

EE 367 Project Proposal

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Introduction

Denoising images has been an important research topic in computational imaging, especially in low level vision as denoising is an important step before such images are processed for further application. Many new methods are proposed as the rise of new deep learning techniques like CNN. In the meanwhile, traditional methods are still playing important roles in many aspects. Therefore, I would like to study and compare some state of the art deep learning based denoising models with the traditional models.

Related work

CNN is widely used in many computational imaging aspects, such as denoising, demosaicing, superresolution, etc. Many CNN based denoising models are developed. More advanced traditional methods are also being developed. Traditional methods can already produce a high denoising quality but generally has the drawback of low computational efficiency and requires the choice of some parameters manually while CNN models are discriminative and claim to be highly effective and computationally efficient.

Approach

After some reading several CNN and traditional methods for denoising, I pick the DnCNN model from Kai Zhang et al., which they apply CNN on Gaussian denoising. In the model, residual learning and batch normalization are used to accelerate the training. For traditional methods, I choose the Block-matching and 3D filtering algorithm by Ymir Mäkinen et al., which they apply an enhanced sparse representation by grouping similar 2D image fragments into 3D data arrays. For evaluation, I will apply the two models to the same set of data and compare the PSNR/SSIM. Both papers realized their models using Matlab. I will try to reimplement their methods in Python.

Milestones and Timeline

Read CNN and RM3D papers and background papers - 1 week

Implement CNN denoising and evaluate results of the method – 1.5 week

Implement RM3D method and evaluate results of the method - 1.5 week

Run final experiments and compare the results - 1 week

References

Beyond a Gaussian Denoiser: Residual Learning of Deep CNN for Image Denoising, Kai Zhang, Wangmeng Zuo, Yunjin Chen, Deyu Meng, IEEE Transactions on Image Processing, Volume: 26, Issue: 7, July 2017.

Deep Residual Learning for Image Recognition, Kaiming He, Xiangyu Zhang, Shaoqing Ren, and Jian Sun, 2016 IEEE Conference on Computer Vision and Pattern Recognition (CVPR)

Batch Normalization: Accelerating Deep Network Training by Reducing Internal Covariate Shift, Sergey Ioffe and Christian Szegedy, Proceedings of the 32nd International Conference on Machine Learning, Lille, France, 2015.

Exact transform-domain noise variance for collaborative filtering of stationary correlated noise, Ymir Mäkinen, Lucio Azzari, and Alessandro Foi, 2019 IEEE International Conference on Image Processing (ICIP).