PhD thesis, 2019

Deep convolutional networks for inverse problems in image and video restoration

Video, deep learning, machine learning, restoration

Deep learning and Convolutional Neural Networks (CNN) have prevailed in many image processing and computer vision applications providing state of the art results. Networks of various structures may address many image or video restoration tasks with the same architecture. Some networks can handle several restoration tasks, sometimes simultaneously [1] (denoising, zooming, deconvolution,...), and some tasks may be addressed by various networks of different structures, often yielding similar performances [1, 2, 3]. For video restoration [4,5], the results obtained with neural networks outperform the classical algorithms (without learning) in most scenarios. However, when the degradation physics or the motion model are simple and well characterised, the standard methods are still better than learning techniques.

In this work, we will investigate the architecture of neural networks to solve image restoration problems, taking into account the physical nature and the mathematical model of the inverse problem. The objective is to develop a method capable of producing networks that are adapted to the problem, mixing the advantages of classical approaches with the representation power of neural networks. The study aims for flexible networks that allow for parametrization at the inference in order to provide results adapted to the current task and to the user.

The candidate will explore various CNNs' architectures for the resolution of inverse problems, and in particular he will:

- Include in the network structure the physical model of the degradation (and/or its inversion),
- Incorporate the parameters of these models that can change through time during the inference,
- Develop new architectures to account for temporal correlation (recurrent neural networks, LSTM, ...),
- Focus on deconvolution applications, video super-resolution, and the mitigation of atmospheric turbulence.

The candidate

The candidate must have a Master 2 degree (or equivalent) with background in machine learning, signal/image processing and statistics. Experience with programming in Python is a plus.

Contact

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- Applications are expected before the 15th of April 2019.

References

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