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An Efficient Color-Image Encryption Method Using DNA Sequence and Chaos Cipher

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Abstract: Nowadays, high-resolution images pose several challenges in the context of image encryption. The encryption of huge images' file sizes requires high computational resources. Traditional encryption techniques like, Data Encryption Standard (DES), and Advanced Encryption Standard (AES) are not only inefficient, but also less secure. Due to characteristics of chaos theory, such as periodicity, sensitivity to initial conditions and control parameters, and unpredictability. Hence, the characteristics of deoxyribonucleic acid (DNA), such as vast parallelism and large storage capacity, make it a promising field. This paper presents an efficient color image encryption method utilizing DNA encoding with two types of hyper-chaotic maps. The proposed encryption method comprises three steps. The first step initializes the conditions for generating Lorenz and Rossler hyper-chaotic maps using a plain image Secure Hash Algorithm (SHA-256/384). The second step performs a confusion procedure by scrambling the three components of the image (red, green, and blue) using Lorenz hyper-chaotic sequences. Finally, the third step combines three approaches to encrypt the scrambled components for diffusion: DNA encoding/decoding, addition operation between components, and XORing with Rossler hyper-chaotic sequences. The simulation results indicate that the suggested encryption algorithm satisfies the requirements of security. The entropy value of confusion and diffusion is 7.997, the key space is 2^{200}, and the correlation coefficient is nearly zero. The efficacy of the proposed method has been verified through numerous evaluations, and the results show its resistance and effectiveness against several attacks, like statistical and brute-force attacks. Finally, the devised algorithm vanquishes other relevant color image encryption algorithms.

Keywords: Color image encryption; DNA encoding; lorenz system; rossler system; SHA-2