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# Adaptive dual synchronization of chaotic (hyperchaotic) complex systems with uncertain parameters and its application in image encryption

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## Abstract:

The adaptive dual synchronization of chaotic (hyperchaotic) complex systems with uncertain parameters has been investigated. The analytical control functions are derived using a theorem to synchronize the chaotic (hyperchaotic) solutions of these systems. The adaptive dual synchronization between the chaotic complex Chen and Lorenz systems is introduced as an example, and another example is used to test the validity of the technique of this paper. Other examples of chaotic or hyperchaotic complex systems can be similarly studied. Based on the up-to-date laws, the parameters of the drive systems can be identified. The image encryption technique based on the adaptive dual synchronization of chaotic complex Chen and Lorenz systems is presented for gray and color images in the same time. Meantime, in the receiver side, information can be recovered successfully by adaptive technique. The presented technique is robust with respect to different levels of white Gaussian noise. The communication channel as well as the effect of the increase of noise are big challenge which have not been considered. Numerical simulations are given to verify the feasibility of our proposed synchronization and better performance of image encryption technique in terms of histogram, robustness to noise and visual imperceptibility.

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