Title:

Classification of Line and Character Pixels on Raster Maps Using Discrete Cosine Transformation Coefficients and Support Vector Machines

Author:

Yao-Yi Chiang and*
Craig A. Knoblock ***
yychiang@geosemble.com
knoblock@isi.edu

Affiliation:

*GeosembleTechnologies, Inc
California, United State
http://www.geosemble.com

**University of Southern California,
Department of Computer Science and
Information Sciences Institute,
California, United State
http://www.isi.edu

Abstract (cont’ d):

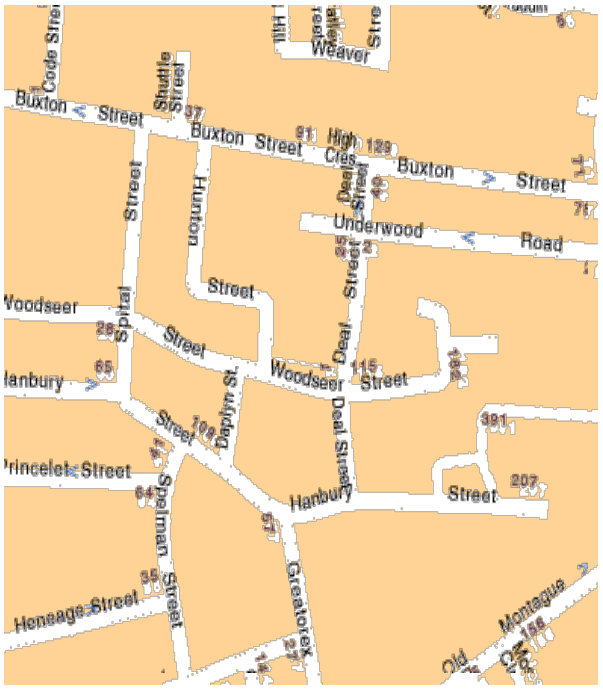
Raster maps are widely available on the Internet. Valuable information such as street lines and labels, however, are all hidden in the raster format. To utilize the information, it is important to recognize the line and character pixels for further processing.

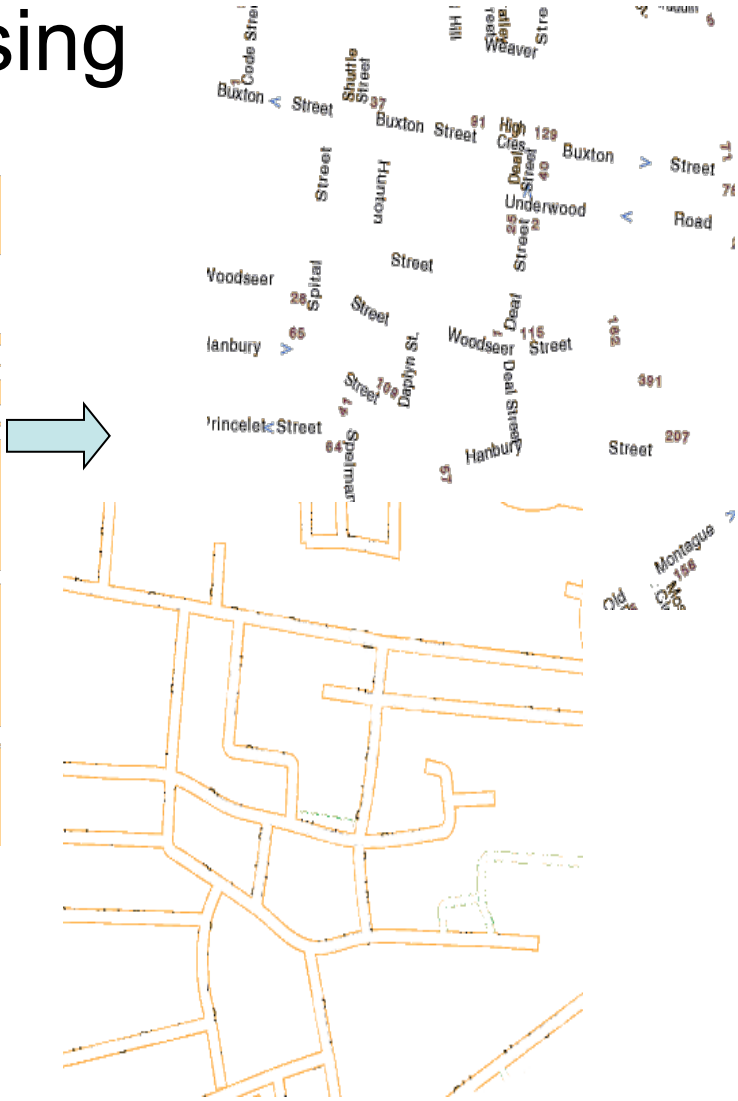
Abstract:

