

Scalable watermark extraction for real-time authentication of JPEG 2000 images

Charith Abhayaratne · Deepayan Bhowmik

Received: 7 October 2010 / Accepted: 2 August 2011 / Published online: 18 August 2011
© Springer-Verlag 2011

Abstract This paper proposes a novel scalable authentication scheme that utilizes the progressive enhancement functionality in JPEG 2000 scalable image coding. The proposed method first models the wavelet-based quality scalable coding to identify the effect of the quantization and de-quantization on wavelet coefficient magnitudes and the data embedded within such coefficients as a watermark. A relationship is then established between the watermark extraction rule and the embedding rule, using the magnitudes of the reconstructed and original coefficients. It ranks the wavelet coefficients according to their ability to retain the embedded watermark data intact under various quantization levels corresponding to quality enhancements. Then watermark data is embedded into wavelet coefficients according to their rank followed by JPEG 2000 embedded coding. At the decoder as more and more quality and resolution layers are decoded the authentication metric is improved, thus resulting in gradually increasing complexity of the authentication process according to the number of quality and resolution enhancements. The low complexity authentication is available at low quality low resolution decoding, enabling real-time authentication for resource constrained applications without affecting the authentication metric. Compared to the existing methods, the proposed method results in highly robust scalable authentication of JPEG 2000 coded images.

Keywords Scalable authentication · Wavelet-based watermarking · JPEG 2000 · Quality scalability · Watermark robustness

1 Introduction

Image authentication based on watermarks involves embedding an unique logo or a fingerprint data into the host image and extracting them at the time of authentication. Influenced by its success in scalable image coding, the discrete wavelet transform (DWT) has been widely used in image watermarking [1–21]. Based on the embedding methodology, wavelet-based image watermarking can be categorized into two main classes: uncompressed domain algorithms [1–13] and joint compression-watermarking algorithms [14–21]. In the former, the authentication requires decoding the image to its pixel level to perform the forward DWT (FDWT) again to extract the watermark to carry out authentication. This two step process increases the complexity of the authentication and makes it difficult for real-time authentication. The second approach integrates watermarking into the compression process, mainly considering JPEG 2000 [22], by avoiding the repeating of the FDWT. The watermark is embedded into quantized wavelet coefficients followed by embedded coding. Although their main aim is to improve the robustness of watermarking to JPEG 2000 compression, these algorithms do not utilize the quality and resolution scalability functionalities available in JPEG 2000. JPEG 2000 Part 8 (ISO/IEC 15444-8, T.807) Secure JPEG 2000 (JPSEC) [15] specifies a framework, concepts, and methodology for securing JPEG 2000 bit streams considering capabilities of JPEG 2000 and also proposes watermarking in the coding pipeline with aim of achieving high robustness as a solution [21, 23].

C. Abhayaratne (✉) · D. Bhowmik
Department of Electronic and Electrical Engineering,
The University of Sheffield, Sheffield S1 3JD, UK
e-mail: c.abhayaratne@sheffield.ac.uk

D. Bhowmik
e-mail: d.bhowmik@sheffield.ac.uk