

## Automatic Road Extraction from Airborne LiDAR : A Review

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### ABSTRACT

LIDAR is the powerful Remote Sensing Technology for the acquisition of 3D information from terrain surface. This paper surveys the state of the art on automated road feature extraction from airborne Light Detection and Ranging (LiDAR) data. It presents a bibliography of nearly 50 references related to this topic. This includes work related to various main approaches used for extracting road from LIDAR data, Feature extraction based on classification and filtering.

**Keywords** – LIDAR, Road Extraction, Classification, Filtering, Digital Elevation Model

### I. INTRODUCTION

Road Extraction from remotely sensed data is very challenging issue and has been approached in many different ways by photogrammetric and digital image processor. [1] Roads have long been important for development and prosperity and are essential for many applications such as urban and rural planning, transportation management, vehicle navigation, emergency response, etc. Often, road database is generated through field surveys with the help of GPS (Global Positioning System) enabled instruments. This approach of road extraction, however, is time consuming and labour intensive. With increase in availability of satellite imagery both in high and low resolutions, automatic road network extraction from satellite imagery has received considerable attention and has been studied extensively since 1970s. Since road region appear as linear segment in low resolution images, earlier research on road extraction focused on extracting road center-line from low resolution images. On the other hand, high resolution satellite images provide an opportunity to extract entire road area, which are particularly useful for vehicle navigation, along with road network. LiDAR (Light Detection and Ranging) has become reliable technique for collection of terrain and non-terrain features from the earth surface. LiDAR system consist of laser scanner, Direct Georeferencing(Direct measurement of the sensor positions X,Y,Z and orientation with respect to ground) ,GPS(Global Positioning System) [2]. Characteristics of LiDAR data include Discrete LiDAR returns, Full waveform LiDAR and LiDAR intensity. Data collection vendors deliver LiDAR data according to user specification (ASCII text file, LAS binary file etc.) [3]. Using this technology we can obtain 3D information very quickly. This paper only focuses on various methods related to road extraction from airborne LiDAR point clouds, and general approaches

used for processing of LiDAR data for Road extraction

Paper is divided into 4 sections. Section 2 discusses general algorithms used for road extraction from LiDAR data. Section 3 discusses feature extraction based on classification. Section 4 and 5 shows survey based on filtering and finally section 6 shows summary on surveyed techniques and how road detection works for LiDAR data.

### II. RELATED SURVEY BASED ON GENERAL ALGORITHM OF ROAD EXTRACTION.

The road network is an essential geographic information system (GIS) layer in applications such as urban and rural planning, transportation management, vehicle navigation, emergency response, etc. Extraction of curvilinear features, linear features has been a popular research topic in Computer vision and Remote Sensing communities. There are several recent algorithms available that makes the use of Airborne LiDAR data for road feature extraction.

Existing airborne LiDAR technology needs a large amount of work in post processing stage. Most of the existing algorithms use some basic methods, but some of which have no definitive boundaries until they are not used in specific processing procedures. [4] Hu X. et al. (2014) [5] proposed a method which detects road centerlines from airborne LiDAR data which consist of three steps spatial clustering based on multiple features using an adaptive mean shift method to detect center point of roads, Stick Tensor Voting to enhance salient linear features and weighted Hough Transform to extract the arc primitives of road centerlines. They denote their as Mean Shift, Tensor Voting, Hough Transforms. They applied their method on two different datasets. Yuan Wang et al. (2013) [6] developed a method using morphological operation which extracts road from airborne LiDAR data. Firstly, they segmented

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