This work presents a novel algorithm using 2-D Discrete Cosine Transformation (DCT) coefficients and Support Vector Machines (SVM) to classify the pixels of lines and characters on raster maps. The experiment results show that our algorithm achieves 98% precision and 85% recall in classifying the line pixels and 83% precision and 96% recall in classifying the character pixels on a variety of raster map sources.

The Problem:

- To understand the information on raster maps
- How? Recognize the line and characters on the raster map for further processing





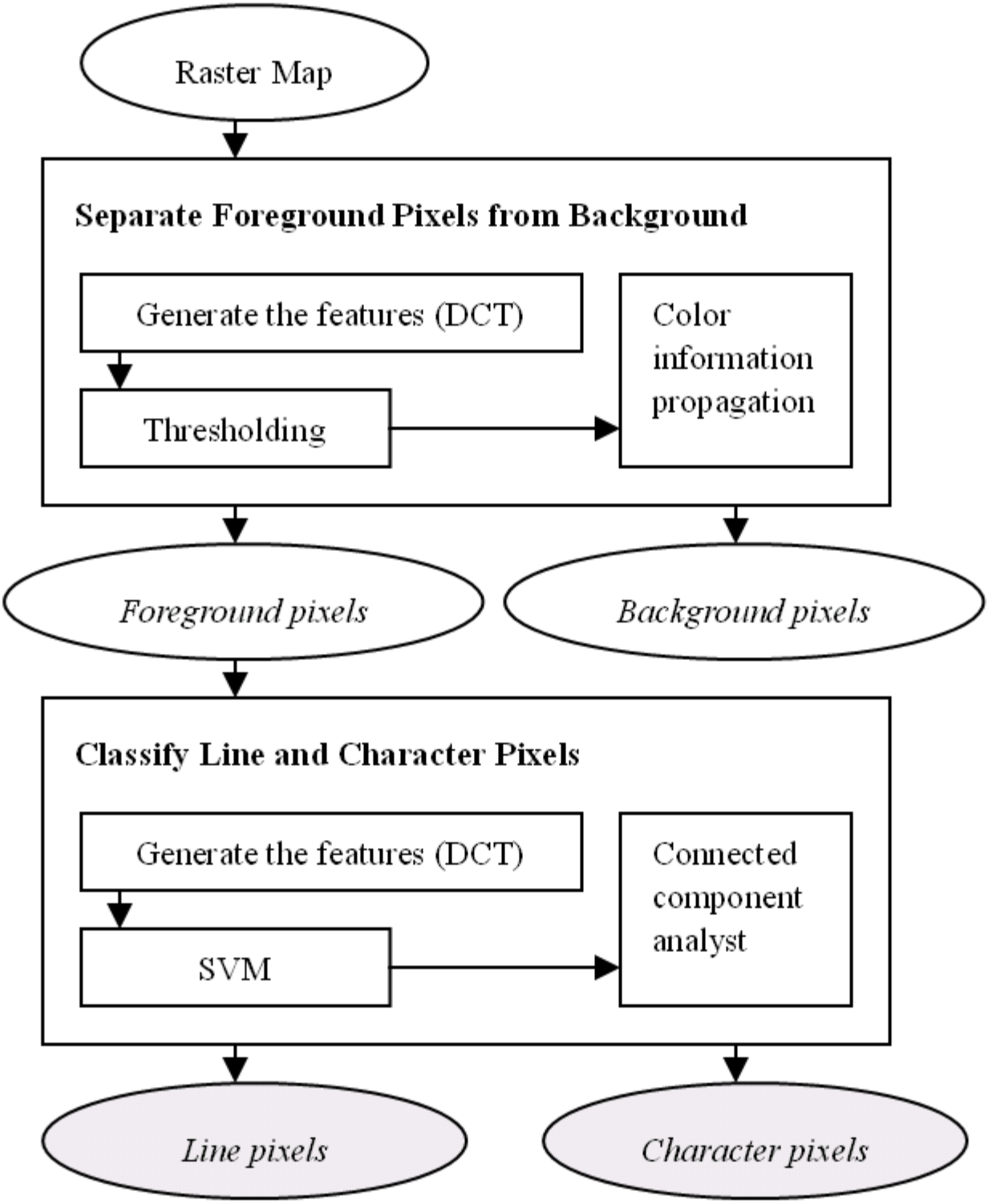
The Solution:

