

## Chapter 2

# Masking Models and Watermarking: A Discussion on Methods and Effectiveness

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### ABSTRACT

*Many audio watermarking techniques, presented in the last years, make use of masking and psychological models derived from signal processing. Such a basic idea is winning because it guarantees a high level of robustness and bandwidth of the watermark as well as fidelity of the watermarked signal. This work first describes the relationship between Digital Right Management, Intellectual Property, and use of watermarking techniques. Then, the crossing use of watermarking and Masking Models is detailed, providing schemes, examples, and references. Finally, the authors present two strategies that make use of a Masking Model, applied to a classic watermarking technique. The joint use of classic frameworks and Masking Models seems to be one of the trends for the future of research in watermarking. Several tests on the proposed strategies with the state of the art are also offered to give an idea of how to assess the effectiveness of a watermarking technique.*

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## INTRODUCTION

Ownership is the one's right to possess something and decide what is to be done with it. The concept of ownership is distinct from possession, intended as having something in one's custody. Such demarcation, very easy to understand and prove in case of a material good (e.g., as a house or a car), becomes particularly ephemeral in case of digital data. First of all, the diffusion and movement of a digital content cannot be practically traced: as an example a collection of songs can be published on a Website, a CD or a DVD, and once it is legally distributed for the first time there is no way to control its following circulation. Then, there are many ways to reproduce a digital content and obtain copies identical to the original. Starting from a copy, a malicious can alter or manipulate the original content, and present himself as the owner. This can result in a great damage for the rights' genuine owner, since an image, or a song, however in a digital format, are esteemed on the whole respect to their origin, which is a proof of quality, source and content integrity. From this introduction it seems, and it is definitely true, that the encountering problems in ownership for a digital content are the digital nature itself of the content: an image, printed on a photo-paper, can be copied more difficulty without the original matrix (e.g., the negative, in case of a photo; or the master registration in case of an audio sample) and, in every case, the copy can be easily distinguished from the original; furthermore, a photo-paper image could not be present on million of instances at the same time as happens to an image published on the Web. For all these reasons, different approaches have been developed for proving origin's copyright information of a digital content. On the whole, Digital Rights Management (i.e., DRM) is any of these technologies, when used to control access to digital data. DRM is not a Technical Protection Measures (i.e., TPM). Actually, such technology controls or restricts the use and access of digital media content on electronic devices with such technologies installed, acting as components of a DRM design (See Figure 1). The objective of this chapter is to provide a comprehensive explanation of the crossing use of masking threshold and watermarking, as one of the most effective DRM strategies.

This work is organized as follows. The first section provides an overview of DRM, discusses the distinction between cryptography and watermarking (explaining the relevant applicative fields in a DRM context of both solutions), describes watermarking in general and introduces the Masking Models. The second part is a description of the crossing use of the Masking Models and watermarking followed by two examples of use from the authors. The third part introduces what has been done in the very recent past in this field of research. Finally, some conclusions on the trade-off robustness/fidelity, and more generally on the use of Masking Models in watermark schemes, are drawn.

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