A SLOW-SCAN VIDEO TECHNIQUE FOR DIGITAL INTRAVENOUS SUBTRACTION ANGIOGRAPHY

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Generalized subtraction techniques with image intensified videofluoroscopy have successfully been used to isolate the small signals provided by intravenous injection of iodinated contrast materials.

Presented first are the fundamental contrasts of iodine signals within varying amounts of patient attenuation using broad-beam X-ray spectra. For these calculations, it was important to detail a computer program in order to study the behavior of X-ray spectra in various radiographic situations.

Theoretical calculations showing image intensifier, television, and digital imaging processor requirements for subtraction imaging are presented. Because of the limitation in spatial resolution of a 256 x 256 pixel array system (inherent to the design of the processor used for imaging and measurement), a method that provides higher spatial resolution by using a "hybrid" combination of digital storage and analog video subtraction is demonstrated.

The X-ray fluence to the patient depends on the desired visibility of vessels containing contrast. The limitations to subtraction angiography are presented, including the required exposure to the image receptor, and the resulting X-ray tube loading and exposure to the patient.

Finally, a slow-scan video technique (one eighth of standard) for imaging is demonstrated; it is usable for those cases where images need be formed only at rates of less than two per second. Television noise considerations are discussed, showing the advantages associated with bandwidth reduction. Television performance characteristics at slow-scan rates are measured and compared with standard-rate operation. The slow-scan method is theoretically shown to provide improvement in signal to noise of two over that of standard rate and, when measured experimentally, to be slightly better than the quality provided by four-field integration (improvement of 2) for a 256 x 256 pixel array system. A system for imaging is described; the methodology for imaging, including some illustrative examples of patient imaging, concludes the discussion.