- Steps to recognize the lines and characters:
  - **FIND AREAS** of characters
  - For each area, **SEPARATE** and **REBUILD** lines and characters
  - Send characters to **Optical Character Recognition** component
  - Send lines to **Vectorization** component
- These steps are interrelated

Related Work:

- Bixler 00’ , Fletcher 88’ , and Velazquez 03’ assume that the line and character pixels are not overlapping
- Li et al. work in local areas to separate the characters from lines
- Cao et al. use the different length of line segments to separate characters from line arts
- **We do not use geometric properties as the previous work**

Approach (cont’ d):



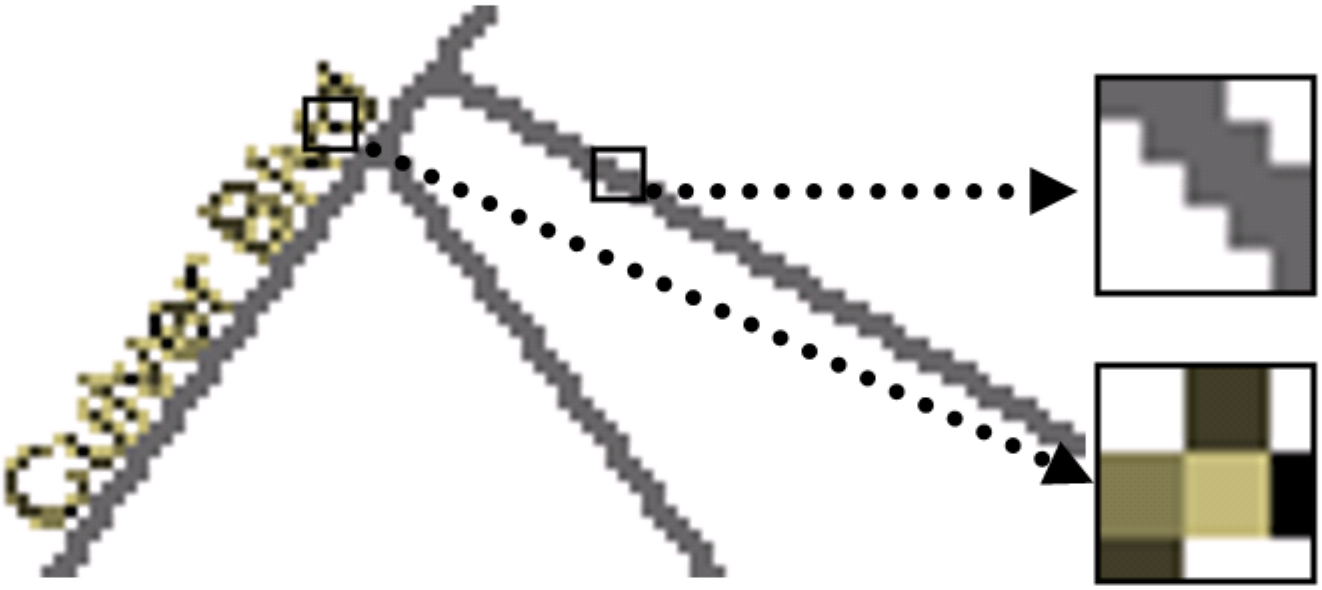
Approach:

- We use texture classification approach to classify pixels
- Features:

