Chapter 15
Intelligent Watermarking for Data Security: An Overview

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ABSTRACT

Artificial intelligence has become widely and increasingly used in various advanced applications, notably classification, optimization, object recognition, and segmentation. Recently, it has been extended into watermarking techniques. It brings some approaches implying innovative security means, which are adjusted to new communications and information technologies. As it generally believed that the use of artificial intelligence in digital watermarking schemes could revolutionize the way digital data is protected. This chapter is about an overview of recent developments in artificial intelligence techniques utilized for watermarking. It begins with the watermarking background. Next, it represents a review of machine and deep learning watermarking techniques followed by a delineation of their advantages and disadvantages. In this light, the main problems are pinpointed with a suggestion of some possible discussed and highlighted solutions. The last point of this chapter is about outlining future research directions.

INTRODUCTION

Artificial intelligence (AI) is the process of developing and implementing a number of techniques designed to enable computers to imitate human intelligence. Artificial intelligence (AI) offers many benefits and can have a significant impact on various sectors for improving efficiency and productivity, and for making faster and more accurate decisions. In this context machine learning and deep learning has become a promising solution for solving various intelligence related problems. It can be actively used for watermarking (Cox,2002) which is defined as a technique that involves inserting a message, logo or

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signature into digital data. The objective is to make it possible to verify the assertion of ownership, the content authentication or the copy Control. Watermarking techniques based on artificial intelligence algorithms are called Intelligent Watermarking (IW) techniques.

Classic watermarking techniques have been the subject of a great deal of research and overview. (Cox, 2002), (Podilchuk, 2001), (Mahto,2021),(Kumaraswamy,2020). However, a limited number of studies have been concerned with intelligent watermarking. In his book (Pan, 2004), Pan gives a general introduction of digital watermarking by focusing on its areas of use, categories and other various characteristics. He ends with listing a number of classic watermarking methods. Solely, the last part of his book is kept for intelligent watermarking methods in which he covers soft computing and machine learning. Nonetheless, the AI methods were merely recognized within a classic framework. In (Singh, 2022), Singh reviews watermarking properties, applications and attacks. Generally, he reviews various watermarking techniques in the space and frequency domains by pinpointing the transition from the classical techniques into the new ones featuring with soft computing. He investigates grey scale and colour images in addition to a video. Wu (Wu, 2014) examines watermarking techniques by shedding light on the optimization algorithms, also known as soft computing, and by processing the three methods of the genetic algorithms (GA) (Katoch, 2021), the particle swarm optimization (PSO)(Clerc, 2010),and the differential evolution (DE)(Opara, 2019). They are detailed and compared, essentially by showing their advantages and disadvantages, each apart.

The aim of this book chapter is to provide an overview of intelligent watermarking for digital data. This chapter presents a detailed study of watermarking using current and popular technologies, such as artificial intelligence, soft computing, machine learning and deep learning. It also presents a general introduction to watermarking, the type of watermark, the insertion domain, the extraction schema and the most used watermarking applications. The major role and contributions of advanced technologies in watermarking are also underlined. A range of existing WI techniques is presented and the contributions of the studied approaches are discussed and compared. Finally, the book's chapter highlights the advantages and disadvantages of these WI techniques, opening the way to new research directions in this new area.

This chapter is organized by an introductory entry. Section 2 is retrospective by referring to watermarking background as a field standing on its legs. Section 3 is about surveying intelligent watermarking techniques, ranging from machine to deep learning usages. A detailed discussion is presented in Section 4 while some concluding remarks are listed in the last section.

THE BACKGROUND OF WATERMARKING DOMAIN

With the widespread of technology, the transfer of digital documents into networks has become increasingly of a great importance. It is practically essential not only to ensure security during data transfer but also to establish a reliable exchange of information. In this context, its use in watermarking is very demanding, particularly in hiding subliminal information in a digital document, which guarantees a secure service for copyright, integrity, traceability, non-repudiation, and even for informative reasons.

The classic watermarking scheme consists of two distinct stages: watermark insertion and extraction. The first stage happens when a message or mark is inserted imperceptibly into the cover medium before transmitting it via a public channel. However, during the extraction stage, watermarking algorithms are used to find and extract the previously inserted mark.