EE 367 Project Proposal
Single Image Super-resolution with Implicit Neural Representations
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Feb 10, 2021

Motivation

Single Image super-resolution (SR) aims to generate a high-resolution output image from a low-resolution input image. SR has abundant applications in high-level computer vision tasks, such as image classification, object tracking and satellite imaging, where high-resolution images are highly needed.

Related work

SR has been really popular over the last decade. Recent research on single image SR also achieved huge progress with the help of deep convolutional neural network and implicit neural representations. Traditional single image super-resolution methods, such as enhanced deep residual network (EDSR) [1] and residual dense network (RDN) [2], rely on up-sampling modules to extrapolate the output image to a fixed scaling factor. In other words, researchers need to train the up-sampling modules every time for different scaling factors. In addition, it is impossible for researchers to extrapolate the low-resolution images to a scaling factor that is not in the training datasets.

With the help of implicit neural representations, [3] proposed Local Implicit Image Function (LIIF) to learn a continuous representation of an image. LIIF takes the 2D coordinate and image feature maps as the inputs and outputs the corresponding RGB values. What's more, LIIF can represent the low-resolution image in arbitrary resolution, achieving state-of-the-art performance.

[4], recently, proposed a novel implicit neural representation with periodic activation function, which largely shortened the training process. [3], on the other hand, implemented 5-layer MLP with ReLU activation functions.

Project Overview

We will use DIV2K datasets [5], which have 1000 images in 2K resolution and their corresponding down-sampling images to $\times 2$, $\times 3$, and $\times 4$. We will implement RDN-LIIF [3] and replace the ReLU activation function in LIIF with periodic activation functions [4]. Hopefully, we will achieve marginal improvement compared with the original implementation in [3].

Milestones and Timeline

Week 1 (Feb 15 – Feb 21): Set up GPU environments on Google cloud platform and implement RDN-LIIF [3].
Week 2 (Feb 22 – Feb 28): Replace the ReLU activation layers in RDN-LIIF [3] with periodic activation functions [4].
Week 3 (Mar 1 – Mar 7): Debug and tuning.
Week 4 (Mar 8 – Mar 15): Debug and tuning.
Week 5 (Mar 15 – Mar 19): Prepare the project poster and report.

References

[1] Lim, Bee, et al. "Enhanced deep residual networks for single image super-resolution." *Proceedings of the IEEE conference on computer vision and pattern recognition workshops*. 2017.

[2] Zhang, Yulun, et al. "Residual dense network for image super-resolution." *Proceedings of the IEEE conference on computer vision and pattern recognition*. 2018.

[3] Chen, Yinbo, Sifei Liu, and Xiaolong Wang. "Learning Continuous Image Representation with Local Implicit Image Function." *arXiv preprint arXiv:2012.09161* (2020).

[4] Sitzmann, Vincent, et al. "Implicit neural representations with periodic activation functions." *arXiv preprint arXiv:2006.09661* (2020).

[5] Agustsson, Eirikur, and Radu Timofte. "Ntire 2017 challenge on single image super-resolution: Dataset and study." *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition Workshops*. 2017.