Débruitage d'image par l'utilisation d'un perceptron multi-couches

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Sommaire

Table of Contents

Context

Aim

Problematic : Mapping a noisy image (image pixels undergo random fluctuations) to a noisy-free image.

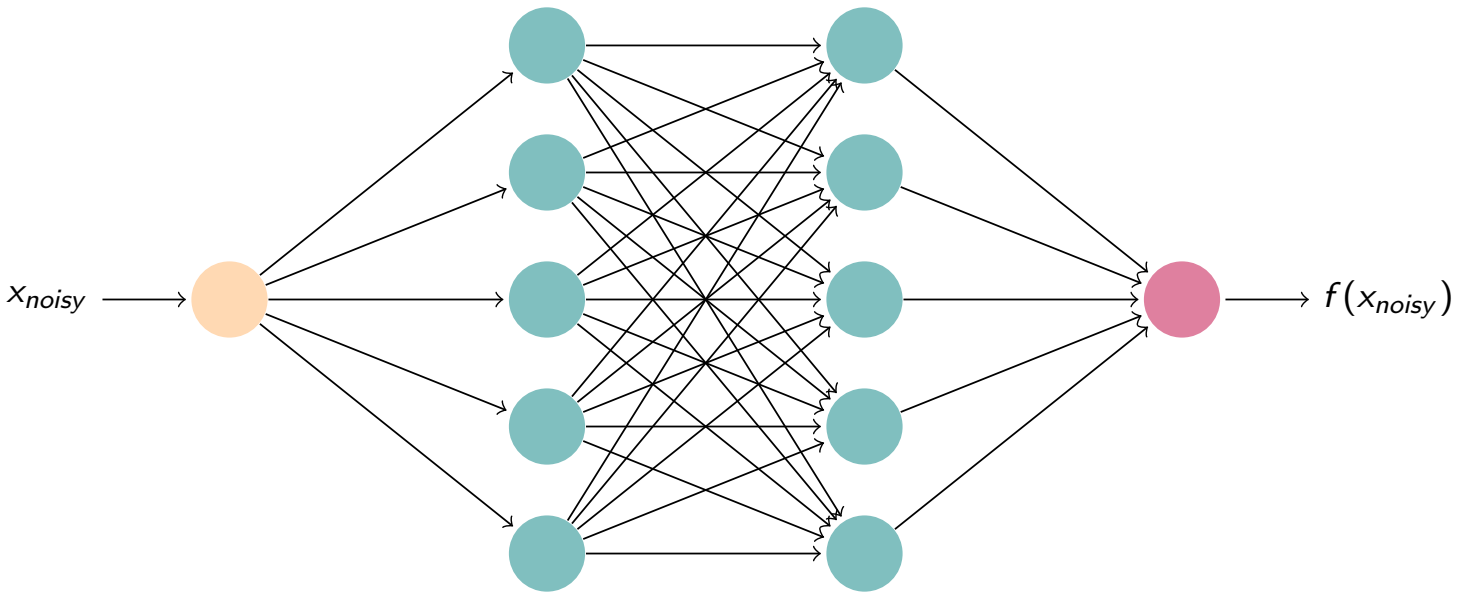
Existing algorithm

Suggested in the article : Using patches with a MLP-based method.

Table of Contents

Table of Contents

MLP-based method



where x_{noisy} is a noisy version of a clean patch x and $f(x_{noisy})$ represents an estimate of x.

Table of Contents

Weight initialization for MLP-based method

Weights w are sampled from an uniform distribution :

$$w \sim \left[-\frac{\sqrt{6}}{\sqrt{n_j + n_{j+1}}}, \frac{\sqrt{6}}{\sqrt{n_j + n_{j+1}}} \right]$$

Loss function

The loss function used is the MSE :

$$MSE = \frac{1}{n} \sum_{i=1}^{n} (f(x_i) - x_i),$$

where $f(x)$ the estimation x and x is a clean patch.

Peak Signal-To-Noise Ratio (PSNR)

PSNR $= 20 \times \log_{10} \left(\frac{m}{\sqrt{\text{MSE}}} \right)$ (dB), where m is the maximum possible pixel value of a given image.

Table of Contents

Results for AWG noise

Definition

Additive white Gaussian noise (AWG) : Mimics the effect of many random processes that occur in nature.

Other type of noise

Table of Contents

Bounds

Clustering-based bounds

There exist inherent limit on denoising quality for images with rich geometric structure.

Bayesian framework

How well any denoising algorithm can perform, which depends on the patch size.

Table of Contents

Block-matching

Block-matching

Idea : Find the patches most similar to a reference patch.

Combine MLP and block-matching

Train MLPs that take as input a reference patch and its nearest neighbors (similar patches).

Results

Block-matching MLPs provides better results on images with repeating structure than plain MLPs.

However, BM3D and NLSC still provide better results on this kind of images.

Table of Contents

Conclusion