Discrete Cosine Transformation (DCT) coefficients

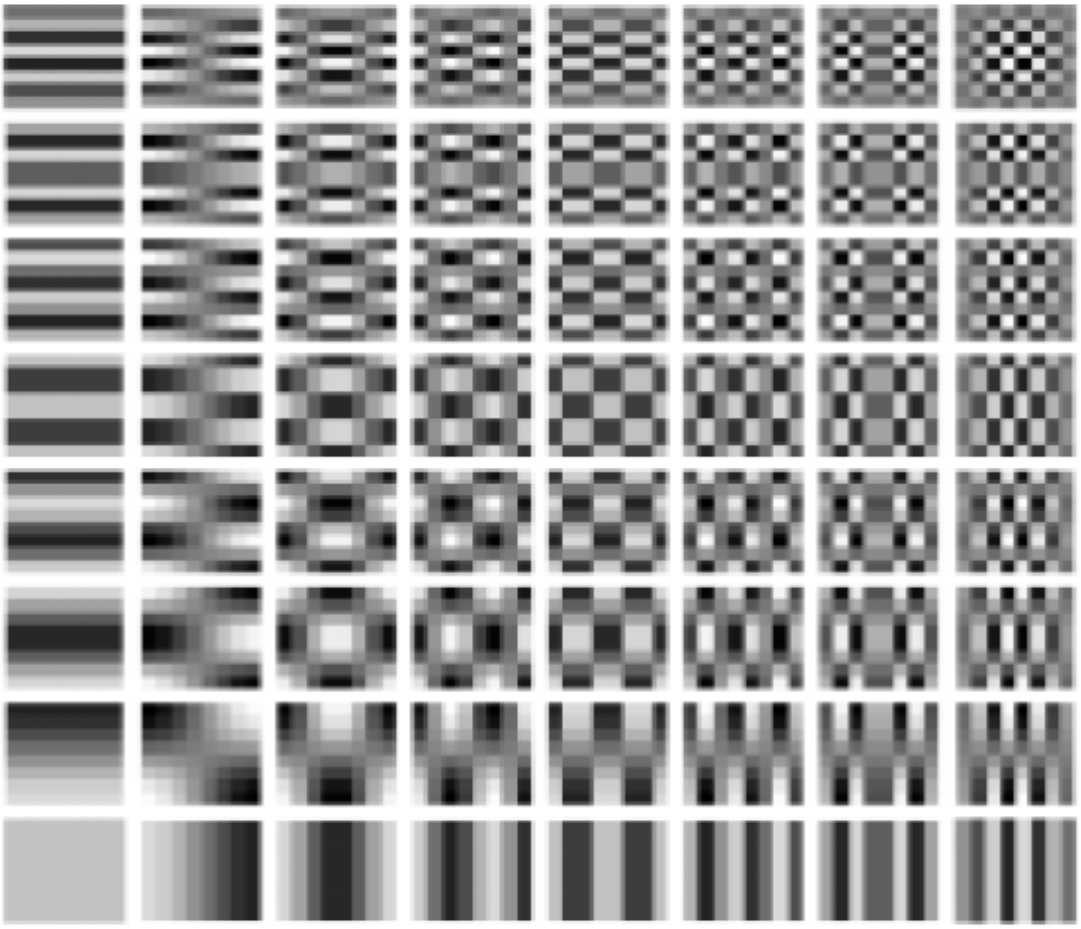
- Classifier:

