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Multi-Agent System for an Image Steganalysis

Akram Boukhamla

Faculty of New Technologies of Information and Communication, Kasdi Merbah University Ouargla BP.511,30000, Algeria

Abstract: Steganography is the science of data hiding, but it can be used by malicious people to use it for destructive purposes. For this reason, the presence of methods detecting Steganography becomes a necessity. The science of detecting Steganography is called steganalysis and evolves with new steganographic techniques. The purpose of this paper is to present a model for detecting the content of JPEG images that have been steganographed.

Our work involves applying Multi-Agent Systems (MAS) in image steganalysis where we use ADMs to reduce the complexity of solving a problem by dividing the necessary knowledge into subsets, combining an independent intelligent agent to each of these subsets and coordinating the activity of these agents.

We opted for the Java Agent Development Framework (JADE) platform for the development and realization of the inter-operable Multi-Agent System.

***Keywords*:** Steganalysis; Steganography; Image; Database

1. Introduction

Steganography has been used since ancient times in various forms[1], as a secret means of transmitting information: the information to be transmitted - called a steganogram - is hidden within a document or object so that a person uninformed of the presence of the steganogram can not identify any "modification" of the support document. A typical example of steganography is to hide bits of information in an image, for example. The image in question must therefore have the minimum of visual and statistical distortions so that no entity can identify the image as suspicious, and thus the concealed information reaches the recipient alone without hindrance.

The purpose of the steganalysis is to prove the presence of hidden information in a host signal. Several families of steganographic analysis techniques have been developed in the literature[2], the messages hidden in an image are imperceptible by the human eye, but this concealment of information leads to a deviation in the statistical properties of the support.

2. Definitions

2.1. Steganography

Steganography is the art of passing information by concealing its very existence.

The purpose of steganography is to avoid drawing attention to the transmission of a hidden message.

Anonymous information is rendered anonymous in a stream of innocuous information. If suspicions exist, then the goal is not achieved

2.2 Steganalysis

Steganalysis is the counterpart of stegano-graphy. The desire to detect steganographic methods is called an attack.

There are 2 types of attack.

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The passive attack, the purpose of which is to detect the presence of hidden messages without being interested in the content.

Active attack not only detects the presence of hidden messages, but also aims to extract, modify or delete the data.

2.3 The multi-agent system

A multi-agent system is a set of agents that coexist in the same universe and interact with each other in a common environment to help solve a given problem that exceeds their individual capabilities and knowledge.

3. Typology of agents

There are two types of agents: cognitive agents vs. reagents

3.1 Cognitive agents

These agents are also described as deliberative or intentional. Ferber[3] defines the characteristics of a cognitive agent as being autonomy, intentionality (he / she has one or more goals) and intelligence (he / she is capable of reasoning on a knowledge base) .

Cognitive agents have a set of explicit representations (about the environment, about other agents, and about themselves) described in a knowledge base they can relate to. They react according to their knowledge, their goals and according to the exchanges with the other agents and the perception of the environment by organizing their actions according to a planning. They are endowed with means and mechanisms of communication to manage the interactions with the other agents (cooperation, negotiation) to reach a common goal (solving a problem, complex task, etc.).

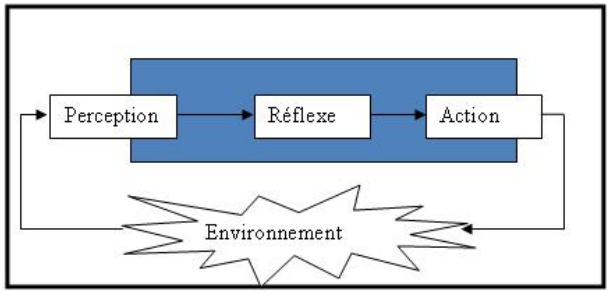


Figure 1 ; Cognitive agent.

3.2 Reactive agents

The reagents can be separated into drive and tropical agents. An instinctual agent will have a fixed mission (for example, to make sure that a tank remains sufficiently full) and will trigger a behavior if he perceives that the environment no longer meets the purpose assigned to him (the level of tank is too low). The tropical agent reacts only to the local state of the environment (there is light, I flee). The source of motivation is in an internal case (drive agents who have a "mission"), in the other case only related to the environment.

