CSCE 5222 Feature Engineering

**Project Plan : Road-Detection**

**Group 9**

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**Git Repo :** [Road-Detection](https://github.com/bring-nirachornkul/Road-Detection)

1. **Problem statement**

The goal of the project is to detect boundaries of roads and fields. This project aims to identify the different line features in images that delineate fields such as roads, canals, or trails. The fact that the roads are not necessarily consistent in size, color, and shape makes this somewhat challenging. The techniques used in this project could potentially be used by a navigation software developer or a space-based photography company to draw the road from the ground truth images, or to identify the boundary of the road for future autonomous cars. (Howe, J., Casterline , M., & Brown, A. ,2022)



1. **Data used**

There are nine satellite images which show the fields, roads, structures, and woods. The size of each image is 2048 by 2048. All of the images are in JPG format.

1. **Method**
2. Convert to grayscale image in order to perform the test of the edge detection in each category.
3. Normalize and equalize the images to make them clearer.
4. Apply different edge detection techniques (Chinenov, T. ,2018) :
   * **Apply Sobel filter** - this filter will verify the gradient between each pixel across an image. It is one of the built-in matlab functions that performs an operation in both the horizontal and vertical direction and combines the results.
   * **Apply Canny filter** - this filter will reduce the noise and the amount of data to be processed which will reduce a lot of false edges in the image. The detection will accurately catch the edge in the image.
   * **Apply Laplacian of Gaussian (Log)** - this filter is great for large images because it can capture tiny details in the image such as roads and field boundaries. This filter will highlight the number of roads and reduce the amount of noise in the image significantly.
5. Apply transformer
   * HOUGH transform : detect lines or the objects in the geometric parameter space. (He, K., & Zhang, L. , 2021)
6. Manual drawing lines
   * To make the road line more clear and eliminate the unused lines from the map.

**Timeline**

| **Date** | **Ibrahim** | **John** | **Phongsiri** |
| --- | --- | --- | --- |
| **10/11** | **Research and experiment with different techniques** | **Research and experiment with different techniques** | **Research and experiment with different techniques** |
| **10/29** | **Compare results with final imageset to determine optimal approach** | **Compare results with final imageset to determine optimal approach** | **Compare results with final imageset to determine optimal approach** |
| **11/12** | **Expanding scope/experimenting with different datasets** | **Expanding scope/experimenting with different datasets** | **Expanding scope/experimenting with different datasets** |
| **11/26** | **Writing report** | **Writing report** | **Writing report** |
| **12/1** | **Organizing data and preparing for presentation** | **Organizing data and preparing for presentation** | **Organizing data and preparing for presentation** |

1. **Evaluation**

Table 1 This is an example of a table

| Name | Size | Type | Filter | Accuracy | Precision |
| --- | --- | --- | --- | --- | --- |
| Image 1 | 1024 x 1024 | JPG | Sobel | Pending | Pending |
|  | 1024 x 1024 | JPG | repmat | Pending | Pending |
|  | 1024 x 1024 | JPG | Candy | Pending | Pending |
|  | 1024 x 1024 | JPG | Laplacian of Gaussian | Pending | Pending |

We found a lot of TN (True Negative), the missing line ,and FP (False Positive), aka. unnecessary lines during evaluation. The only thing we need here is True positive, the line that matched on road.



Our plan to obtain the ground-truth image (expected outcome) is to find the middle zone between overfitting and underfitting the line mark in hough transformation. We will compare ground-truth image (expected outcome) with the result from the generated image via hough transformation by MAP (mean average precision).

Code : averagePrecision(i) = evaluateImageRetrieval(query, imageIndex, expectedIDs(i));

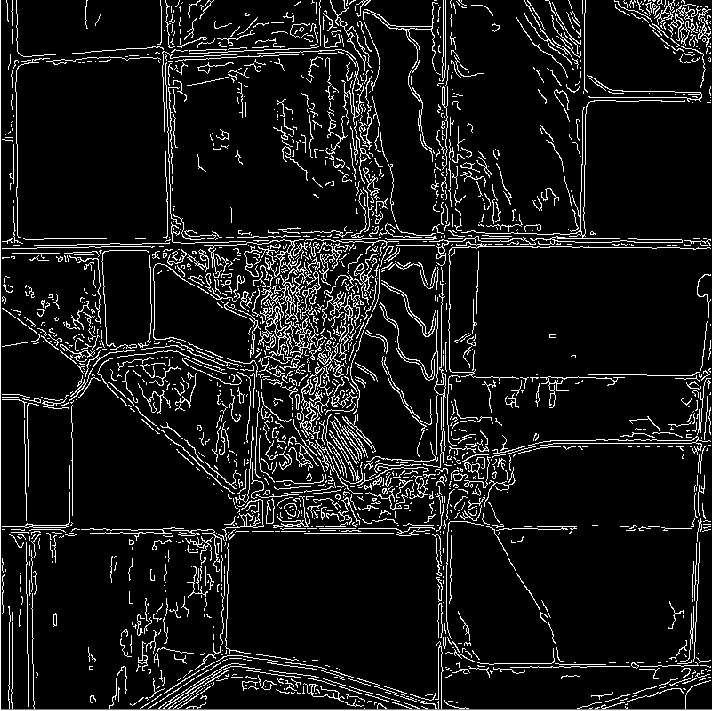


Figure 1 : Candy threshold 0.09

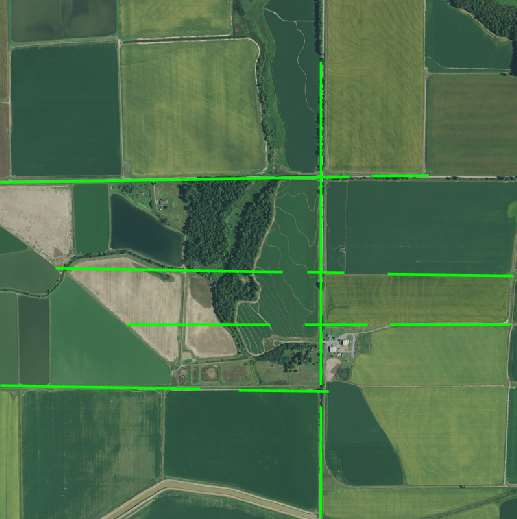


Figure 2 : Hough Transform

**Reference**

Howe, J., Casterline , M., & Brown, A. (2022, August 21). *Solving Spacenet Road Detection Challenge with deep learning* . NVIDIA Technical Blog. Retrieved September 23, 2022, from <https://developer.nvidia.com/blog/solving-spacenet-road-detection-challenge-deep-learning>

Chinenov, T. (2018, December 28). *Finding land area of farm plots using edge detection*. Medium. Retrieved September 23, 2022, from <https://towardsdatascience.com/finding-land-area-of-farm-plots-using-edge-detection-5b070cc05c5a>

Sirmacek, B., & Unsalan, C. (2010). Road network extraction using edge detection and spatial voting. *2010 20th International Conference on Pattern Recognition*. <https://doi.org/10.1109/icpr.2010.762>

He, K., & Zhang, L. (2021). Vehicle detection in satellite images with deep neural networks and vehicle shape features. *2021 IEEE International Geoscience and Remote Sensing Symposium IGARSS*. <https://doi.org/10.1109/igarss47720.2021.9553697>