model is first generated using the geo-referenced laser range data, where urban features like buildings, ground surface and trees are extracted in a hierarchical way. Different urban features are represented using different geometric primitives like planar face, TIN and triangle. Texture of the urban features is generated by projecting and re-sampling line images on the geometric model. Out-door experiments are conducted, and textured CAD models of real urban environments are reconstructed in an automatic mode.

Pedestrian tracking

In this research, we propose a novel method of monitoring and tracking pedestrians in wide and open area, such as shopping and exhibition hall, using a number of laser range scanners (LD-A). LD-A, produced by IBEO Lasertechnik, is a single-row laser range scanner. It has a profiling rate of 10Hz, a maximal range distance of 70 meters, and a measurement error of 3cm. In each profiling (scan line), 1080 range distances are measured equally in 270 degrees, where 90 degrees of blind area exists due to hardware configuration. LD-As are set doing horizontal scanning at an elevation of 20cm above the ground. Each LD-A is controlled by a client computer, which gathers laser data, extracts moving points by background substraction,

and sends them to a server computer through internet. The server computer synchronizes the client computers, integrates the moving points from all client computers to a global coordinate system, and tracks trajectories by identifying the pattern of moving legs. Experiments are conducted in an exhibition hall, where three LD-As are exploited. About 50 trajectories are tracked simultaneously.

"A Study on Measurement System for Modelling of Migration Activities of Shoppers"

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In this study, I developed a measurement system of pedestrian's movements, which consists of a gyro-sensor, RFID-tag system and a small video camera. Positional data, in other words, tracks of how each pedestrian move around and image data which shows what he/she looked at during his/her journey can be obtained from this system. This data will be used for modelling of human behaviour, specifically of shopping-round activities. Making multi-agents-based simulation using this model will be my near-future work.