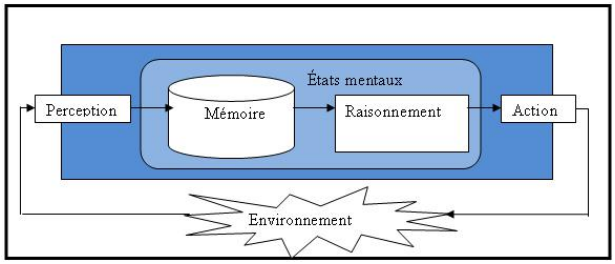


Figure 2 ; Réactive agent.

3.3 The cognitive / reactive distinction

The distinction that can be made between cognitive and reactive is essentially the representation of the world available to the agent. If the individual is endowed with a symbolic representation of the world from which he is able to formulate reasoning, we will speak of a cognitive agent, whereas if he has only a sub-symbolic representation, that is to say, limited to its perceptions, we will speak of reactive agent. This cognitive / reactive distinction corresponds to two schools of thought of multi-agent systems. The first supports a family approach of "intelligent" agents to collaborate, with a more sociological perspective. The second one studies the possibility of the emergence of "intelligent" behavior of a set of non-intelligent agents (ants type)[4].

3.4 Hybrid agents

These are the agents that result from the combination of cognitive agent and reactive agent. Their goal is to achieve behavior that is consistent with the goals and plans of the agent whose reactions are guided by the objectives and not only by stimuli from the environment.

4. Advantages and disadvantages

The choice of application of the SMAs is not made at random but in order to solve the following problems:

1. Problems are distributed by nature and require to be solved by several agents

2. ADMs can improve performance through parallel work with different agents

3. The ease of "scalability" because many agents can dynamically add or remove from a system

4. Reduced Software Development Costs: The more modular software is, the lower the complexity and cost of development.

Despite all the advantages of ADMs they have some disadvantages such as:

1. Application security: The possibility that all agents can communicate without any external control poses security problems

2. Modularity: In a classical program, there are entities that are grouped into "packages" or modules. These modules can be visible or not by other modules called private modules. This concept does not exist in ADMs, all agents are accessible by all. So you have to group active agents who work together in a group and make them able to modify their grouping dynamically according to general rules.

3. Last but not least, multi-agent systems are complex software that is difficult to understand and design[10].

5. Description of the Dissimulation Algorithm

JPHide & JPSeek[5], developed by Allan La-tham in 1999. This algorithm modifies the low-order bits of some coefficients dct randomly chosen to hide the data in jpeg images[6], this random choice makes the detection quite difficult . With an insertion rate of less than 5% and the absence of the cover-medium detection of concealment will be almost impossible but as soon as the insertion rate exceeds 15% the change-ment will be noticeable.

6. Changing gray level values

The pixel gray level tests allow to deduce if an image has been modified by a steganography software or not[7].

When inserting a message into an image, changes will be made to the RGB values, the software used for stegraphy conceals the information in different low-order bits of the DCT coefficient, so there is will have a difference between the bit values of the original image with respect to the steganographic image, which makes possible the detection of hidden mes-sages.

In the case of passive steganalysis, obtaining the original image is a great advantage over the active steganalysis, thanks to the presence of a marker to compare it with other images to be steganalyzed.

Having multiple images to compare with the marker (the original image) requires cooperation between the marker image, and the other images to be mastered. This notion of cooperation will be more effective in a multi-agent system, where agents will cooperate with each other to achieve a specific goal.

7. Architecture of the proposed application

In the following we present the passive staged analysis scheme with the implementation of multi-agent systems for the detection of steganographed images in JPhide / Seek, the steps are illustrated in **Figure 3.**

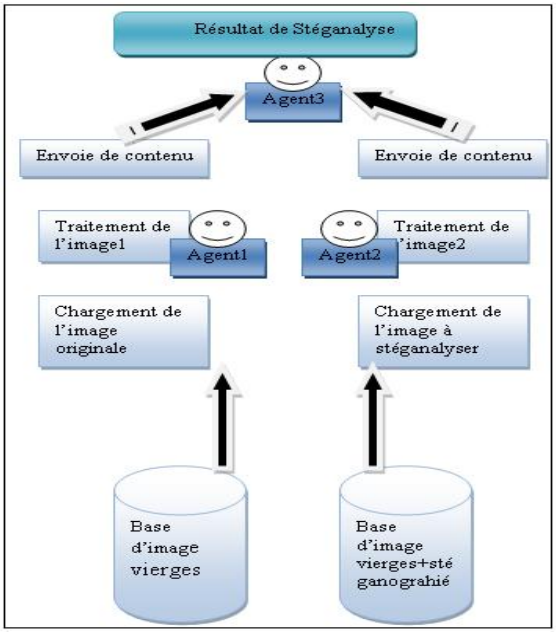


Figure 3 ; Steganalysis with SMA scheme.

