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Abstract

A novel digital watermarking technique for color images using magic square and ridgelet transforms is designed, developed, tested, and described in this book. The novel feature of the method is to generate and use multiple copies of the digital watermark. This is tested for embedding digital watermark into color cover images and resulted in very high PSNR value and yielded comparable results with existing watermarking techniques. The book also deals with fractal coding technique for enhancing the robustness of the watermark techniques.

Six different techniques are designed, developed, and tested leading to the technique using magic square and ridgelets. Two other techniques are designed, developed, and tested using fractals. Chapter 1 discusses the fundamentals of digital watermarking like definitions, history, life cycle, properties, applications, classification, problems, and benchmarking.

Four digital watermarking techniques (image watermarking using curvelet transform (WCT), watermark wavelets in curvelets of cover image (WWCT), resized watermark into curvelets of cover image (RWCT), resized watermark wavelets into curvelets of cover image (RWWCT)) based on curvelet transform are discussed in Chap. 2. In WCT both the embedding and extraction procedures are discussed, where the watermark is embedded into the curvelets of the color cover image. In WWCT the wavelets of watermark are obtained. These wavelets are embedded into the color image curvelets. In the RWCT the watermark is resized based on magic square technique and then embedded into the color image curvelets. In RWWCT the resized watermark obtained through the magic square procedure is transformed through wavelet transformation and then the wavelets are embedded into the curvelets of the cover image. The results indicate that the embedding and extraction procedures of WWCT and RWWCT are much superior to WCT and RWCT. The regeneration of watermark image is satisfactory, but lossy.

Two more techniques (image watermarking based on magic square (MST) and image watermarking based on magic square and ridgelet transform (MSRTT)) are discussed in Chap. 3. In the MST the watermark image is resized through the magic square procedure and was embedded into the color cover image. In the MSRTT the resized watermark is transformed by ridgelet transformation. The color cover image

is also transformed by the ridgelet transformation to obtain cells consisting of displacement and angle. The displacement values of watermark cells are added to cover image displacement values and the watermarked image is generated. The results indicate that the embedding and extraction procedures of MSRTT are superior to MST. The regeneration of watermark image is satisfactory, but lossy.

Two more techniques (digital image watermarking using fractals (DWF)) and digital image watermarking based on fractals and curvelets (DWFC) are discussed in Chap. 4. In DWF, the host image is encoded by the proposed fractal coding method. To embed the watermark evenly over the whole host image, specific range blocks are selected. Then, the scrambled watermark is inserted into the selected range blocks. Finally, the watermarked image is obtained by the fractal decoding method. In DWFC, the technique implements curvelet transform on the original color image to obtain curvelet coefficients. These coefficients are then transformed by using 2-level DWT to get LL2 and LL1 low-frequency sub-bands. The mutual similarities between LL1 and LL2 sub-bands are considered for embedding watermark. The obtained watermarked image has better quality when compared to a few exiting methods. The results indicate that the embedding procedures of DWF and DWFC are superior to MSRTT and extraction procedures of DWF and DWFC are comparable to MSRTT. The regeneration of watermark image is satisfactory.

Conclusions and future scope of work are discussed in Chap. 5. It is suggested that further work can be done in the following areas.

- The methods are tested only for compression attacks, so the techniques can be tested for various other image processing attacks like cropping, scaling, and rotation.
- The methods can be implemented and tested for video and audio watermarking.

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"I've been blessed to find people who are smarter than I am, and they help me to execute the vision I have."—Russell Simmons

From the desk of Dr. C.R. Rao

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From the desk of Dr. M.V.N.K. Prasad

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