

Abstract

Title: Digital Fluoroscopic Imaging: Acquisition, Processing, and Display

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Digital fluoroscopic imaging has been clinically available since the mid 1970's, and continues to play a valuable role in the acquisition of dynamic x-ray image sequences for a variety of diagnostic procedures. Acquisition devices are historically based on the high gain, low noise image intensifier (II), but flat-panel detectors now have capabilities that approach the II/TV system in terms of image quality (although at a higher entrance exposure per image), with inherent advantages of smaller size, larger field of view, and fewer geometrical distortions. Image processing and display of digital fluoroscopy sequences are crucial for optimization of information at the lowest possible radiation dose, regardless of the detector.

Signal amplification, sampling, and bit depth requirements of analog to digital conversion are considered in terms of minimizing quantization errors and defining spatial resolution in the image. Processing algorithms are described generically: in terms of noise reduction by temporal data averaging and low-pass filtering; in terms of contrast and spatial resolution enhancement by look-up-transformations and high-pass frequency processing methods; and in terms of isolating temporal and energy dependent changes from superimposition of anatomy. Details of digital subtraction angiography (DSA) are explained regarding motion compensation with re-masking or sub-pixel shifting and quantitative measurements (e.g., relative stenosis, volumetric densitometry). Geometric and non-linear degradations inherent in the detector design, acceptance of x-ray and light scatter that affect quantitative accuracy, and potential methods for correction are described. Discussion of image display requirements, calibration, and data archiving issues conclude the presentation.

Objectives:

1. Review recent advances in equipment technology for fluoroscopic image acquisition
2. Illustrate acquisition requirements for achieving optimal digital image quality
3. Discuss image processing techniques used in fluoroscopic and interventional procedures
4. Describe display requirements and storage needs necessary for a fully functional digital fluoroscopy system in an electronic imaging environment