Satellite Roadmapping
TSBB11, Linkoping University

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Introduction

The quality of satellite imagery of the earth's surface is good enough for a person to distinguish roads so why shouldn't a computer program be able to do the same?

Extracting roads from satellite images is a useful application of image processing since there are some areas of the world where the road system is poorly mapped, whilst satellite images of these areas exist. Another benefit of creating a robust system for finding roads is that it is possible to keep the road map up to date during times of drastic changes such as landslides, forest fires and earthquakes.

This poster presents a pipeline for extracting roads from satellite images. The output of the pipeline is a vectorized road network. This network contains the positions of all crossings and which crossings are connected. In order to evaluate the accuracy a road mask from an intermediate step in the pipeline is used. This mask is compared to a manually labeled ground truth. This paper does not present any new theory for road extraction. Instead the focus was to find a way to combine already existing techniques to find a well performing pipeline.

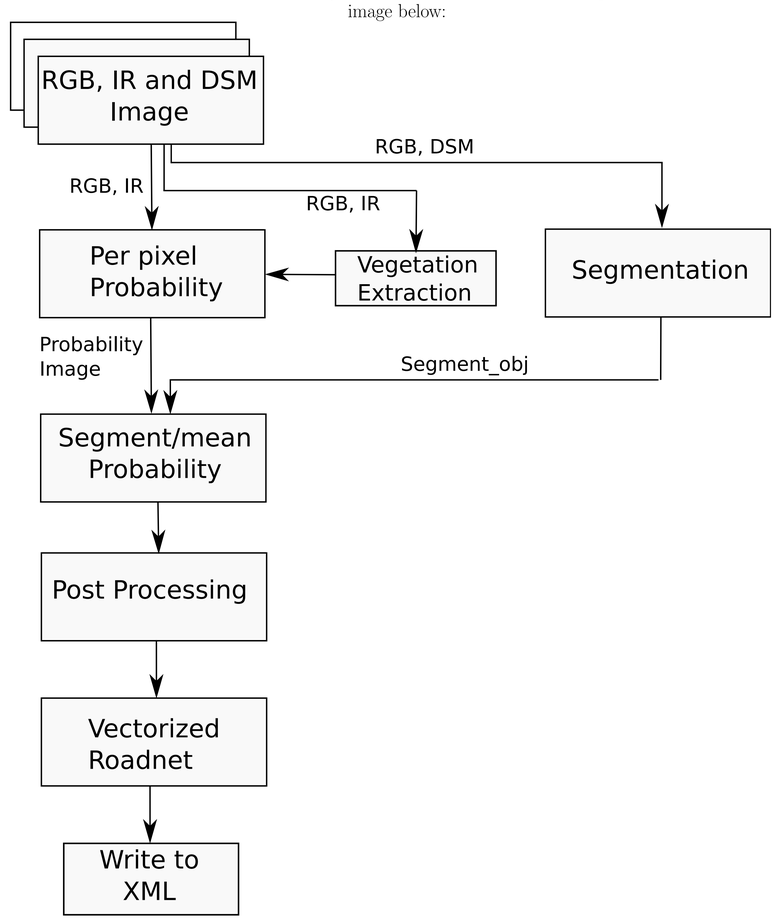
Imagery

5-channel input imagery is provided: RGB (Red, Green, Blue), nIR (near InfraRed) and DSM (Digital Surface Model) image, also a high detailed PAN (grayscale) image is provided.

Upper left: RGB, Upper right: nIR, Down left: PAN, Down right: DSM

Pipeline

By the use of vegetation index, RGB and nIR data a per pixel probability estimate is produced. This is followed by extracting superpixels (groups of pixels with similar color and position) using mean shift segmentation to find a road mask. Superpixels and per pixel probability output are utilized to estimate if the superpixel is a road or not. The mask is then vectorized into a network and stored as XML file from which the result can be visualized. The system is divided in several sub-components outlined in the image below:



The output of the pipeline are road network information and images presenting which pixels are labeled as roads and which are not.

Road extraction results

Applying our pipeline on the satellite images, we get:

- A binary image revealing which pixels belong to a road and which ones do not.
- A road network image presenting crossings with dots and roads between crossings with lines. ...

Result image where pixels labeled as roads have been highlighted.

Conclusions and future work

The results have been satisfactory given the quality of data. The presented road network is a good start for further development of a road extraction pipeline to be used commercially. Taking the next step would start with improving the superpixel probability values by using a method that takes into consideration a set of pixels rather than single ones at a time.

The main goals of this project was to fulfill these requirements:

- Create road network where a majority of the roads wider than 5 meters are correctly detected.
- Number of false positive roads detected are fewer than the number of true positives
- Output a graph defining crossings as nodes and roads as lines.
- Create complete C++ roadmapping program.
- Create a program which automatically evaluates the accuracy of the road detection.