



DEVELOPMENT OF ROAD NETWORK MODEL AND ALGORITHM FROM SATELLITE IMAGES FOR HYDERABAD CITY

Environmental Science

**Dr.Uma Devi
Randhi***

Assistant Professor, GITAM University, Hyderabad. *Corresponding Author

**Dr. K.Santosh
Kumar**

Assistant Professor, H&S Dept., Methodist college of Engineering and Technology, Hyderabad

Dr.M.Anji Reddy

Professor of Environment, Centre for Environment, IST, J.N.T.University Hyderabad

ABSTRACT

This project deals with the automatic detection of roads in high resolution satellite images. Suggested approach comprises of preprocessing the satellite image via a series of wavelet based filter banks based on frequency response of the corresponding FIR filter. Here we use two different wavelet bases in order to filter and de noise the satellite image. The resulting two images are fused together in to a single image of same size as the original satellite image using Karhounen-Louve transform (KLT) transform which is based on Principal component analysis (PCA). Then a fuzzy inference algorithm is used to detect roads based on statistical information and on geometry which classifies each pixel as road or non-road with regard to fuzzy inference rules yielding in a binary image. This output is then fed as input to the geographical information system (GIS) for the purpose that are in need.

KEYWORDS

Road Network, KLT, PCA and GIS.

1. INTRODUCTION

Extraction of road network from raster images is a very important part of many GIS activities such as GIS updating, geo-referencing, and geospatial data integration. However, extracting road networks from a raster image is a time-consuming operation when performed manually, especially when the image is complex. Automatic road extraction is critical and essential to the fast and effective processing of large number of raster images in various formats, complexities and conditions. How roads are extracted properly from raster images depends heavily on how roads appear in raster images. In this paper, we study the road extraction from high resolution images, e.g., satellite image, aerial photos. A high resolution satellite image typically has a resolution of 0.5 to 1 m. Under such high resolution, a road is not a thin line any more, instead, objects such as cars and trees are easily identifiable [8]. This class of images contains very rich information and when fused with vector map can provide a comprehensive view of a geographical area. Google, Yahoo, and Virtual Earth maps are good examples to show the power of such high resolution images [2]. However, high resolution images pose great challenges for automatic feature extraction due to the inherent complexities. First, a typical aerial photo captures everything in the area such as buildings, cars, trees, etc. Second, different objects are not isolated, but mixed and interfere with each other, e.g., the shadows of trees on the road, building tops with similar materials [9]. Third, roads may even look quite differently within the same image, due to their respective physical properties. Assuming all roads have the same characteristics will fail to extract all the roads. In addition, the light and weather conditions have big impact over images. Therefore, it is impossible to predict what and where objects are, and how they look like in a raster image. All these uncertainties and complexities make the automatic extraction very difficult [1]. Due to its importance, much effort has been devoted to this problem. Unfortunately, there are still no existing methods that can deal with all these problems effectively and reliably.

2. Motivation

These urban areas are characterized by the existence of diversity of complex features such as buildings, roads, and bridges. One important urban feature is the road network which is extracted from up-to-date high-resolution images such as Ikonos, Quickbird, WorldView, and Geo Eye. Many modern applications in many disciplines use these networks. These applications are widely used by a large number of individuals, organizations, and institutes such as car navigation system, emergency rescue system, and urban and environmental planning [6]. There are two types of approaches for extraction and identification of road network features in a remotely sensed image: manual and task specific automated approaches. In the past, most feature extraction methods are usually done by visual interpretation

and manual digitizing from aerial photographs or satellite imagery. Although this is still the predominant approach to geospatial data production, but it consumes labor and time for manual feature extraction or identification. Successful development of feature extraction technologies from high resolution satellite can greatly increase its usability in geographic databases updating and remote sensing application [10]. At the present, there are many algorithms, semiautomatic and manual for the extraction of road network features. Automated Feature Extraction (AFE) methods have been the long-term goal of geospatial data production workflows for the past 30 years; extracted features over small training sets can then be applied to larger areas, reducing the extraction time required by several orders of magnitude. Automated Feature Extraction applications use spectral, ancillary information, and feature characteristics such as spatial association, size, shape, texture, pattern, and shadow [3]. Machine-learning algorithms and techniques serve to automate the feature recognition process.

3. Methodology

The main objectives of the present study are:

- To Detection of linear features using Algorithms.
- Automatic Road Detection in High Resolution Satellite Images.
- Image Enhancement
- Development of best suitable algorithm for road detection from High Resolution Satellite images

The methodology adopted for the present study.

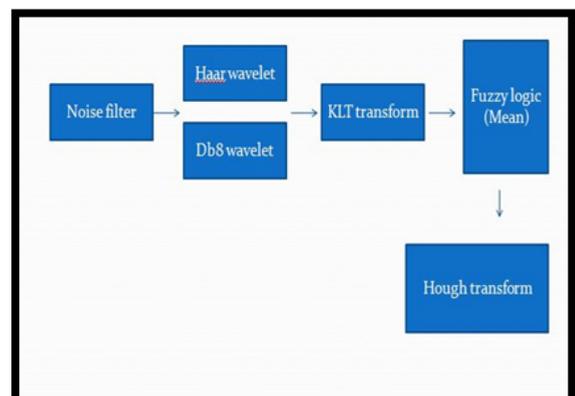


Figure-1 Methodology adopted for the Study

4. Results & Discussion

Input image is taken from the Google earth and the study area is Hyderabad city and the same Algorithm can be applied for Cartosat-2 satellite images also. The higher the resolution of the satellite the finer and accurate will be output. KL transform output shows How pixels are correlated in typical images, With the pixel values forming the axes of a vector space, a rotation of this space can remove this correlation[4,7]. The basis vectors of the new space define the linear transformation of the data. The basis vectors of the KLT are the eigenvectors of the image covariance matrix. Its effect is to diagonalize the covariance matrix, removing the correlation of neighboring pixels [11].



Figure-2 Initial satellite Image

An automated method for extracting road networks from satellite images is done in this project. Wavelet based filter banks such as Haar and db8 are used for pre-processing the image. In order to eliminate the disadvantages of ordinary decomposition, Karhounen-Louve transform is employed for image fusion. Road detection is carried out by fuzzy inference algorithm that can mimic human logical reasoning well. For this, six rules are formulated. In this study, the approach introduced is structured such that it is quite possible to introduce very efficient parallelization in order to do the real time processing of images [5].

It has great potential for updating old GIS data sets and uplifting the commercial value. Especially this new methodology can be applied update road data in both urban and sub urban areas. Here algorithm detects all linear features from High resolution Satellite Images, however here in this study we focused on Road detection.



Figure-3 The final Output for the entire image is as shown above

Automatic road extraction from remotely sensed imagery saves lot of time and money for GIS data collecting and updating tasks. In this research Matlab was used to extract Road network but it has some limitations, therefore future direction of this research is need to develop using typical computer programming languages like C++ or Java. By this research it has provided automatic road feature extraction method and has opened up the avenues for new software creation for automatic road feature extraction from High resolution Satellite images.

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