

# EE367 Project Proposal

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## 1 Motivation

Image denoising is an important step of the image processing pipeline, which has a significant impact on any downstream uses ranging from simple consumer needs, people want to take visually pleasing photos in various conditions with practical devices, to object identification and localization in robotics, and information extraction in scientific imaging. As a result noise reduction remains an actively investigated problem in the field of computational imaging. Over the years a wide range of techniques have been applied to this problem from classical signal processing approaches such as low pass filtering to modern convolutional neural networks being trained to remove noise. The aim of this project is to gain further insight into the topic of noise reduction by implementing a state of the art technique based on weighted nuclear norm minimization.

## 2 Related work and project overview

Many different techniques have been developed for image denoising over the years. As part of the class we have already implemented Gaussian, median, bilateral, and non-local means filters, as well as total variation regularization and denoising convolutional neural network (DnCNN) based approaches. It has been demonstrated that non-local approaches generally outperform local approaches [1] with current state of the art being block matching and 3D filtering (BM3D), weighted nuclear norm minimization (WNNM), and DnCNN based approaches.

Matrix low rank approximation is a commonly used technique for identification of low dimensional structure in data. The weighted nuclear norm minimization approach is based on finding a low rank approximation of a matrix that has noisy patches of the image as its columns [2]. In this project I am going to implement WNNM based denoising. Its performance on images with Gaussian and Poisson distributed noise is going to be assessed by comparing it to the results achieved using the methods implemented in class. The comparison is going to be both qualitative (visual) and quantitative (PSNR).

### 3 Timeline

- Fri 2/18 Project proposal due. Think about technical aspects of the implementation and identify potential challenges.
- Fri 2/25 Implement WNNM.
- Fri 3/4 Perform comparison to other methods. Start preparing poster and report.
- Wed 3/9 Submit poster presentation
- Fri 3/11 Submit project report

### References

- [1] Linwei Fan, Fan Zhang, Hui Fan, and Caiming Zhang. Brief review of image denoising techniques. *Visual Computing for Industry, Biomedicine, and Art*, 2(1):7, 2019.
- [2] Shuhang Gu, Lei Zhang, Wangmeng Zuo, and Xiangchu Feng. Weighted nuclear norm minimization with application to image denoising. In *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, June 2014.