Abstract

The high dynamic range imaging (HDR) techniques can provide excellent visual experience which is comparable to the human visual system, thus it is supposed to be the future of imaging techniques. However, because of the relative slow pavement in development and deployment of HDR display technology, most consumers, who are only equipped with conventional low dynamic range (LDR) displays, cannot benefit from the new imaging technology because the HDR images are not directly viewable on LDR displays. Backward-compatible solutions are needed so that LDR consumers can gradually accept and upgrade legacy LDR imaging techniques to HDR ones.

In this thesis, we provide three backward-compatible solutions in the *acquisition*, *display* and *compression* stages of the high dynamic range imaging pipeline. In the *acquisition* stage, we propose a detail-enhanced exposure fusion algorithm to directly acquire an HDR-like LDR image by merging a bracket of differently exposed LDR images. The acquired LDR image, which preserves information in brightest and darkest regions as well as the find-details of the scene, can provide superior HDR-like visual experience without generating the HDR images. In the *display* stage, we propose an efficient saliency-aware tone mapping operator to reproduce the HDR image on conventional LDR displays. Our method takes the overall brightness, contrast and details preservation and visual attention into consideration. We manage to view

HDR images on LDR displays without degrading its visual quality too much. In the *compression* stage, we propose an two-layer local inverse tone mapping algorithm to estimate an HDR image from its locally tone-mapped version. And we successfully adopt it in HDR image scalable coding to improve the coding efficiency for efficient backward-compatible distribution of HDR images.

In conclusion, our backward-compatible solutions enable LDR consumers to enjoy the superior visual experience provided by the HDR imaging techniques. Our work should be helpful for transition from LDR imaging techniques to HDR ones.