香港浸會大學理學院
HKBU Faculty of Science

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DEPARTMENT OF COMPUTER SCIENCE

PhD Degree Oral Presentation

PhD Candidate:	Mr Hao Tian WU
Supervisor:	Dr Yiu Ming CHEUNG
External Examiner:	Prof Xiamu NIU Prof Lenan WU
Time:	3 September 2007 (Monday) 10:00 am – 12:00 nn (35 mins presentation and 15 mins Q & A)
Venue:	R905, Conference Room, Sir Run Run Shaw Building, HSH Campus

"Information Hiding for Media Authentication and Covert Communication"

Abstract

In the past decades, data hiding on the media content has been studied for a variety of applications. In this thesis, we investigate several problems on information hiding for media authentication and covert communication, termed as fragile watermarking and steganography, respectively.

On fragile watermarking, we firstly review the existing data embedding methods, through which we sketch out the inherent properties of using information hiding for media authentication. Moreover, the general procedures of some public-key authentication schemes are given. To enhance the security of using the quantization-based hiding for private authentication, a sequential quantization strategy (SQS) is proposed to improve the sensitivity of the embedded watermark to illegal modifications while preserving the property of semi-fragility, e.g. resistance to some content-preserving processing. For mesh authentication, two different algorithms are developed for 3D triangle meshes and arbitrary polygonal meshes by modulating the chosen primitives to embed a semi-fragile watermark, respectively. The optimal mesh traversal strategy is proposed to reach the upper bound of capacity and the SQS is adopted to enhance the security. Furthermore, the public-key scheme with the LSB replacement is applied to 3D mesh models for public authentication.

To perform the authentication in a distortion-free way, the technique of reversible data hiding is studied: (1). A new difference expansion algorithm is proposed by using the neighborhood of an element in the cover object for prediction. It is shown that our algorithm is more suitable for the high information-rate applications and we further apply it to 3D mesh models by expanding the difference between a vertex position and the one predicted from its traversed neighbors. (2). A quantization-based algorithm is also developed by reserving the modulation information in the watermarked signal so that each element of the

original one can be recovered with the smallest error. Provided that the redundancy in the watermarked signal can be exploited to save the error information, the exact recovery can be performed. In addition to the authentication applications, reversible data hiding can also be used for content annotation in the archiving applications.

As for steganography, we propose a quantization-based data mapping method to hide a piece of secret message into a cover object, which can be a digital media such as audio, image, video, text, geometry, etc. By quantizing the distribution range of the data elements in the cover object into the non-overlapping bins with the same size, two adjacent bins are utilized to form an individual embedding unit, in which the data elements are mapped to each other for data embedding. Different from the previous data hiding methods such as the least significant bit (LSB) replacement and the quantization index modulation (QIM) scheme, there is no new value generated in the stego object so that the cover distribution is inherently preserved. Our method can be implemented on the cover object with the discrete or continuous distribution and the perceptual distortion of the stego object can be minimized in terms of the mean squared error (MSE). Some image staganalysis algorithms (including the sample pair analysis using the high-order statistics) can be well evaded by implementing our method on the set of pixels in which one's neighbors are with the same values as those of another one.

***** ALL INTERESTED ARE WELCOME *****