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A NOVEL REVERSIBLE WATERMARKING METHOD USING PRE-SELECTION STRATEGY

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Abstract. *The histogram shifting based reversible watermarking method manipulates the prediction error of the pixels either to avoid overlapping or to embed the watermark. The embedding distortion of this kind of methods is mainly introduced by the pixels with large prediction error. In this paper, we employ the gradient-adjusted predictor (GAP) to improve the prediction efficiency and present a pre-selection algorithm to decrease the number of large prediction errors in the embedding process. Consequently, the embedding distortion is greatly reduced in the encoder. In addition, in order to obtain the optimal embedding thresholds, we design an earning-cost ratio (ECR) based selection algorithm whose computation complexity is much lower than that of the traditional iterative method. Experimental results verify the superiority of the proposed method by comparing with some existing schemes.*

Keywords: Reversible watermarking, Histogram shifting

1. **Introduction.** Digital watermarking for copyright protection and content authentication has become one of the most important issues in the digital world [1, 2]. Usually, the watermarking algorithms introduce irreversible distortions to the host image during the embedding process. Even though the embedding distortion is slight and imperceptible, it is still unacceptable to some high-fidelity applications. For example, any modification to the original image caused by the medical image processing may affect a doctor's diagnosis and lead to legal problems. Therefore, this requirement arouses the common interest in the so-called 'reversible watermarking' technique, which is able to perfectly recovery the host image in the decoder [3, 4, 5].

One objective of the reversible watermarking is to embed the desired watermark while keeping the distortion low. Thus, reversible watermarking methods are commonly evaluated by the embedding capacity and the embedding distortion. In most cases, the embedding capacity-distortion curve is constructed to evaluate the performance of the watermarking algorithm. There are huge reversible watermarking algorithms having been presented in the literature. Tian's difference expansion (DE) method [6] is the foundation of many following reversible watermarking algorithms. The DE method expands the difference of two adjacent pixels to carry one bit of watermark. Owing to the correlation between the neighboring pixels, this difference usually has small magnitude. Thus, the DE method introduces low distortion to the host image. In addition, Tian designed the location map technique, which is widely adapted by the following reversible watermarking algorithms, to solve the overflow/underflow problem. Notice that, the maximum embedding capacity of the DE method is 0.5 bits per pixel (BPP) because two adjacent pixels are utilized to embed one bit of watermark.