Abstract

Nowadays, a low-resolution image gives us the impression of low-tech, old fashion, awkward style and uncertainty. This is particularly true if the image is used for advertising electronic microscopes, in surveillance, for medical diagnosis, or in object recognition. The low-quality face image might devalue a person's beauty and faith. In order to relieve the problem, we may turn the image into a higher resolution, with super-resolution technology. Image super-resolution (SR) usually refers to an increase of the resolution of a single low-resolution (LR) image by up-sampling, deblurring and denoising, while the resultant high-resolution (HR) image should preserve the characteristics of the natural image, such as sharp edges and rich texture. This proposal is on a study of large-scale face super-resolution of small images, or even incomplete images. In this proposal, an incomplete image refers to an image which is so small that it is faint and unclear, and part of the details might be missing. This is a very difficult and ill-posed problem, since a number of unknown pixels have to be inferred from very limited information, say in the case of 16x super-resolution, or even higher.

We propose to investigate large-scale face super-resolution not only because we have fruitful experiences in face recognition and regular face super-resolution, but enlarging a face with good quality is always demanding, and viewers can easily appreciate the effect of good quality. We must stress that results of our investigation should be useful for many applications, such as on-line teaching, video conferencing, remote medical diagnosis, remote operation monitoring, computational photography, video surveillance, multi-media amusement and metaverse. Actually, the resultant techniques can also be generalized (not limited to faces), applying to medical imaging, the development of low-cost electronic microscopes, etc.

We have a strong background in digital signal processing, imaging and video technology, pattern recognition, machine learning and deep learning, which are particularly suitable for this proposal. We start to propose a new and effective deep learning structure with back projection framework for the face super-resolution. Novel arrangement and new algorithms will be proposed with some new techniques in deep learning, including the generation of a latent edge component, back-project strategy, smart arrangement of StyleGAN for high-resolution face generation, attention mechanism for global structure acquiring, etc. The following are some more brief points.

(i) We start with the super-resolution of 64x64 face images to 1024x1024 images.

(ii) Edge quality is important to an image; hence we form latent vector structure which is generated with the assistance of the edge image generated from the original LR image.