AbstractID: 2725 Title: Digital Image Processing in Radiography

Digital Radiography Image Processing

Digital radiography systems are capable of capturing a wide range of x-ray exposures in a single image. The wide latitude of these capture devices dictates that images are digitally processed before display. Attempting to directly print or display the full dynamic range of the captured image will result in an image with low contrast that is unacceptable for diagnostic interpretation. Image processing algorithms are used to identify the range of exposures (represented as code values) that correspond to the diagnostically relevant regions, followed by a rendering process to transform signal values in the diagnostically relevant regions to display values. The image processing algorithms need to perform these steps completely automatically, or with a minimum amount of human intervention, to facilitate technologists' workflow. Image processing performance is ultimately gauged by the ability to automatically and consistently generate images of diagnostic quality.

Recognition of the diagnostically relevant exposures consists of segmentation of the collimation, direct exposure, and anatomy regions. This is a challenging computer-recognition problem because several factors cause the characteristics of the image, and corresponding code value histogram, to vary. These factors include the body part and projection, exposure technique, collimation, use of anti-scatter devices, use of contrast media, etc. Robust segmentation will also automatically recognize other features such as prosthetic implants, pacemakers, and left-right markers. Once the image is properly segmented, the signal values for the diagnostically relevant regions are transformed into values for display. Rendering the region of interest for display generally consists of establishing the image grayscale rendition, and signal equalization and contrast enhancement, which is based on spatial frequency decomposition and reconstruction. Because of the tremendous flexibility to render images to different aims, understanding the rendering preferences of radiologists is a critical component of digital radiography image processing. Establishing the aim appearance for different exam types, then adapting the image processing algorithms and database parameters to automatically and consistently deliver the preferred rendering, will affect both the technologists' and the radiologists' satisfaction with the capture device.

This course will review fundamentals of image processing for digital radiography. Specific course content will include a discussion of radiographic image segmentation, correlation of image content with different regions of the histogram, and a review of image-rendering functions, including the tone scale, spatial frequency methods to enhance contrast, and signal equalization. The course will also include a review of the role of image processing in the end-to-end image chain (capture through interpretation), with considerations for image quality performance of different capture and display devices, the effect of the human visual system and ambient viewing conditions, and grayscale calibration.