Ain Shams University
Faculty of Engineering
Department of Engineering Physics and Mathematics

MATHEMATICAL TECHNIQUES FOR MULTIPLE LAYER SECURITY SCHEMES

A Thesis Submitted
for the Degree of Master of Science in Engineering Mathematics

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ABSTRACT

The massive development in information transmission and communication technology requires several potentials for information security. Many methods have been developed and enhanced for exchanging information protection such as steganography and cryptography. Steganography is the art of hiding secret information within an appropriate visible cover media, such that only the authorized recipient, can know about the hiding of the information. The hidden information can exist on the form of text, image, audio or video. The approaches used in concealing secret data are seeking to select suitable cover media to these secret data in each approach. On the other hand, cryptography can be defined as the process where data or messages are converted into secret code for exchanging over a public channel. The main objective of this thesis is to develop and propose a new hybrid technique for data security through the integration between cryptography and improved steganography algorithms. The proposed system will be used to embed an encrypted secret message into a 3D cover image with minimal change and error in the received stego-image. The embedding is performed using the Least Significant Bit (LSB) approach into 3D grayscale image in its spatial domain. In this hybrid approach the secret message is encrypted first before being hidden, using Blowfish encryption technique that is chosen due to its proven security and efficiency. Steganography is implemented through slicing the 3D cover image into 2D slices. These 2D slices are randomly shuffled according to certain keys. Then the pixels in each slice are randomly shuffled with other keys. After that, the LSB data embedding takes place. Finally, re-shuffling of Shuffled pixels and slices are performed to obtain the stego-image. In this work, after performing the proposed techniques, several steganography performance evaluation metrics are incorporated including the peak signal to noise ratio (PSNR), Mean Square Error (MSE) and structural similarity index (SSIM). A comparison between the original image file (cover image) and the stego-image is carried out through these metrics. Also, the developed scheme is compared to some of its counterparts from the literature and the results show its superior performance and simplicity over the methods in comparison.

This is to ensure less distortion of the original cover file after embedding the secret message. Experimental results presented at the end of the thesis confirm a relative improvement and efficiency in the used approaches.

Keywords: 3D image Steganography, Data Security, Information Hiding, Shuffling, Blowfish algorithm.

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