Using Superpixels for Road Segmentation in Street View Images

David Abou Chacra University of Waterloo, ON, Canada
John Zelek University of Waterloo, ON, Canada

Abstract

Google Street View is a useful database that houses a large amount of information. This information, however, is unlabelled. We explore the use of superpixel methods for segmentation of images in this database, specifically road segmentation.

1. Introduction

The Google Street View (GSV) image database is a relatively untapped gold-mine of data. It is well maintained, uniform, global and readily available to researchers.

Road are one of the key components in GSV images. They exist in every image, as the car holding the camera has to use them. As such, it is useful to be able to segment the road portions of a GSV image.

For this purpose we're looking at various superpixel segmentation methods and their usefulness and performance in segmenting the roads in GSV images.

2. Google Street View

Google Street View provides real-world data that can be a key component of a lot of applications. Images in this database are 360 degree panoramas at systematic locations across North America, most of Europe, and in major cities around the world. GSV gives large amounts of data and is updated quite frequently, approximately every 2 years for large cities.

GSV has been used in numerous applications. Street View data has been mined for the detection of how accessible the ramps are in certain geographic regions [1]. In [2], the authors used Street View data for localization and object detection. Street View imagery has also been used to aid visually impaired bus riders to find bus stops in new locations [3].

The abundance of Street View data has also been capitalized upon for learning methods for driver assistance systems, and are being tapped into by self-driving car researchers [4].

3. Superpixel Segmentation

Road segmentation from GSV images can prove useful in numerous applications, from self-driving cars, to localization. We study this problem from a Superpixel segmentation perspective. These methods provide fast segmentation of the image into meaningful regions, which can then be merged to provide a complete segmentation. The more successful methods are:

SLIC Superpixels:

Simple Linear Iterative Clustering Superpixels proposed in [5] segments based on colours in the L*A*B* colour space. It works by assigning similar pixels in the neighbourhood of the super pixel to it, and then updating the cluster centres. It is a gradient-ascent based method

Structured Forests Superpixels:

Researchers at Microsoft developed "Structured Forests" [6], an algorithm that combines structured learning with random decision trees to detect edges. Their algorithm takes advantage of the fact that local edges exhibit certain structures, and is able to detect accurate edges in real-time. The method produces a contour map which can be used to obtain a superpixel segmentation. A sample output can be seen in figure 1.

SEEDS Superpixels:

Superpixels Extracted via Energy Driven Sampling [7] is another gradient ascent method that refine existing superpixel segmentations by using colour histograms and exchanging blocks of pixels between neighboring superpixels.

4. Conclusions

Each of the super pixel methods works reasonably well. However, moving forward requires a merging predicate that can merge the individual super pixels into a complete road segmentation that includes the entirety of the road patches in the image. These road patches are sometimes discontinuous due to obstructions, like vehicles and pedestrians, which poses some segmentation challenges. Also, shadows, sidewalks, and non-uniform roads are segmented separately and could prove difficult to merge.

References

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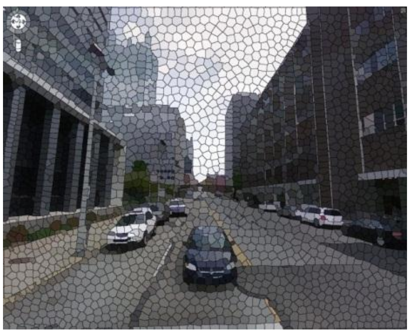

Fig. 1: Structured Forests Superpixel Output