

Scene Adaptive Video Watermarking

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WATERMARKING

- **What is Watermarking?**
 - the insertion of a “controlled” amount of distortion is introduced into a multimedia element
- **Where are watermarks used?**
 - digital cameras
 - DVD video
 - audio (SDMI)
 - broadcast video (in US - ATSC)
 - “binding” mechanism for multimedia databases
 - key distribution systems
 - preventing forgery of bank notes
- **Used as a complementary technique to encryption**
 - for example, when media is converted to an analog representation
- **Elements of a watermarking system:**
 - the watermark (what is inserted)
 - embedding technique
 - verification or detection technique
- **Important Issues**
 - transparency
 - robustness (not necessary for fragile watermarks)
 - capacity (how much data can be hidden)
- **Attacks**
 - compression
 - filtering
 - printing and rescanning
 - geometric attacks - cropping, resampling, rotation
 - collusion - spatial and temporal
 - conversion to analog

VISUAL MODELS

- **Robustness Tradeoff**
 - transparency \Rightarrow weaker embedding
 - delectability \Rightarrow stronger embedding
- **How do you satisfy both of these?**
 - use human visual system model - embed the watermark in areas that not “seen” by the observer
 - a visual model predicts how sensitive a region of an image or a video sequence is to distortions
 - there are many human visual properties that have been studied, such as luminance sensitivity, frequency sensitivity, and contrast masking.

IMAGE ADAPTIVE WATERMARKING

- **Advantages of employing a visual model:**
 - more information can be embedded for a given level of perceived distortion.
 - the embedded watermark is image-dependent, and is more robust against re-watermarking or forged watermark attacks.
 - the embedded watermark is more robust to “normal” signal processing, such as lossy compression.

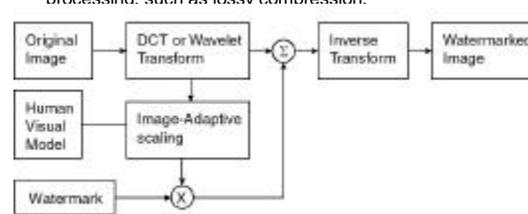


Image-Adaptive DCT Watermarking of “Fruit”



Original Watermarked Difference

Image-Adaptive DCT Watermarking of “Girls”



Original Watermarked Difference

Image-Adaptive DCT Watermarking of “Peppers”



Original Watermarked Difference

VIDEO WATERMARKING

- **A video sequence cannot simply be treated as an ordered collection of images:**
 - visibility issues in the use of “still” image watermarks
 - visibility issues in stop frames
 - human perception of motion is not accounted for in visual models for still images
 - embedding the same watermark in all the frames of a video sequence is not secure, an attacker can correlate across the entire sequence to estimate the watermark (temporal collusion)
 - embedding completely different watermarks in successive frames of a video sequence is not secure
 - successive video frames are highly correlated, an attacker can exploit this to estimate and remove a watermark
 - The techniques for compressing video do not necessarily encode each frame of the sequence identically
 - The synchronization of the audio with the video sequence may be a consideration for watermark protection

The Goal of this project is to develop a temporal masking model of the human vision system that addresses the above issues.

PRELIMINARY RESULTS



Original

Watermarked