Single-Image Super-Resolution

MAJOR PROJECT ABSTRACT

Submitted in partial fulfilment of the
requirements for the degree of

Bachelor of Technology
in
Electronics and Communication Engineering

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April 2016

SUPER-RESOLUTION

INTRODUCTION

The central aim of Super-Resolution (SR) is to generate a higher resolution image from lower resolution images. High resolution image offers a high pixel density and thereby more details about the original scene. The need for high resolution is common in computer vision applications for better performance in pattern recognition and analysis of images. High resolution is of importance in medical imaging for diagnosis. Many applications require zooming of a specific area of interest in the image wherein high resolution becomes essential, e.g. surveillance, forensic and satellite imaging applications.

However, high resolution images are not always available. This is since the setup for high resolution imaging proves expensive and also it may not always be feasible due to the inherent limitations of the sensor, optics manufacturing technology. These problems can be overcome through the use of image processing algorithms, which are relatively inexpensive, giving rise to concept of super-resolution. It provides an advantage as it may cost less and the existing low resolution imaging systems can still be utilized.

Super-resolution image can be obtained from multiple low-resolution images of the same scene, as well as from a single image. Different approaches are used in the two types of input to obtain the super-resolved image as explained below.

1. Super-resolution from multiple input images

This approach is based on the idea that a combination of low resolution sequence of images of a scene can be used to generate a high resolution image or image sequence. Thus it attempts to reconstruct the original scene image with high resolution given a set of observed images at lower resolution.

The general approach considers the low resolution images as resulting from resampling of a high resolution image. The goal is then to recover the high resolution image which when resampled based on the input images and the imaging model, will produce the low resolution observed images. Thus the accuracy of imaging model is vital for super-resolution and an incorrect modeling (such as motion) can actually degrade the image further.

2. Super-resolution from single input image

In this approach, the correlation between low resolution images and corresponding high resolution images is learnt from a database of known low and high resolution image pairs. This learning is then applied to a new low resolution image to obtain its most likely high resolution image. As the input available here is lesser than the multiple images super-resolution technique, this method requires more complex algorithms. But multiple images are not available in all cases. Thus single image super-resolution technique finds many applications in forensics, sports, astronomy, crime detection, etc.