Chapter XXIV

Adaptive Image Steganography Based on Structural Similarity Metric

Guangjie Liu
Nanjing University of Science and Technology, China

Shiguo Lian
France Telecom R&D (Orange Labs) Beijing, China

Yuewei Dai
Nanjing University of Science and Technology, China

Zhiquan Wang
Nanjing University of Science and Technology, China

ABSTRACT

Image steganography is a common form of information hiding which embeds as many message bits into images and keep the introduced distortion imperceptible. How to balance the trade-off between the capacity and imperceptibility has become a very important issue in the researches of steganography. In this chapter, we discuss one kind of the solution for disposing the trade-off, named adaptive image steganography. After a brief review, we present two methods based on structural similarity metric. The first one is based on the generalized LSB, in which the substitution depth vector is obtained via the dynamic programming under the constraint of an allowable distortion. The second method is proposed to use adaptive quantization-embedder to carry message bits. Different from the first method, the distortion index is constructed by contrast-correlation distortion. The other difference is that the parameters of the adaptive quantization embedder are embedded into the image containing message bits by the reversible data hiding method. Besides that, we also bring forward some attractive directions worthy of being studied in the future. Furthermore, we find that the existing methods do not have a good way to control the amount of information and the distortion as an extract manner, and most schemes are designed just according to the experiences and experiments.
INTRODUCTION

Steganography is the art of covered or hidden writing. The practice of steganography has quite a history. The earliest example can be dated to the Greek historian Herodotus, who describes how one of his cunning countrymen sent a secret message warning of an invasion by scrawling it on the wood underneath a wax table. To casual observers, the tablet appeared blank. Roman empires would hide secret message in ordinary message that only a certain formula when applied could reveal the real message. This was of course to prevent the real message from falling into the wrong hands. Both Axis and Allied spies during World War II used such measure as invisible inks as tiny punctures above key characters in a document that form a message when combined or ‘invisible inks ’ that could only be read when heat was applied.

The earliest study concerning modern steganography was presented by G. J. Simmons (Simmons, 1983). In (Simmons, 1983), the famous story of Prisoners’ problem explains what capabilities and merits steganography has to offer when public communication channel is insecure. The story is about two prisoners Alice and Bob who are put to different cells in a jail and what to plan to escape form the prison together as Fig.1 illustrates. However, any communications between them have to pass though the warden Eve, so only plaintext (i.e. content that have clear meanings) can be handed on by Eve, while anything in the form of ciphertext(i.e. contents that seems meaningless) will not be allowed. Bob and Alice want to conspire to escape, but they can not send a clear message to each other showing the intention of escaping, and neither can they encrypt the secret message about their plan of escape into a cipher text in an attempt to hide their intention before the message comes to Eve. To solve this problem, Alice can use a picture (like illustrated in Fig.1) as the cover to conceal the very existence of the secret message from Eve.

It is worthy to be noticed that often dictionaries have defined steganography the same as cryptography, however there is a clear difference between the two. The purpose of steganography is covert communication to hide the existence of a message from a third party, which differs from cryptography, the art of secret writing, which is intended to make a message unreadable by a third party but does not hide the existence of the secret communication. The steganographic process generally involves placing a hidden message in some transport medium, called the carrier or the cover medium. The secret message is embedded in the cover medium to form the stego medium. The use

Figure 1. Prisoners’ problem
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