Research Proposal

Topic: High-resolution image completion/inpainting utilizing deep learning

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1. Background

Image inpainting methods are dedicated to object removal [1] and damaged image repairing. Until now, many methods are proposed for image inpainting, which can be classified into classic methods and deep learning methods. The common methods in classic methods are diffusion-based [2] methods, texture synthesis-based [3] methods, and patch-based [4] methods. Since deep learning has a strong ability to learn adaptive and high-level features, many effective frameworks are proposed to inpaint images with deep convolutional networks (CNNs) [5-7], encoder-decoder networks [8-10] based on CNN, Generative Adversarial Network (GAN) [11-14], and Recurrent Neural Network (RNN) [15]. Deep learning methods can achieve better-inpainted results than classic methods, but there is still some room for improvement. First, as the resolution of the image is higher and higher, the memory consumption will be extremely large. Second, the quality of the inpainted image can not be ensured when the missing area increases. Third, plenty of high-resolution training data is not easy to find to feed the networks.

2. Research Question

This proposal aims to deal with the following issues:
-How to develop a framework that can process the large high-resolution images within a certain memory consumption?
-How to enable the framework to inpaint the large missing area?
-How to use less high-resolution training data to recover high-resolution images?

3. My idea

-Improving contextual attention in [16] and semantic attention [9] to reduce memory consumption.
-Applying and improving lightweight Networks (eg. EfficientNet [17]) to compress memory usage.
-Integrating deep learning with other technologies to achieve better inpainting results, such as tensor decomposition and sparse representation.
-Applying and improving Contextual Residual Aggregation (CRA) proposed in [18] to ensure that less training dataset is required.

4. Methodology

I will study the lightweight networks and design coarse-to-fine-based networks like [18] and

GAN-based networks like [12] with different attention, and figure out how the position of the attention mechanism impacts the performance of a network.

Based on the above research, I will devote myself to seek a comparatively good combination mode between image inpainting and attention mechanism. Then I will try to find some way to integrate the deep learning framework with other technologies to enhance the image inpainting qualities.

Successively, I am going to extend the high-resolution image inpainting methods to remote sensing image reconstruction.

5. Expected results

Developing an image completion/inpainting framework which can obtain satisfactory repaired images. The novel model enables to use limited memory and computing resources to inpaint large images with high resolutions and considerable missing areas. The model enables to be applied on large images after training on the small images, which reduces the demand of the high-resolution training datasets. On that basis, the framework may be used to reconstruct the missing data in the remote sensing images.

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