DOCTORAL DISSERTATION:
A VIDEO STEGANOGRAPHY METHOD ROBUST TO ANALOG DISTORTIONS

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Abstract

This doctoral dissertation focuses on the development and analysis of the RAI (Robust Adaptive Incremental) video steganography method, aimed at hiding messages - among others, in the form of QR codes - within video content in a way that ensures high resilience, particularly against potential analog interference. The core of the proposed solution lies in the iterative retrieval of hidden information from consecutive video frames, enabling the gradual reconstruction of the full hidden message even under extremely adverse transmission or playback conditions. This incremental data recovery approach allows for successful message decoding despite significant degradation of the video quality.

The RAI method was developed with two key requirements in mind: robustness and imperceptibility. Top priority was given to resistance against distortion, ensuring that even severe disturbances - such as those occurring when the video is displayed on a television screen - do not hinder the accurate automated reading of the hidden information. At the same time, the modifications introduced into the video remain invisible to the human eye, thereby providing a high level of undetectability.

Experimental studies have confirmed the effectiveness of the RAI method, enabling the determination of minimal encoding parameters and thresholds for imperceptible alterations to the human eye. The obtained results may find application in video steganography scenarios that require secure transmission, especially under extremely challenging technical conditions.

This dissertation also presents a mathematical model of the proposed method, based on a more general iterative steganography framework, thus serving as a concrete example of its practical implementation.

The proposed RAI method may contribute to the development of more reliable and robust video steganography techniques, as well as the implementation of specific technical and teleinformatics solutions that enable video steganography in scenarios characterized by substantial analog interference.

Keywords: steganography, steganalysis, information theory, video steganography, RAI (Robust Adaptive Incremental)