Shape Inference from Compressed Images

Chris Kreucher and Sridhar Lakshmanan
Department of Electrical and Computer Engineering
University of Michigan – Dearborn, Dearborn, MI 48128-1491
Email: ckreuche, lakshman@umich.edu

Abstract - **This paper presents a method for inferring lane shape from JPEG compressed image archives of common roadway scenes. Given a description of the overall geometry of the roadway of interest, such as those possessing straight, curved, narrow, or wide lanes, the method quickly retrieves those images from the archive that match that description. A degree of confidence is also attached to every such retrieval.**

DESCRIPTION OF THE METHOD

The enormous amount of image and video data present today mandates use of compression techniques [1]. However, such compression typically makes image inference and query time consuming and inefficient. Most standard procedures for image inference and query matching require a spatial domain representation of the target image in order to perform the necessary feature extraction and analysis. This is computationally expensive, as it requires a decompression of the compressed image [2] before those procedures can be applied.

Several methods exist for analyzing compressed images, and they broadly fall into two categories:

- Those that compress images so that certain spatial domain features are easily identified even upon encoding. Some involve non-standard techniques whose compression rates are lower than standard ones, and others change the standard format and hence cannot guarantee the overall fidelity of the decompressed image.
- Those that work directly with images compressed using standard techniques. They use "image keys"-a vector of compressed domain quantities-to match a query with other compressed images with similar keys. This matches visually similar images, however, there is no semantic or spatial meaning to the keys.

This paper presents a method for inferring lane shape from JPEG compressed images of common roadway scenes. Such images are obtained by placing a forward looking camera in a vehicle, and capturing typical scenes as the vehicle traverses various types of streets and highways. The method overcomes the deficiencies of earlier ones by using ideas from statistics and information theory - It works directly with images compressed using standard techniques, it accepts queries that have global geometric significance in the target images, and it provides a ranking of all those target images that "match" a given query. Corresponding to each compressed image, a set of frequency-domain features is directly computed from its discrete cosine transform coefficients. These features are then used in a likelihood probability model to assess the degree to which the target image is likely to contain a specific geometric lane shape. The likelihood probability model is subsequently combined with a deformable template model to yield a maximum *a posteriori* (MAP) estimate of the shape of the lane present in that image. A target image is deemed to contain a certain type of lane ("straight", "curved", etc.) if the MAP estimate falls within certain corresponding regions of the parameter space. A degree of confidence is also attached to every such categorization. The confidence measure is computed by determining how peaked the global maximum of the posterior probability density function (pdf) is relative to its floor, along with how far in the interior of the corresponding regions the MAP estimates lie.

REFERENCES

[1]Pennebaker, W. B., *JPEG still image data compression standard,* New York : Van Nostrand Reinhold, 1992.

[2]Smith, B. C. and Rowe, L., "Algorithms for Manipulating Compressed Images" *IEEE Computer Graphics and Applications*, pp. 34-42, Sept. 1993 .

Figure 1. Four images classified by the method.

	Straight Score	Curved Score	Narrow Score	Wide Score
#1	0	17.04	9.91	0
#2	16.85	0	11.48	0
#3	12.45	0	0	24.21
#4	0	82.82	0	40.27

Table 1. Classification results for images #1 to #4.