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Discrete fractional watermark technique

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Motivation

- Watermark is often used to protect the copyright of images and chips against clone products.
- In discrete fractional calculus (DFC), finite sum is used for fractional operators. In comparison with classical fractional calculus, we can implement a watermark with less computational cost and better accuracy.
- Discrete memory effects were successfully introduced in standard logistic maps and rich dynamics was obtained. It can be concluded that DFC provides an exact discrete-time method without loss of memory.

Main idea

- Using a fractional logistic map, we generate chaotic series. We obtain an encryption watermark where the fractional order is used as a key.
- To decrypt the image, we first extract the encrypted watermark. Then, using the keys which include the fractional order, we can obtain the watermark image.

Method

1. Encrypt the watermark image W using the logistic chaotic series and obtain an encryption image W^* .
2. Add watermark image W^* to the original image P to obtain watermark result R .
3. Extract W^* from R to decrypt the image and compare the decrypted image W^* with the original one W .

Major results



(a) Image W



(b) Encryption of W



(c) Lena



(d) Watermark result



(e) Extraction of the image W^*



(f) Decrypted result

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Conclusions

- Discrete fractional calculus provides more keys to increase the key space and improve the security of watermark.
- The results show that it is a powerful watermark technique.
- Discrete fractional calculus provides an exact discretization method and is suitable for image processing.