AUGMENTING THE ITERATIVE CLOSEST POINT (ICP) ALIGNMENT ALGORITHM WITH INTENSITY

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TITAN® is a mobile terrestrial multi-LiDAR system. It uses GPS and an Inertial Measurement Unit (IMU) to determine its position and attitude. By using four LiDARs, the TITAN system has overlapping coverage. When the GPS signal is lost, the position error increases exponentially with the duration of the interruption. Drift in the position data manifests itself as a misalignment of the overlapping point clouds. By determining the change in pose required to align the overlapping point clouds, the amount of position drift can be estimated.

This paper explores the feasibility of increasing position accuracy by incorporating corrections obtained from the alignment of overlapping LiDAR point clouds. The performance of point cloud alignment is improved by integrating intensity information into the Iterative Closest Point (ICP) alignment algorithm. Unfortunately, overlapping point clouds for the TITAN system contains little geometric and intensity variation. This severely limits the availability of areas on which to base an alignment.

Le TITAN® est un système terrestre mobile de radar optique (Lidar) multiple. Il utilise le GPS et une unité de mesure par inertie (UMI) pour déterminer sa position et son orientation. En utilisant quatre Lidar, le système TITAN fournit une couverture qui se recoupe. Lorsqu'on perd le signal du GPS, l'erreur de position augmente de façon exponentielle selon la durée de l'interruption. La dérive des données sur la position mène à un désalignement des nuages de points qui se chevauchent. En déterminant le changement de pose nécessaire pour aligner les nuages de points se chevauchant, il est possible d'évaluer la valeur de dérive de la position.

Cet article évalue la possibilité d'améliorer l'exactitude de la position en incorporant les corrections obtenues par l'alignement des nuages de points Lidar qui se cheveuchent. Le rendement de l'alignement des nuages de points peut être amélioré en intégrant l'information sur l'intensité à l'algorithme d'alignement itératif du point le plus près (ICP). Malheureusement, les nuages de points se chevauchant du système TITAN contiennent peu de variation géométrique et d'intensité. Ceci limite grandement la disponibilité des régions sur lesquelles baser un alignement.

1. Introduction

LiDAR (Light Detection and Ranging) is an established remote sensing method of acquiring geospatial information. Data from a typical LiDAR sensor is a collection of points in a three dimensional coordinate system that usually contains additional attribute information, for example, intensity and/or colour. Data in this format are widely known as point clouds.

In most circumstances, LiDAR data are collected from an airborne platform. Airborne LiDAR systems typically have an average point density of one point per square metre [*von Hansen et al.* 2008]. For 3D urban mapping, much greater point densities are required and airborne surveys fail to capture the facades of buildings and other fine details. For this reason, simple ground surveys, in which static LiDAR sensors are deployed on tripods, are used to complement the airborne surveys, but this is however a labour intensive task, as the sensor requires frequent repositioning. These limitations and the increasing demand for accurate urban map products at densities in excess of 100 points/m^2 have led to recent advances in mobile terrestrial LiDAR systems.

There are currently several different mobile terrestrial LiDAR systems in service: Streetmapper [*Haala et al.* 2008; "*StreetMapper Mobile Laser Mapping*"] operated by IGI mbH in Germany and 3D Laser Mapping in the United Kingdom, Lynx operated by Optech Inc. based in Vaughn, Ontario, Canada ("*LYNX Mobile Mapper product brochure*"), and TITAN®, operated by Terrapoint Canada, based in Ottawa, Ontario, Canada ("*TITAN: Accurate*