7.1 Building the image database

To validate our steganalysis approach, it would be necessary to enrich the image database with a number of steganographed images, which will allow us to widen the size of the image base, during the performance and the reliability of will be better.

For that, we have recovered from the web[8,9], the

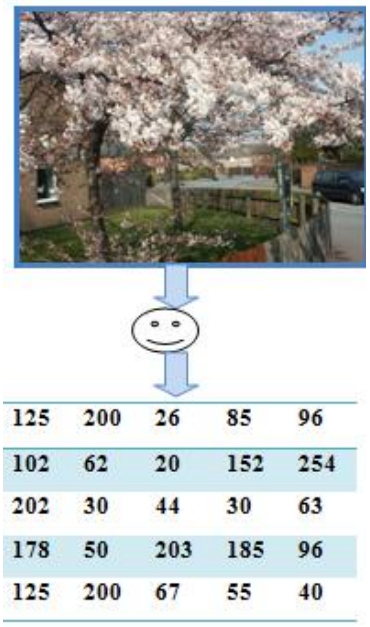
second version of the standard base ucid "an Uncompressed Color Image Database", after we must apply the algorithm Jphide / Seek to stegame images of the base UCID.

7.2 Loading image

In this step the Agent1 and the Agent2 respectively choose two images img1 of the base1 (virgin images) and img2 of the base2 (virgin + steganographed images) to compare them, because the dissimulation algorithm used is the Jphide / Seek, the steganized images are for-matte JPEG, the format supported by JPhide / Seek.

7.3 Image processing

The agents extract the pixels of the image in order to convert them into an integer matrix so that a comparison can be made.



125	200	26	85	96
102	62	20	152	254
202	30	44	30	63
178	50	203	185	96
125	200	67	55	40

Figure 4 ; Conversion de l'image en matrice de pixels**.**

7.4 Sending the content of the two images

At the end of the processing, the two agents send the matrix of pixels of each image to the Agent3 which will make a comparison of the contents of the two images, and it is at this moment that one obtains the result of the steganalysis of which it can be positive, if the values of the RGB have been changed by inserting a message or a negative one, in case there will be no change in the values of the RGB.

8. Conclusion

Our objective, was to detect the presence of a hidden message in an image of the base used, to do this we exploited the notion of Sys-tem Multi-agent "SMA". The process of steganalysis requires cooperation between the different agents of the system.

Once the agents transfer their data into two separate matrices, another agent performs an analysis on the pixels of the two matrices.

Since these two conditions are verified:

• Adding a new agent increases the performance of the group.

• Agent cooperation is used to avoid or resolve current conflicts.

It is concluded that the agents of this application are in a state of cooperation in order to achieve the desired goal which is passive steganalysis.

Among the possible perspectives from the proposed system, we quote:

Because hiding can be done in different image formats it would be interesting if the proposed model will be extended to different image formats.

Design an active steganalysis model to estimate the size of the hidden message and determine its nature.

Given the large number of steganographic software available, it will be interesting to design a universal steganalysis model capable of detecting the presence of hidden messages generated by different steganographic software.

References

1. J. Barbier. "La stéganographie moderne: d'Hérodote à nos jours". In Computer & Electronics Security Application Rendez-vous, CESAR 2007, Rennes, France, novembre 2007.
2. Arooj Nissar and A.H. Mir "Classification of steganalysis techniques: A study" Digital Signal Processing 20 (2010) 1758–1770
3. Jaques Ferber. « Les systèmes multi-agents Vers une intelligence artificielle ».1995
4. Linda Dib. « Système Multi-agents ».2007
5. http://www.freewr.com/freeware.php?download=jphide-and-jpseek&lid=258
6. J. Barbier, E. Filiol et K. Mayoura: "New features for specific JPEG steganalysis". 3rd International Conference on Computer, Information, and Systems Science,and Engineering, CISE, Novembre 2006.
7. C.-K. Chan and L.M. Cheng. "Hiding Data in Images by Simple LSB Substitution. Pattern Recognition", 37, pp. 469–474, 2004.

8. http ://vision.cs.aston.ac.uk/datasets/UCID /ucid.html
9. G. Schaefer and M. Stich, “UCID – An uncompressed colour image database”, in Proc. of SPIE, Storage and Retrieval Methods and Applications for Multimedia, pp. 472–480, San Jose, USA, 2004.
10. MEGHTRIA Riad, KELLACI Med Amine , “Une plateforme sécurisée pour les agents mobiles”, ESC,Algérie,2009