A Unified Framework for Full Reference and No Reference Image Quality Assessment (PI: Dr. Zhang Lei; 2012/13)

Objective image quality assessment (IQA) aims to use computational models to predict the perceived image quality by human subjects, and recently it has been increasingly attracting interests from researchers in fields of signal/image processing, computer vision, visual psychophysics, neural physiology and machine learning, etc. Depending on if a pristine reference image is available or not, IQA methods can be classified into full-reference (FR), reduced-reference (RR) and no-reference (NR) ones. In this project we focus on FR-IQA and NR-IQA, while the proposed methods can be readily adapted for RR-IQA. Though some successful FR-IQA methods have been developed, general purpose NR-IQA is much more difficult and is much less matured. In the current research, FR-IQA and NR-IQA are viewed as two rather independent problems, and the natural scene statistic (NSS) models are widely used in NR-IQA algorithm development. However, NSS is not effective to describe the image local quality. Meanwhile, the reference images are involved in the subjective scoring of all the IQA databases available in community, and thus these databases are not truly appropriate for NR-IQA method evaluation. All the above problems make the existing NR-IQA method less reliable and effective.

In this project, a novel framework will be constructed to unify NR-IQA as an FR-IQA like problem. The basic idea is that we could estimate one or more local feature maps of the unavailable reference image from the distorted image and/or its local feature map, and hence the local quality map (LQM) of the given distorted image can still be built, as in the FR-IQA problem. Compared with the commonly used NSS models, which

describe the holistic statistics of an image, the LQM can better characterize the quality of image local structures, leading to more reliable NR-IQA results. The proposed framework is a novel and effective generalization of FR-IQA and NR-IQA studies, while it can improve the performance of both of them. Several key issues of the framework will be deeply investigated in the project, including quality and distortion aware feature extraction, distortion-free feature map estimation, reliable LQM calculation, and robust regression model learning, etc. With some preliminary implementations, our experimental results showed that the proposed framework is very promising, and it leads to competitive performance with state-of-the-art methods. In addition, considering that the existing IQA databases may make the NR-IQA evaluation biased, in this project we will establish a large scale benchmark image database specifically designed for NR-IQA research. Such a database will be the first of its kind and will greatly benefit the IQA community.