Image Style Transformation Basing on Convolutional Neural Network

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*Abstract*—This document introduces the style changing of drawing piece depends on Convolutional Neural Network (CNN). Consider an image transfer problem that the original image is transfer into desired image. Feed forward Convolutional Neural Network is proposed to solve this problem via training. The desired style of image could be generated by defining and optimizing perceptual loss function which based on high level features extracted from pretrained network. Combination of two approaches for our method of style transformation. The result shows that it is similar optimization-based method. The simple-image super-resolution also gives visually results.

Keywords—Convolutional Neural Network (CNN), Image style transformation, Feed-Forward Neural Network, VGG network, Deep Learning, Super-Resolution

# Introduction

There are a lot of existing problem for image transformation. A system received an image and transfer to another style image. Super-resolution, and colorization provide methods with inputting a noisy image, but outputting in a high-quality image. With image segmentation and image depth estimation, the former methods implement the transformed output scene.

One of the approaches to solve the transformation problem is to train a feed-forward convolutional neural network in a supervised manner. Calculate the loss function for each pixel for measuring the difference between base-image and the output. This has been used by Dong *et al* for super-resolution [1], by Cheng *et al* for colorization [2], by Long *et al* for segmentation [3], and by Eigen *et al* for the depth and surface prediction [4]. This combination of method only needs a forward pass through the trained network because approaches are that efficient. Though it only passes the trained network, however, the losses function used in the method so not get the perceptual difference between output and the base-image. Take the two identical image coordinates from each image, no meter how they are similarly, their perceptual measurement would be very different if measure by each pixel’s losses calculate by loss function.

Recent work has shown that the high-quality image can be generate by *perceptual loss function* via the pretrained convolutional neural networks. They also use the minimizing loss function to approach the generation. This strategy has been used in feature inversion [5] by Mahendran *et al*. On the other hands, the visualization is provided by Simonyan *et al* [6] and Yosinski *et al* [7], and texture synthesis and style transfer by Gatys *et al* [9,10]. The method and implementation help to produce the high-quality image, but the speed is slow for calculation because the solving an optimization problem.

Our goal is to combine the benefits of these approaches. We train a feed forward *transformation* depending only on low-level pixel information because the training time would be long since solving an optimization problem. During the training, perceptual losses measure similarity more robustly than each-pixel losses, and the time measurement is in real-time.

Implement the style transformation by the former discussion. Compare with single-image super resolution. For the transformation, there is no single correct output.

# Related work

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