

# Chapter 9

## Securing Digital Photography Images by Encryption– Watermarking CFA (Color Filter Array) Images

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### **ABSTRACT**

*Research in image processing of digital color photography is in full expansion, especially on CFA (color filter array) images. These raw CFA images are very important for image analysis because they have not undergone any processing (interpolation, demosaicking, etc.) that would alter their reliability. The chapter presents three robust hybrid algorithms combining chaotic encryption and blind watermarking techniques of CFA images based on the quaternionic wavelet transform (QWT) to propose solutions related to the problems of confidentiality, security, authenticity of these images transmitted over digital networks, the size of some CFA images, and the large amount of data to be transferred in a non-secure environment where resources in terms of throughput and bandwidth are quite limited. The three hybrid algorithms were implemented simultaneously and successively.*

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## INTRODUCTION

Today's digital networks are so highly developed that they have become an essential communication medium. They enable the transmission of all kinds of information: text, sound and above all, images. The increased use of the latter is reinforced by the emergence of cameras, digital cameras, cell phones, scanners and IRM.

The rapid development of communication technologies and image-processing tools raises a number of important issues: illegal distribution, duplication, falsification, confidentiality and so on. Authors and providers of multimedia data are reluctant to allow their data to be distributed in a networked environment because they fear unrestricted duplication and dissemination of copyrighted material.

These problems have prompted a number of researchers to take an interest in securing digital data through various protection techniques such as steganography, encryption, watermarking and even encryption-watermarking. The hybrid method of encryption-watermarking is the one we'll be studying in our work with a view to *i)* ensuring the secure transfer of digital photographic images *ii)* achieving a better compromise between invulnerability (robustness and security) and the amount of information to be embedded (capacity and imperceptibility).

To meet these needs, a new line of research is rapidly developing: hybrid encryption-watermarking algorithms. In this work, our contribution is to propose three robust hybrid algorithms combining chaotic encryption and blind watermarking of CFA images based on the quaternionic wavelet transform (QWT) to solve the various problems posed in our approach.

Although the hybrid encryption-watermarking algorithm is a new line of research, it has gained a lot of attention and evolved very rapidly. In the literature, several efficient encryption-watermarking methods have been developed, satisfying certain conditions depending on the problem at hand. However, earlier work includes that of Puech et al. (2001), who proposed a hybrid encryption-watermarking technique for secure image transfer. After generating a key to encrypt the image, they watermark this encrypted image with two components: the encryption key and the text data associated with the image. Puech et al. (2001) present a combination of image encryption and watermarking techniques. They proposed a system for securely transferring medical images by generating a key to encrypt the image, then watermarking the image with the encryption key and patient data. Autrusseau et al. (2003) present an algorithm for Mojette encryption-watermarking of medical images. This algorithm is a combination of watermarking based on the Mojette transform (MT), the Fourier transform (FT) of an image, and Mojette encryption so as to memorize the list of unambiguous matches during direct MT, then keep a unique path in this list, then scramble (encrypt) unused bins and finally drown in encrypted data, the plaintext data kept. Puech and Rodrigues (2005) present a new method

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