

Poissonian-Gaussian denoising using ADMM

Nicholas Tan
EE367, Stanford University

Motivation

Techniques for denoising are based on priors that assume noise characteristics are either purely Poissonian or Gaussian. Real world images are a mixture of both, with Gaussian read noise dominating at lower intensities and Poissonian shot noise dominating at higher intensities.

This study shows that we can achieve better SNR performance during denoising by using a mixed model

Repeat for N iterations or until convergence:

- Compute Poissonian priors

$$\frac{\lambda^k e^{-\lambda}}{k!}$$

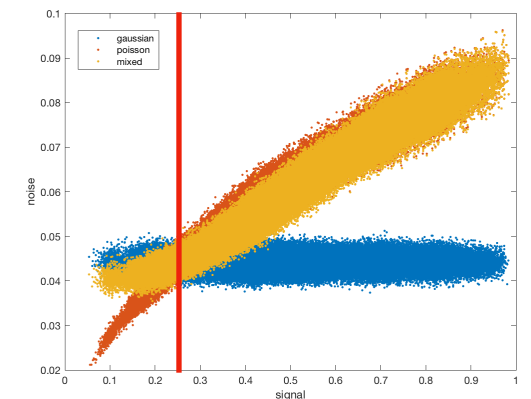
- Compute Gaussian priors

$$\frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

- Compute signal-based weights
- Mix Poissonian / Gaussian priors based on weights

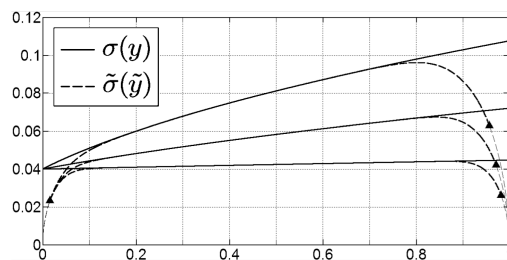
New Technique

Signal Based Thresholding



Related Work

Practical Poissonian-Gaussian noise modeling and fitting for single-image raw-data - Alessandro Foi characterizes the Poissonian-Gaussian noise model for sensors

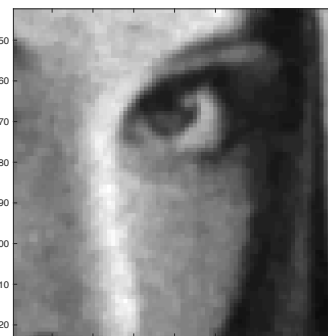
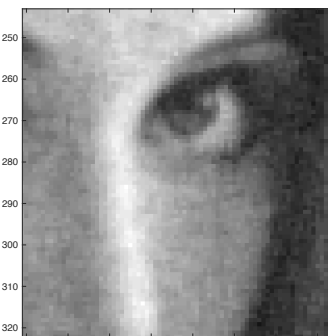
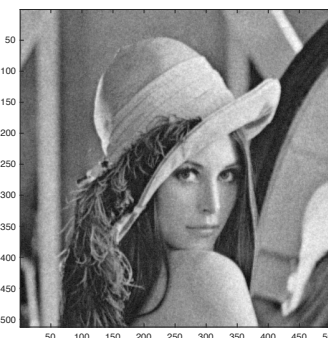


Restoration of Poissonian Images Using Alternating Direction Optimization - Mario A. T. Figueiredo develops techniques for applying ADMM to denoising images with Poissonian modeled noise

Poissonian Pure



Poiss-Gauss Mix

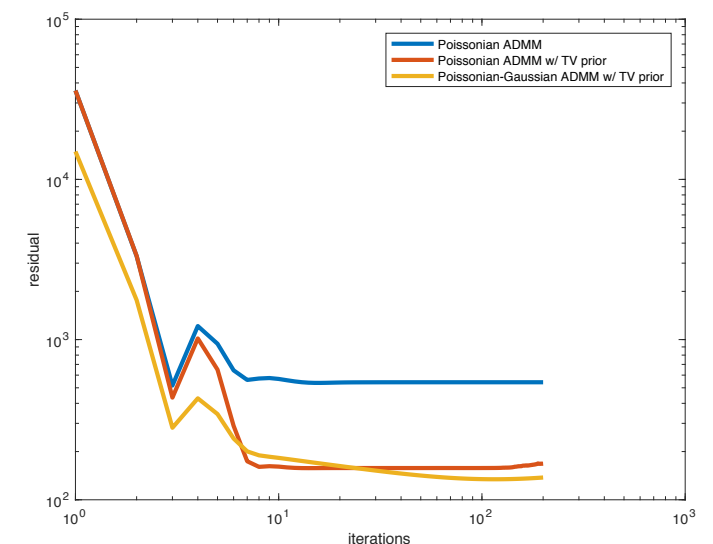


28.3656

PSNR

28.6575

Experimental Results



- Using a TV prior improves the Poissonian denoising by optimizing for sparse gradients
- Mixing Gaussian & Poissonian ADMM improves the performance of Poissonian ADMM