

## 2 · 項目簡介

(項目所屬科學技術領域、主要研究內容、發現點、科學價值、同行引用及評價等內容。)

5G is around the corner! Enormous images and videos are uploaded to the Internet or transmitted over public channels in Macau, China, and all over the world. These images and videos may contain private, sensitive, or even classified information. Providing security to these images and videos has become an urgent and critical issue for individuals, organizations and governments. Image encryption is a technique to encrypt images and videos by transforming them into an unrecognized format. Existing image encryption methods may suffer from security defects or heavily computational burden. This research project aims to develop innovative image encryption technologies and concepts and then apply them to reversible data hiding and secret image sharing. The main contributions of this project are listed as follows.

- (1) Several chaotic systems are developed as general nonlinear frameworks to produce a huge number of new chaotic maps for image encryption.
- (2) 2D chaotic maps and their corresponding image encryption algorithms are developed. A novel strategy is proposed to inject additional random pixels to the surroundings of the original image such that every execution of the proposed algorithms yields a completely different encrypted image.
- (3) An image encryption concept is proposed using a source image that is any image with the same size of the original image to be encrypted. Using this concept, image encryption algorithms are developed using the bitplane or edge map of the source image as the secure key image for image encryption.
- (4) A concept of visually meaningful encryption is proposed to transform an original image into another visually meaningful encrypted one. According to this concept, an image encryption system is developed using a reference image. The final encrypted image is visually the same as the reference image. The original image is protected not only by the preencryption algorithm but also by the visual appearance of the reference image.
- (5) Several parametric schemes for reversible data hiding in encrypted images are proposed to embed secret data into encrypted images while protecting the original image with a high level of security.
- (6) A lossless  $(k, n)$  secret image sharing scheme is proposed using image encryption. The scheme can completely recover the original image and to detect a fake share.

This research project selects 25 journal papers from 170+ publications for this award application, in which 5 papers are listed as "Highly Cited Paper" in the Web of Science database, and 15 papers are published in prestigious journals ranked top 10%, including IEEE Transactions on Cybernetics (IF: 10.387, No. 1 of 62 journals in Automation & Control systems, No. 1 of 23 journals in Computer Science, Cybernetics) and IEEE Transactions on Industrial Electronics (IF: 7.503, No. 1 of 61 journals in Instruments & Instrumentation, No. 2 of 62 journals in Automation & Control system). According to statistics by Google Scholar, the outcomes of

this research project have received over 4200 citations since 2015. The outcomes of this research project have great impacts to the research community of Macau and China.

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