LiDAR-based 3D mapping and localisation system for Ground Penetrating Radar

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Abstract

As mining activities expand into deeper mines in South Africa's geology there are increasing safety concerns for personnel working within these mines. Ground Penetrating Radar can be used to find faults in the rock face; however, current GPR devices do not provide positioning data to identify where in the mine the scanning has occurred. This paper describes a compact, LiDAR-based mapping and localisation system that could be attached to a GPR device to provide localisation information. The system uses a 16-beam, 3D LiDAR device, an inertial measurement unit, and an embedded computer that runs mapping and localisation software using the sensor measurements. The system is capable of communicating with an external computer via WiFi, and can be powered by a battery. The LiDAR system is shown to map and localise itself accurately within a ground truth reference frame. A Vicon motion capture system is used for ground truth pose measurements. In experiments, the system is found to localise itself to within 101 mm of translation error and to less than one degree of rotational error.