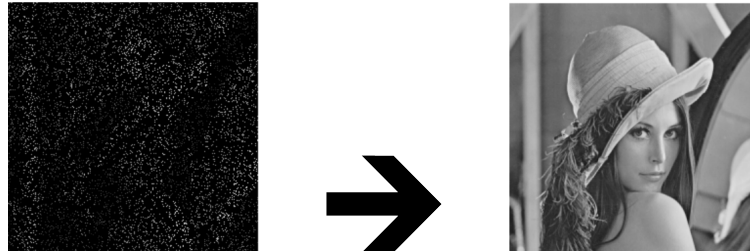


Image Restoration using a CNN as Regularization

Master's Project / Master's Thesis



One exemplary image restoration task is image inpainting. Image inpainting involves either the reconstruction of damaged or superimposed regions in an image, or restoring an image from scattered pixels which is closely related to image compression.

Objective:

In this project, we will make use of the rich feature space of a Convolutional Neural Network (CNN) to regularize the space of possible solution images for the task of image restoration. This task can be formulated as a bi-level optimization problem within a classical energy minimization framework:

$$\min_w \|u - g\|_2^2$$

$$\text{subject to } \min_u w^T \Phi(u) + \frac{\lambda}{2} \|Au - f\|_2^2$$

The function $\Phi(u)$ should ideally be a representation of natural images. As such a representation, you will experiment with the feature space of a trained CNN and find out which features and which layers are necessary to obtain the restored image u . Using the bi-level approach, you will explore how the features should be weighted via the parameter vector w . Starting points for the work are [1] and [2].

Qualifications:

- Student of Biomedical Engineering, Information and Computer Engineering, Computer Science or Software Engineering and Management
- Knowledge in the field of Computer Vision, Optimization, Machine Learning
- Programming skills in Matlab/Python, C++/Cuda optional

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References

- [1] Alexey Dosovitskiy and Thomas Brox. "Inverting Convolutional Networks with Convolutional Networks". In: *arXiv* (2015). arXiv: 1506.02753.
- [2] Aravindh Mahendran and Andrea Vedaldi. "Visualizing Deep Convolutional Neural Networks Using Natural Pre-images". In: *IJCV* (2016).