

Vertex angle image watermarking with optimal detector

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Abstract This paper presents a robust image watermarking method based on geometric modeling. Four samples of wavelet approximation transform on each image block along with the mean value of other coefficients on that block are modeled as three points in 2-D space. The length and width coordinate of the point associated with the mean value are equal. Two line segments with a shared endpoint can be drawn using these three points. The vertex angle formed between the line segments is utilized as a watermarking variable. In order to embed message bits, the vertex angle is altered by displacing of points. To preserve the imperceptibility of the watermark, geometrical tools are elegantly used to minimize the embedding distortion. Moreover, Maximum likelihood decoder is implemented at the receiver side. To this end, the probability density function of the noisy embedded angles is well approximated by the *Beta* distribution for wavelet approximation coefficients of images. Due to embedding in the vertex angle, the proposed scheme is not vulnerable to the gain attack. Using the low frequency components of the image blocks and the mean value of each block makes the proposed method robust to the noise and compression attacks. Experimental results confirm the validity of the theoretical analyses given in the paper and show the superiority of the method in contrast to similar techniques in this field.

Keywords Image watermarking · Vertex angle · Maximum likelihood detector · Gain attack

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