Final Project Proposal

Anonymous ICCP submission

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Abstract

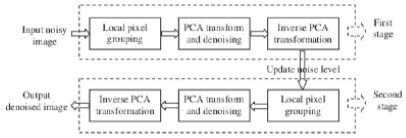
The motivation for this paper is to use different image denoising techniques determine the best method in a certain application. Specifically, we'll be attempting to use post processing to improve the fidelity of aerial photos. First, we'll apply Alternating Direction Multipliers Minimization (ADMM) with an isotropic total variation (TV) prior. Next, we use a non-linear means algorithm to generate the prior. We then plug this prior into the ADMM algorithm. Finally, we use principal component analysis (PCA) to generate an unsupervised interpetation of a wide variety of scenes. We use images from a police chase captured from a helicopter. This provides us with a visual light filter as well as an infrared filter at multiple aspects. Hopefully, by improving image fidelity in post processing, we can help improve the accuracy and efficiency of policework.

1. Introduction

In this section we will provide a project overview, related work as well as milestones, timeline and goals for the project.

1.1. Related Work

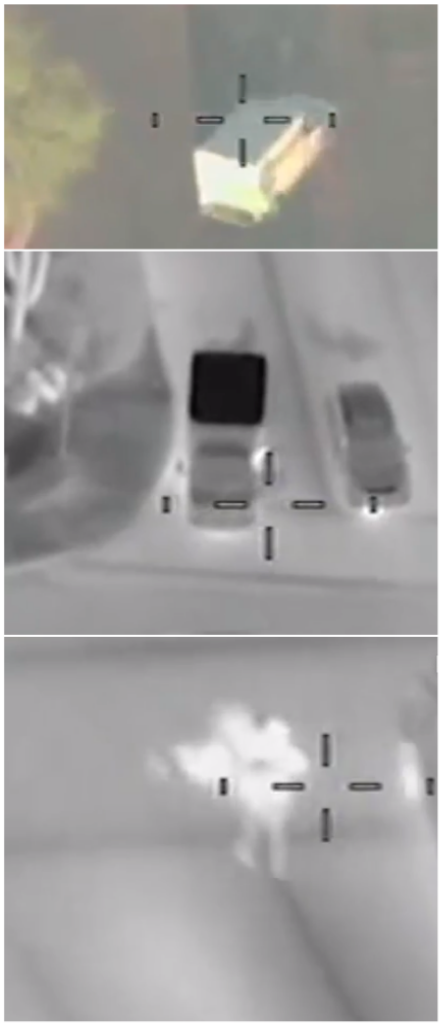
There are three main sources that are related to this project. The first is "Distributed Optimization and Statistical Learning via the Alternating Direction Method of Multipliers" by Stephen Boyd et al. In this paper the author goes through multiple methods to statistically analyse data. Specifically, we'll be using this as a reference for our ADMM isotropic with a TV prior. This source doesn't make any claims on how to denoise, but provides most of the statistical building blocks that we'll need to complete the assignment. The second source is "A review of image denoising algorithms, with a new one" by Antoni Buades et al. This study claims that the non-local means algorithm is the most "asymptotically optimal" method for reducing nosie in an image. We'll use this to expand upon part one by changing the prior of ADMM. The third source is "Two-stage image denoising by principal component analysis with local pixel grouping." This study presents PCA as a means to denoise an image. Below is a layout of the algorithm:



1.2. Project Overview

The intent with this project is to analyze photos taken from a helicopter in multiple different aspects, filters and subjects. For example, we look at pictures that are taken in color (daylight) and pictures that are taken using an IR filter. We also look at how different algorithms denoise people vs vehicles vs buildings. In all cases, I would do a qualitative analysis in terms of what denoising method makes it look "best." This will serve as a sanity check as to how a policeman would most likely interpret the pictures. Also, a quantitative analysis will be performed. For all pictures, I'll compute the MSE and the PSNR for all images in all analysis types. Again, this would be

1) the isotropic ADMM with a TV prior
2) the anisotropic ADMM with a NLM prior and
3) PCA. Below are some example images I would analyse.



1.3. Milestones, Timeline and Goals

For this project there are three main milestons based on the three main tasks I'd like to perform. The overall goal of this is to use methods in class to provide real world benefits to the customer. This timeline assumes that I will begin the project on 20th of February (after collaboration with the course staff, mentor selection, etc.). The presentaiton for this project is on the 11th, so I'll plan to be done by the 10th of March. Here's an outline of the 3 part completion plan:

Milestone 1: the isotropic ADMM with a TV prior (26 Feb)
Milestone 2: the anisotropic ADMM with a NLM prior (4 Mar)
Milestone 3: PCA (10 Mar)

1.4. References

https://www.nowpublishers.com/article/Details/MAL-016

https://epubs.siam.org/doi/abs/10.1137/040616024

https://www.sciencedirect.com/science/article/abs/pii/S0031320309003677