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Automated identification and modeling of longitudinal objects from LiDAR point clouds

TECH ID #: 1160.3

Background

Dr. Mostafa Arastounia and Prof. Derek Lichti (from the Department of Geomatics Engineering at the University of Calgary) have developed a fully-automated software that is able to simultaneously identify and generate as-built models and registration-refined version of longitudinal objects (such as poles and pipelines) with circular and regular polygonal cross sectional shapes from LiDAR point clouds. The method employed in this software allows for identification and modeling of poles and pipelines with any orientation in 3D space and it works quite robustly despite the challenges introduced by the following six effects that are often present in LiDAR data: (1) outliers; (2) non-uniform point sampling; (3) gaps (due to occlusions and/or far distance of an object from the laser scanner); (4) registration error; (5) dense configuration of neighboring objects; and (6) attached objects.

This algorithm has been tested on four different datasets including two different industrial site point clouds, an urban roadway point cloud, and LiDAR data of a pole-like monument with a regular dodecagonal cross section. The employed datasets have very different volume, resolution, and configuration in order to test the developed algorithm’s performance and robustness. It achieved greater than 98% average precision and accuracy at the point cloud level and 100% precision and accuracy at the object level for all four datasets.

Object	**Sample Dataset**		
	Number of poles	**Accuracy** (%)	**Precision** (%)
Circular pole	27	99.74	98.72
Octagonal pole	13	99.25	97.27
Square pole	12	99.60	98.06
Total number/Average	52	99.53	98.02

Table1: The number of poles and the associated recognition accuracy and precision at point level in LiDAR data of an industrial site (electrical substation)

Technology Advantages

- Achieves over 98% recognition precision and accuracy at point level and object level
- Robust performance on datasets with different volume, resolution, and configuration
- Object-oriented implementation in C++ (high code readability)

- Maintaining a high computational efficiency
  - The entire processing (identification, modeling, and registration refinement) of a sample 5-metre pole with over 70,000 3D data points can be accomplished within 8 seconds on a laptop computer with a 2.5 GHz CPU and 8 GB RAM

Applications

- Identification and modeling of objects with circular and regular polygonal cross sectional shapes including but not limited to:
  - Oil and gas pipelines (maintenance applications such as deformation and displacement analysis)
  - Poles and pipelines in industrial sites (such as electrical substations and pump stations)
  - Under-construction columns and pillars in construction sites (for project management applications such as progress monitoring)
  - Columns and poles in indoor environments (for indoor navigation and modeling)
  - Road furniture such as lamp posts and traffic sign/light posts (for 3D modeling of urban environments)
  - Rail traffic sign/light posts and masts
  - Towers and monuments with a circular or regular polygonal cross sectional shape
  - Buildings with square cross section

Stage of Development

- Available as C++ library with object-oriented implementation
- CPU and GPU parallel processing-enabled versions will be released within the next few months

Intellectual Property Status

- Patent Pending