基于密文域扩展和 DNA 双向编码的可逆水印算法

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摘　要：在综合考虑可逆水印算法的鲁棒性和嵌入容量的基础上，提出一种基于密文域扩展的加密域可逆水印算法，该算法不仅保证了高鲁棒性，还使嵌入容量高达 8.0625dB.首先，基于 IWT 和 DNA 双向编码完成对二维载体图像和二维水印图像的加密，然后，基于密文域扩展将加密后水印嵌入加密后载体图像，最终，二维载体图像扩展为含水印的三维图像，算法完成.采用 SSIM 评价指标对图像的恢复质量进行分析，SSIM 值为 1 说明文中算法实现了完全可逆，求得文中算法的嵌入容量为 8.0625dB，远大于其他文献，鲁棒性分析显示文中算法具有较好的鲁棒性.该算法在保证原始载体内容安全的前提下实现了密文域中水印信息的完全可逆性及原始图像的无损恢复.

关键词：可逆水印； IWT ； DNA 双向编码 ；密文域扩展 ；鲁棒性

Reversible watermarking algorithm based on ciphertext domain extension and DNA bidirectional coding

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Abstract： Based on the comprehensive consideration of the robustness and embedding capacity of the reversible watermarking algorithm，A cryptographic domain reversible watermarking algorithm based on ciphertext domain extension is proposed. This algorithm not only ensures high robustness， but also makes the embedding capacity as high as 8.0625dB. Firstly， the two-dimensional carrier image and the two-dimensional watermark image are encrypted based on IWT and DNA bidirectional encoding. Then， the encrypted watermark is embedded into the encrypted carrier image based on the ciphertext domain extension， and finally， the two-dimensional carrier image is converted into a watermarked image. Three-dimensional image，the algorithm is completed.The SSIM evaluation index is used to analyze the restoration quality of the image. The SSIM value is 1 and the algorithm is completely reversible. The embedding capacity of the algorithm is 8.0625dB， which is much larger than other literatures. The robustness analysis shows that the algorithm is better. The algorithm achieves the complete reversibility of the watermark information in the ciphertext domain and the lossless recovery of the original image under the premise of ensuring the security of the original carrier content.

Key words： reversible watermarking; IWT; DNA bidirectional coding; ciphertext domain extension; robustness

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