Image Super Resolution

Team Kota

Mentor - Gowri Lekshmy

Project Details

Team Name - Kota

Topic ID - 7

Members

1.Manvith Reddy - 2018101057

2.Sai Srinivasa Likhit Kota - 2018101043

3.Ainsly Dsouza - 2018101060

4.Anshul Padhi - 2018114013

About the Paper

The paper we are planning to implement is titled “Learning a Single Convolutional Super-Resolution Network for Multiple Degradations” published in CVPR 2018. It is authored by Kai Zhang, Wangmeng Zuo and Lei Zhang.

The paper proposes a general framework with dimensionality stretching strategy that enables a single convolutional super-resolution network to take two key factors of the SISR degradation process, i.e., blur kernel and noise level, as input. Consequently, the super-resolver can handle multiple and even spatially variant degradations, which significantly improves the practicability.

Paper Link : https://arxiv.org/pdf/1712.06116v2.pdf

Introduction

Super-resolution imaging is a class of techniques that enhance the resolution of an imaging system. The process of Super Resolution involves recovering a High Resolution (HR) image from a given Low Resolution (LR) image.

In today's world, image super-resolution is commonly used in the medical domain for better diagnosis, in media platforms for easier transfer of images, for surveillance purposes, etc. Due to the rise of deep learning systems, the problem of image super-resolution has become increasingly popular.

Objective

Through the implementation of this paper, we aim to answer two main questions :

1. Can we learn a single model to effectively handle multiple and even spatially variant degradations?
2. Is it possible to use synthetic data to train a model with high practicability?

To tackle the first question we take into consideration LR input, blur kernel and noise level as input to CNN. However, their dimensionality mismatch makes it difficult to design a single convolutional super-resolution network. In view of this, the paper introduces a dimensionality stretching strategy which facilitates the network to handle multiple and even spatially variant degradations with respect to blur kernel and noise.

To tackle the second question, a large variety of degradations with different combinations of blur kernels and noise levels are sampled to cover the degradation space. In a practical scenario, even when the degradation is more complex, we can select the best fitted degradation model rather than the bicubic degradation to produce a better result. It turns out that, by choosing a proper degradation, the learned SISR model can yield perceptually convincing results on real LR images.

Method

Method Overview

- Pose SISR using MAP framework to be a function of noise, blur kernel and the low-resolution image
- Perform dimensionality stretching on blur kernel using PCA
- Create degradation maps, which are concatenated to the original image
- This modified input is sent through a plain CNN, to show effectiveness of dimensionality stretching
- To explain this more precisely in mathematical notation, we prepared model.pdf which can be found in the same directory.

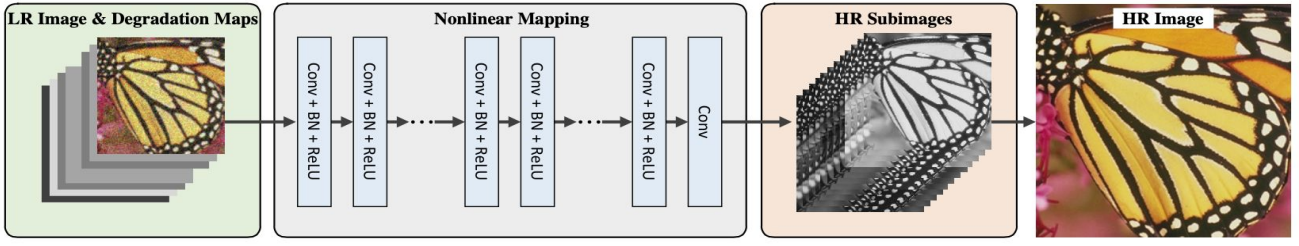
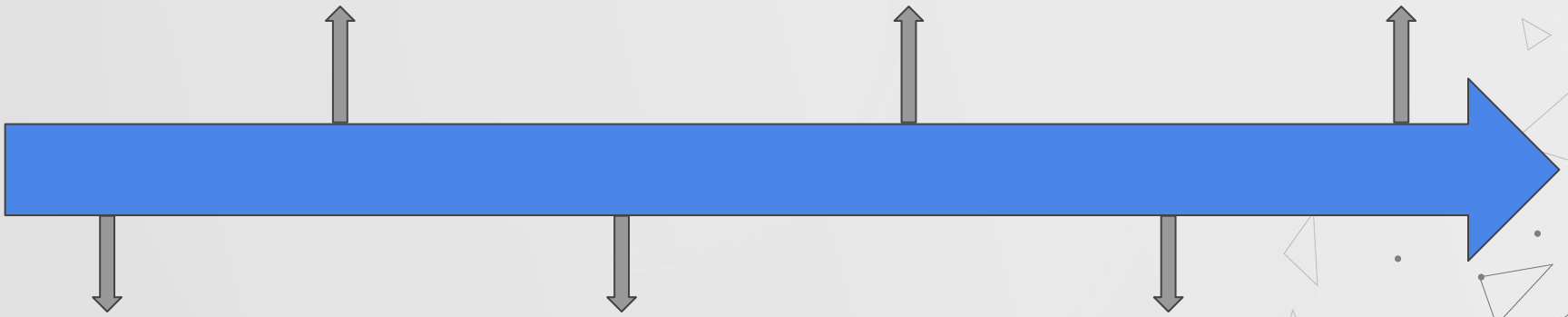


Figure 3. The architecture of the proposed convolutional super-resolution network. In contrast to other CNN-based SISR methods which only take the LR image as input and lack scalability to handle other degradations, the proposed network takes the concatenated LR image and degradation maps as input, thus allowing a single model to manipulate multiple and even spatially variant degradations.

Goals

In this project, we hope to build an effective super-resolution network with high scalability of handling multiple degradations via a single model. Different from existing CNN based SISR methods, the proposed super-resolver takes
both LR image and its degradation maps as input. We hope to show results on synthetic LR images that the proposed super-resolver can not only produce state-of-the-art results on bicubic degradation but also perform favorably on other degradations and even spatially variant degradations. Moreover, we plan to test the results on real LR images(based on availability) and hope to reconstruct visually plausible HR images. In summary, the proposed super-resolver offers a feasible solution toward practical CNN-based SISR applications.

Project Timeline



Find Dataset and program kernels

Take noise, blur kernel and integrate them as part of the input using PCA

Build Baseline Model and test it with Bicubic Degradation

Midsem deliverable

Finetune the Model

Testing model on general Degradations, spatially variant degradations.

Final deliverable

Test Model on Real Images and finetune it