CCIT Report #564
December 2005

Optimal Watermark Embedding and Detection Strategies under Limited Detection Resources *

Neri Merhav and Erez Sabbag

December 7, 2005

Department of Electrical Engineering
Technion - Israel Institute of Technology
Technion City, Haifa 32000, Israel
{merhav@ee, erezs@tx}.technion.ac.il

Abstract

We propose an information–theoretic approach to the watermark embedding and detection under limited detector resources. First, we present asymptotically optimal decision regions in the Neyman–Pearson sense. We expand these results to the case of zero-mean i.i.d. Gaussian covertext distribution with unknown variance. For this case, we propose a lower bound on the exponential decay rate of the false–negative probability and prove that the optimal embedding and detecting strategy is superior to the customary linear, additive embedding strategy in the exponential sense.

1 Introduction

Information embedding and watermarking have become a very active field of research in the last decade, both in the academic community and in the industry, due to the need of protecting the vast amount of digital information available over the Internet and other data storage media and devices (see, e.g.,[1]–[5], and references therein). Watermarking (WM) is a form of embedding information secretly in a host data set (e.g., image, audio signal, video, etc.). In this work, we raise and examine certain fundamental questions with regard to customary methods of embedding and detection and suggest some new ideas for the most basic setup.

The most popular approach to watermark embedding and detection has been the following (see, e.g., [2],[6],[4, sec. 4.2] and references therein): Denoting by $\boldsymbol{x} = (x_1, \ldots, x_n)$ a block from the covertext source and by $\boldsymbol{w} = (w_1, \ldots, w_n)$ the independent binary (± 1) watermark vector,

*This research was supported by the Israel Science Foundation (grant no. 223/05).