Robust Digital Image Cryptosystem Based on Nonlinear Dynamics of Compound Sine and Cosine Chaotic Maps for Private Data Protection

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Abstract—this paper presents a digital image cryptosystem based on nonlinear dynamics of a compound sine and cosine chaotic map. The compound sine and cosine chaotic map is proposed for high-degree of chaos over most regions of parameter spaces in order to increase high-entropy random-bit sources. Image diffusion is performed through pixel shuffling and bit-plane separations prior to XOR operations in order to achieve a fast encryption process. Security key conversions from ASCII code to floating number for use as initial conditions and control parameters are also presented in order to enhance key-space and key-sensitivity performances. Experiments have been performed in MATLAB using standard colour images. Nonlinear dynamics of the chaotic maps were initially investigated in terms of Cobweb map, chaotic attractor, Lyapunov exponent spectrum, bifurcation diagram, and 2-dimensional parameter spaces. Encryption qualitative performances are evaluated through pixel density histograms, 2-dimensional power spectral density, key space analysis, key sensitivity, vertical, horizontal, and diagonal correlation plots. Encryption quantitative performances are evaluated through correlation coefficients, NPCR and UACI. Demonstrations of wrong-key decrypted image are also included.

Keyword—Hash function, Chaotic Sinusoidal map

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