Support vector machine

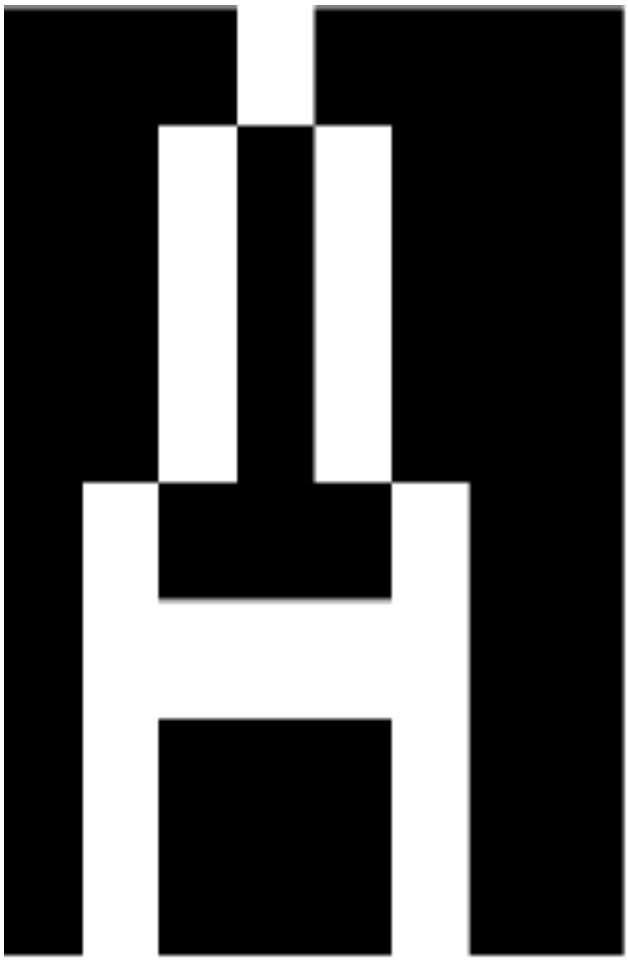


Discrete Cosine Transformation

- DCT gives us the strength of each component to build a single image

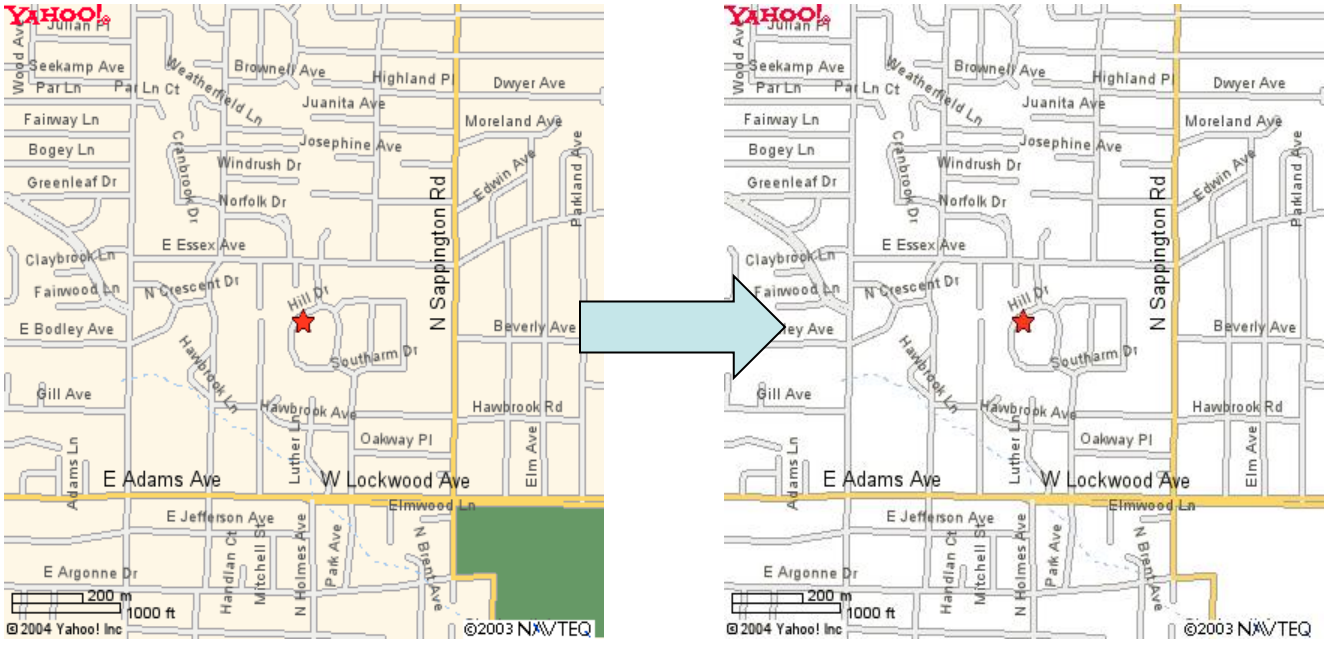


Discrete Cosine Transformation



Remove background

- We apply DCT transformation for each pixel
- The DCT coefficients represent the variation around each pixel
- The pixels with low variation (near 0) around them are the background pixels

