OPTIMIZATION OF SELECTIVE EXPOSURE RADIOGRAPHY OF THE CHEST

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A major technical limitation in conventional chest radiography is the mismatch of the x-ray transmission dynamic range with the useful exposure range of a radiographic film when a patient is presented with a uniform incident exposure field. When the lung is imaged with adequate film densities, the less transmissive areas such as the heart, mediastinum, and subdiaphragmatic areas suffer from reduced contrast since they lie in the toe of the characteristic curve. Several investigators have shown dramatic improvements in image quality by compressing the dynamic range through the use of heavy metal compensating filters. However, these filters are not routinely used because of difficulties in fabricating and positioning them rapidly for individual patients. The goal of this project is to develop a faster and more reliable "selective exposure" system to fabricate and position a compensating filter (or digital beam attenuator, DBA) for clinical use.

The essential components of this system include a dose efficient test-image detector, a special purpose field grabber (image memory), a custom made fast printer, a transport channel, and a computer. The fabrication process begins with acquisition of a 64 x 64 format low-dose patient image which undergoes corrections for detector nonunformity and scatter. The corrected data after log transformation are used to calculate thickness of filter material needed to compensate for the image dynamic range. Using this thickness information the computer controls the printer which fabricates an attenuator by overprinting multiple layers of cerium oxide on a 35 mm film substrate. Although the images are acquired in a 64 x 64 format, the attenuator is constructed in a dithered 16 x 16 format using a special algorithm. After fabrication, the attenuator is automatically conveyed through the transport channel and is positioned in the x-ray beam between the collimator and x-ray tube before the final compensated radiograph is taken.

Our initial experience indicates that the attenuator could be fabricated in less than a minute although further reduction in time is possible. Such a system with certain modification may retrofit to the existing chest units for regular clinical use.