Chapter 7

Conclusions and Future Work

In recent years, many watermarking algorithms have been developed. Still, several important and difficult problems are not fully resolved. In this thesis, through the DCT-domain coefficient selection framework we investigate the important watermarking design issues including robustness, detection reliability, imperceptibility, and data payload. We focus on the data payload and detection reliability issues under the combined criteria of watermark robustness and imperceptibility. An iterative procedure is proposed for identifying the effective coefficients under a specified attack to ensure both high detection reliability and watermarking robustness, while the image fidelity is retained.

Although the iterative procedure can pick up the nearly optimal transform coefficients for watermarking purpose, it requires a large amount of computations. Often, fast algorithms are needed for real-time applications. Therefore, a set of simple and fast coefficient selection rules is further proposed to reduce the computational complexity in the previous scheme; in the meanwhile, the performance loss is quite small. These rules are derived from the theoretically optimized data with the aid of parametric classifiers.

Finally, we tackle the problem of geometric invariant image watermarking with blind detection. The proposed robust digital image watermarking scheme aims at resisting both geometric distortion and signal processing attacks. This scheme is designed using the image feature extraction and image normalization techniques.

As for the future work, there are several problems worth further investigation.

● The first problem is blind detector for optimal watermarking coefficients. How the optimally selected coefficients on the embedding side can be made known to the watermark detector without referencing to the original host data or other side information. This problem is difficult due to the fact that these coefficients are strongly host data dependent.

● To improve the watermark robustness, all blocks are embedded with the same copy of the watermark in the watermarking scheme presented in Chapter 6. Sometimes, the watermark detector design could be improved under the consideration of copy voting issue.

● In Chapter 6, the performance could be further improved if the feature points were more robust. Thus, one direction of future research can be the search for more stable feature points and/or more reliable extraction algorithms under severe geometric distortions and scaling attacks.