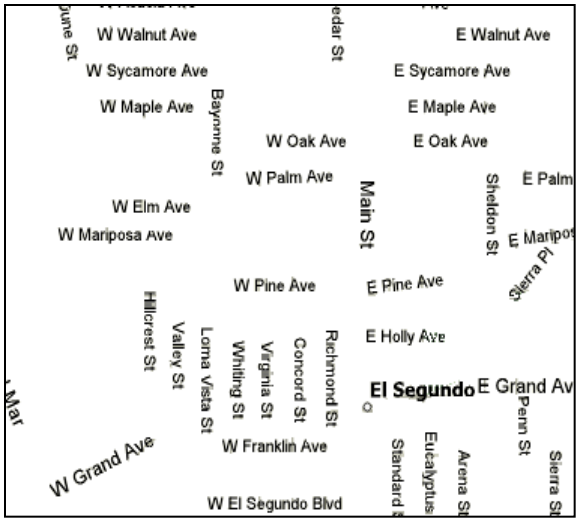


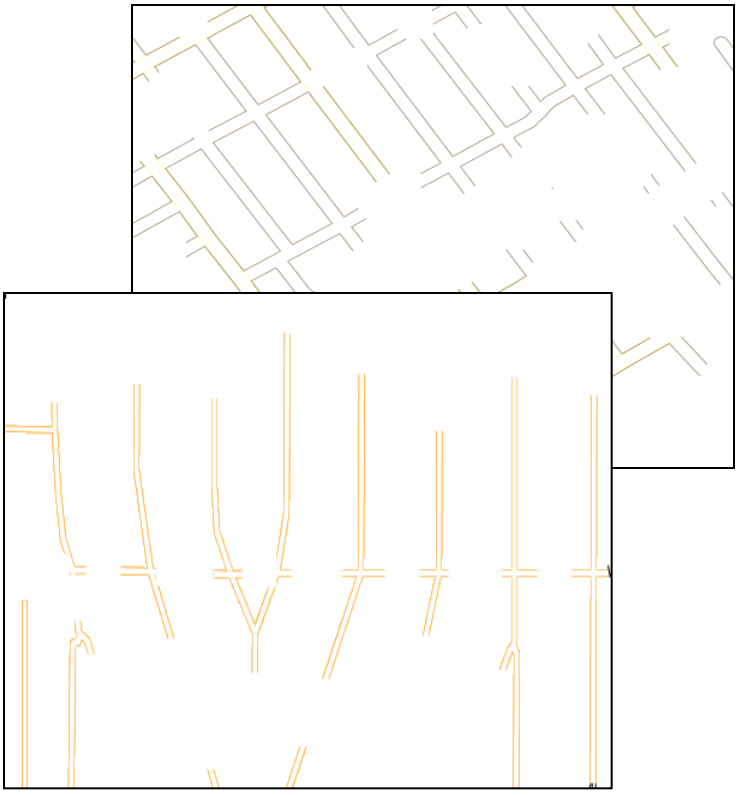
Classify Line and Character pixels

- We apply DCT transformation for each foreground pixel
- The DCT coefficients now represent the variation around each **foreground pixel**
- We use the DCT coefficients as features for SVM to classify the pixels

