Joining variational and CNN approaches for image colorization.

Phd thesis proposal.

1 Context

In recent years, convolutional neural networks (CNNs) have been successfully used to extremely varied applications. They are very powerful predictive tools that are able of to be trained on large set of data in large dimensions. U-networks are suitable for image editing and can produce results in this area. In the same way, GANs can generate high-resolution results. On the other hand, the artifacts and stability of such methods are still misunderstood by the scientific community. In image editing, variational methods have also been very successful, in particular to solve inverse problems in image processing (tomographic reconstruction, editing image, etc). Contrary to CNNs, they do not enable effective prediction and require good input data. On the other hand, they produce precise results. These last approaches are also more stable and give guarantees on results (e.g. maximum principle) can be provided. Combining the two types of methods would combine the advantages of both.

2 State-of-the-art

The link between variational approaches and CNN has been introduced to solve inverse problems with a regularization based on learning by [2] or to optimize some parameters of optimization scheme [1].

In the case of [2] the neural network is based on a variational method. The learning part is used as a regularizer of the variational model of a reverse problem.

The method developed by [1] consists of a deep neural network whose layers are based on a numerical scheme inspired by a variational model. The learning part helps to improve the convergence of iterations by optimizing the parameters (step time and fidelity-to-data parameter) based on a regression of the input image through deep learning.

The use of CNNs in colorization has led to a significant number of recent contributions. We can divide this literature into two categories of methods. The first ones are based on an evaluation of the statistical distribution of colours [4]. The network computes in each pixel the probability of each color. The seconds take a grayscale image as input and provide a color image as output, mostly in the form of chrominance channels [3]. Some methods use a hybrid of both [5].

3 Research axis

The purpose of the thesis is to combine variational methods with CNN approaches in order to benefit from the ability of CNNs to estimate high-level semantics and increase the accuracy of the result with a variational model. We want to have an approach that combines both the power of CNN prediction and the stability of variational methods. A first approach that we want to develop is to use the CNN to have an initialization of existing variational methods. Afterward, the variational method will be integrated into the learning step. The application subject will be image colorization.

4 Advisors

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References

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