Non-local Color Demosaicking, Denoising and Zooming Methods for Digital Color Cameras (PI: Dr. Zhang Lei; 2009/10)

With the increasingly wide use of digital color cameras in our daily life, users are demanding higher and higher image quality to match or even exceed that of traditional film. A vast majority of digital cameras use a single sensor array in conjunction with a color filter array (CFA) for image acquisition. At each pixel only one of the red, green and blue colors is sampled. The reproduction of high-fidelity and high-resolution color images involves three processes: color demosaicking, denoising, and resolution up-conversion. The demosaicking process is to interpolate the missing color components in the CFA image. The denoising process is to remove sensor and ambient noises in image acquisition. If higher than sensor resolution is desired, then resolution up-conversion or digital zooming is performed. Although the above three processes have intrinsic interplays, the current practice is to perform these tasks separately in tandem. This simplistic approach is suboptimal and prone to color artifacts. To overcome the aforementioned drawbacks of the existing technologies for digital cameras, we propose to apply the new non-local image processing methodology to color demosaicking, denoising and zooming. Inspired by the success of non-local-means technique in image filtering, we will first study non-local grouping strategy for CFA images to efficiently exploit the redundancy in the CFA image, and then develop corresponding algorithms for demosaicking, denoising and zooming. Since all the three processes are of the nature of signal estimation, we will treat them jointly under a unified optimal signal estimation framework. The proposed non-local approach for joint demosaicking, denoising and zooming presents a significant departure from the current techniques, and scientifically

more principled. We expect this project to advance the state-of-the-art of image processing for digital cameras and significantly improve the image quality of single chip digital color cameras.