ADAPTIVE IMAGE PROCESSING ALGORITHMS FOR INTRAVENOUS DIGITAL SUBTRACTION CORONARY ANGIOGRAPHY (FILTERING, PATTERN RECOGNITION)

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Due to physically and temporally superimposed iodinated cardiac and pulmonary structures in addition to several other limitations, visualization of coronary arteries following intravenous contrast injections is extremely difficult. This investigation was undertaken to address the problem of overlying opacified pulmonary veins which provide distracting background during intravenous digital subtraction coronary angiography. To cope with this problem, we have developed an adaptive image processing technique based on temporal pattern recognition in which the degree of similarity between the contrast pass curves in individual pixels and a reference region is used to adaptively suppress pulmonary structures.

The adaptive processing begins with a phase-matched coronary image sequence obtained from an intravenous DSA examination of a dog. Using a digital video image processor (DVIP II) and a special-purpose decision circuit, a sum-of-squared-deviations (SSD) parametric image with pulmonary veins (PV) as reference is acquired and employed as a template for selectively eliminating the unwanted contrast. Pixels which are highly correlated with the pulmonary veins have small SSD values and are adaptively suppressed. However, other structures such as coronary arteries having SSD values above a temporal threshold are passed without modification.

Animal studies using dogs demonstrate that after adaptive processing, the overlying pulmonary veins are removed while other structures including coronary arteries are relatively unaltered. With the removal of confusing pulmonary structures, the conspicuity of coronary arteries is enhanced. Nevertheless, artifacts are often produced in regions of overlap between the coronary arteries and other interfering structures such as large pulmonary veins when a single SSD template with PV as reference is used. A composite template approach using a linear decision function obtained from a linear combination of two SSD images is employed to restore the coronary contrast. In addition, a repetitive dynamic display of adaptively processed images has shown to be useful not only in helping identify coronary arteries from artifacts and random noise but in improving the coronary signal-to-noise ratio due to eye integration.