Classify Line and Character pixels

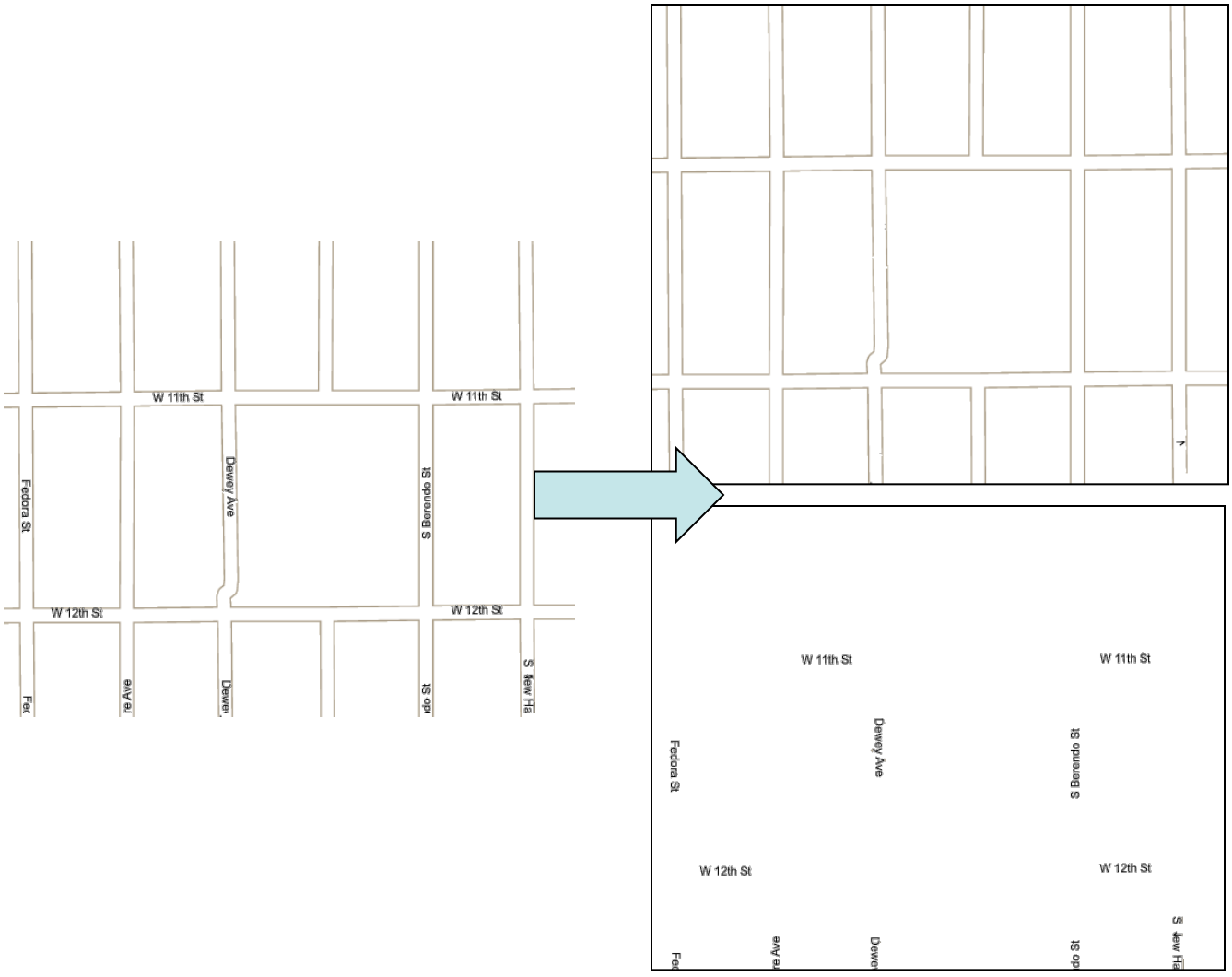
- Training
  - One MapQuest map for character samples
  - One Google map and one Viamichline map for line samples





Classify Line and Character pixels

- Classification
  - The testing maps are disjoint from the training samples



Result:

Map Source	Precision/Recall of Classification			
	Line Pixels		Character Pixels	
	Ours	Cao's	Ours	Cao's
A9	**99/91%**	95/91%	**79/98%**	77/85%
MSN	**99/79%**	91/87%	**75/99%**	81/86%
Google	**99/99%**	95/99%	**98/99%**	95/72%
Yahoo	**95/91%**	70/96%	**91/92%**	88/30%
Mapquest	**99/78%**	88/73%	**84/98%**	76/85%
Map24	**95/74%**	97/70%	**73/96%**	70/98%
ViaMichelin	**83/34%**	44/57%	**87/96%**	90/68%
Multimap	**89/82%**	98/64%	**63/90%**	46/97%
TIGER/Line	**99/94%**	97/89%	**83/99%**	67/90%
Average	**98/85%**	85/82%	**83/96%**	71/71%

- Computation time:
  - For a 400x400 Google Map:
    - 2 seconds to remove background
    - 4 seconds to classify line and character pixels
- No threshold needed

Future Work:

- For the road lines:
  - Combine with vectorization program and conflation technologies from Geosemble to automatically geo-referencing the map and align the map with other geo-spatial sources

Future Work:

- For the characters:
  - Combine with OCR and conflation technologies from Geosemble to automatically and accurately label satellite imagery