Diagnostically Lossless 3D Wavelet Compression for Digital Angiogram Video

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ABSTRACT
A novel method for the compression of angiogram video sequences is presented. The approach consists of a 3D wavelet encoding algorithm, incorporating a region of interest (ROI) estimation model to provide higher-quality image reconstruction in areas considered to be diagnostically significant. This is coupled with a texture modelling procedure, which provides a model for some of the high frequency wavelet coefficients corresponding to diagnostically insignificant regions. This allows some of the wavelet coefficients to be represented extremely efficiently. The results are evaluated by trained cardiologists with promising results.

1. INTRODUCTION
The storage requirements for digital coronary angiogram video are very demanding. A typical procedure of 5 minutes, taken at 30 frames per second for 512x512 pixel images results in approximately 2.5GB of raw data. To enable more efficient storage and transmission of such data, compression is highly desirable. This paper presents such a compression approach based on the 3D SPIHT\(^1\) algorithm.

2. METHOD SUMMARY
The proposed method can be summarised by the 3 main stages:

**ROI Detection:** The regions of the image that may contain diagnostically significant information are identified. This is done by exploiting differences in image motion of the important coronary related areas that are affected by motion attributed to the beating of the heart, and other areas affected by the background image motion. This motion estimation process is achieved using a robust estimator scheme.

**SPIHT Compression:** A wavelet-based approach based on the 3D SPIHT algorithm is used to compress the angiogram video. In this case we incorporate a ROI operator which removes from the two highest wavelet pyramid levels of the wavelet decomposition all of the coefficients corresponding to areas outside the ROI.

**Texture Modelling:** A texture modelling approach is applied to model the wavelet coefficients not explicitly encoded by the SPIHT compression method.

3. RESULTS
The results were evaluated using perceptual techniques. A group of cardiologists were asked to grade a set of compressed images as compared with the original images. The proposed method was compared against the conventional 3D SPIHT approach, over which a consistent performance gain in perceived image quality was measured.