AbstractID: 2258 Title: Rendering considerations: the impact of image rendering on observer preference and performance

Digital imaging technologies acquire image data that is not directly suitable for viewing and diagnostic interpretation. Image rendering, which includes image processing and display, is therefore an essential component of the imaging chain that ultimately links imaging physics to actionable diagnostic findings (medicine). Widely accepted physical characteristics (MTF, DQE, etc) of x-ray detectors provide valuable metrics of potential image quality. While it may seem obvious that increased image quality should provide improved medical diagnosis, the details of this relationship are complex, depending critically on the diagnostic task and scene content as well as the image processing and display components of the imaging chain. The goal of image rendering is to allow the full medical diagnostic potential of the acquired image data to be realized.

Image processing describes a broad range of capabilities. In its simplest form it may involve; image segmentation, tone scale rendering, edge-restoration and equalization. While images similar in appearance to screen-film can be readily produced, the full advantage of digital acquisition can be realized by creating images unlike screen-film images. Optimized tonal renderings have been derived from understanding the acquisition physics, the human visual system, the display characteristics and the diagnostic imaging task. Equalization, which extends visible dynamic range of the image while preserving detail contrast over the full range, has been shown to increase diagnostic quality for a wide range of examinations. Image synthesis from multiple acquisitions can enhance diagnostic capability in a variety of ways. Finally, computer assisted diagnosis provides meta-data in various forms to increase diagnostic performance. The goal is always the same … to allow the full diagnostic potential of the acquired image data to be realized.

Display is the final step in the diagnostic imaging process prior to the human observer. The characteristics of currently available display technologies will be reviewed, including trans-illuminated printed film and emissive displays. Recent advances in display technology have led to dramatic improvements in image quality and operational efficiency. Displays need to be well matched to the needs of the human observer and the diagnostic task. The DICOM standard and emerging display QC standards provide the necessary tools for maintaining overall image display integrity.

Fully understanding and exploiting the multi-faceted connections between imaging physics and diagnostic medicine remains a work in progress. Nonetheless, substantial progress has been made on many aspects of this relationship. In the last decades of the 20th century, image rendering has evolved from an art to a science. Increased understanding of acquisition devices, image processing and displays has without doubt advanced the diagnostic utility of medical images and will continue to do so. Together with better characterization of the diagnostic task, growing knowledge of imaging physics is strengthening our understanding of the link between physics and medicine. The author is an employee of Eastman Kodak Company.

Educational Objectives:
1. To gain an overview of digital image processing methods.
2. To describe and compare the characteristics of display technologies.
3. To understand how image processing and display influence image quality and diagnostic performance.