



المؤتمر العلمي السنوي الحادي عشر



Utilizing genetic operations on Sudoku game for system hiding

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Abstract

Information hiding becomes one of the important human need due to various reasons if its in personal level or higher level especially with the rise of big amount of data transfer over social media and social networking. There are a lot of mechanisms to achieve various kinds of information hiding, her mix of genetic operators and the predicted Sudoku solutions to achieve map that will play a role for hiding process inside a database of digital images. The quality metric of PSNR ranged from worst 61 to best 73. The intelligent solutions of Sudoku game will be achieved on the determined window then this solution will be feed it into mathematical cross over model the result will form a map for hiding mechanism.

Key words: genetic operation, Sudoku game, information hiding.

المستخلص

اصبح امن المعلومات واحد من اهم الاحتياجات لدى الانسان لعدة اسباب على المستوى الشخصي او مستوى اعلى من ذلك نتيجة تصاعد كم البيانات المنتقل في شبكات التواصل الاجتماعي. هناك عدة طرق لتوفير امن المعلومات باستخدام الاخفاء. في هذا البحث نقدم خلية باستخدام معاملات الخوارزمية الجينية مع احجية sudoku لتلعب دور في نظام الاخفاء داخل قاعدة بيانات من الصور الرقمية. معايير القياس المستخدمة لل psnr تراوحت نتائجها من 61 الى 73. حيث يوفر الحل الذكي لاجحية sudoku الذي يغذى في عمليات التزاوج الجينية خارطة الاخفاء المطلوبة للنظام.

1. Introduction

Security system will remain one of the human needs due to wide variety of reasons like personal (protecting special social information) or general reasons (protecting agency or military information), thus with huge data that transmit over internet the security need become over and over one of the interesting field for researchers. Security system may build using many concepts like cryptography algorithms or steganography and many other tools, the big question is how to build a system that can handle both cryptography and steganography algorithms criteria and balance all of them in such a manner that give high security system [1]. Many researchers had done the cryptography and steganography algorithms individually or they mix both for constructing a security system. For concealing information steganography is used not only as art but also as science [4]. Hiding the existence of the information that could exchange by embedding messages is the main goal of the steganography using unsuspecting digital covers. Cryptography contains methods for encryption and decryption as well that could be used in many protocols for communication. But the context of using steganography differs from cryptography while both techniques manipulating data to achieve information security [5]. To obscure the meaning of a message the Cryptography used over and over does not conceal the fact that there is a message. Making data unreadable by unauthenticated user is the main aim of cryptography, whereas the steganography goal is to achieve hiding the information from a third party. There is ancient origin for both techniques, but the modern field is relatively young [2]. Fundamental components of computer formed by not only Cryptography but also steganography [3]. In steganography there are several technique used in spatial and frequency domain used in many researches, all of these techniques have field to take care of like with some of drawbacks on others some of this technique focus on the quantity of the secret information while other focus on the perceptually and robustness [6]. As many of the researchers used the mixing of steganography and cryptography techniques to achieve high level of security, but as consequences of mixing these techniques will affect each other through of choosing the best place for hiding which will cause less distortion. This paper focus on using genetic operator for achieves encryption and hiding process as well. Measurement result will be showed in term of PSNR and MSE.

SUDOKU MATRIX

Sudoku Puzzles and their variant have become extremely popular in the last decade. And can found it daily in most major U.S. newspapers. The Japanese puzzle company Nikoli, used to name by Sudoku, meaning "single number", popularized Sudoku in 1986. As well known Sudoku is a logic-based, combinatorial number-placement puzzle consisting of a 9 by 9 grids. Here we define a Sudoku Matrix as an X by X matrix with the numbers from 1 to N with the constraints that X is a square number and $N = X$, such that each number occurs exactly once in each row, exactly once in each column and exactly once in each block. The following Figure 1 shows an

instance solution of a Sudoku puzzle and its solution in figure 2, when $X = 9$. Can called as solution of the Sudoku puzzle a Sudoku matrix.

5	3			7				
6			1	9	5			
	9	8					6	
8				6				3
4			8		3			1
7				2				6
	6					2	8	
			4	1	9			5
				8			7	9

Fig.1. Sample Sudoku puzzle

5	3	4	6	7	8	9	1	2
6	7	2	1	9	5	3	4	8
1	9	8	3	4	2	5	6	7
8	5	9	7	6	1	4	2	3
4	2	6	8	5	3	7	9	1
7	1	3	9	2	4	8	5	6
9	6	1	5	3	7	2	8	4
2	8	7	4	1	9	6	3	5
3	4	5	2	8	6	1	7	9

Fig.2. Solution to sample Sudoku puzzle (Sudoku matrix)

3. Heuristic crossover

Using the fitness value of the two parents chromosomes for determining the direction of the search in Heuristic crossover operator . The offspring are created according to the equation:

Offspring1= bestparent + r (bestparent -worstparent).

Offspring2= Bestparent.

Where r is the random number between 0 and 1. Possibly that offspring 1 will not be feasible. It can happen if r chosen such that if one or more of its genes fall outside fall out side allowable upper or lower bounds. For this reason heuristic crossover has a user defined parameter n for a number of times to find r that result in feasible chromosome. If a feasible chromosome is not produce after n tries, the worst parent is returned as offspring1.

4. Proposed algorithm

Input:

Sudoku solution window (SSw)

Cover image Jpg (RGB)

Secret message (Sm)

Output:

Stego-Object (image).

Process

Determine plain area in cover image (PA).

Read Sudoku solution window.

Normalize Sudoku solution window for fit hiding indexes, such that

$NSSw = \text{Max-value} - 1$

Apply heuristic crossover over (PA) using the following:

Offspring1 = bestparent + r (bestparent - worstparent).

Offspring2 = Bestparent.

Such that $r = (S_window12 - S_window01) / 10$.

Get the binary format for offspring1, ignore offspring2.

Ct = (Sm) X-or offspring1.

Hide encrypted secret message with the guide of normalized Sudoku solution window NSSw.

Result

Table below show the result of the above algorithm over Lena images with different size with also different Secret message size. PSNR used as metric, which is ranged from 61 to 73 with ignoring the fraction part.

Image size	Secret message size	PSNR
1024*1024	2 Kbyte	73
512*512	1.5 Kbyte	68.7
256*256	1 Kbyte	61.6
128*128	1 Kbyte	61.1

Conclusion

It is not an easy decision how to distribute your secret message for achieving hiding and balanced the hiding criteria, that is why I developed such adaptive system that can make this decision. System will be able to choose the best cover in DB as well as provide a complex distribution mechanism for secret message to avoid prediction. Finding the total matching between the secret message and cover will reduce the suspicion that could rise through the

sensing and analyzing processes over the transmission channel. Using the genetic operator achieve good effect on PSNR value in cooperate with Sudoku solution window.

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