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SECURE COMMUNICATION USING A HYPERCHAOS BASED SIGNAL TRANSMISSION SCHEME

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ABSTRACT

A new hyperchaos based signal transmission scheme is proposed to transmit digital information signal by using the conventional synchronization of hyperchaos and digital transmission approaches. In this scheme the two different hyperchaotic system is used to generate an analog key after thresholding a different hyperchaotic signal. This signal along with the information digital signal is used to generate the transmitted signal. Then the transmitted signal is masked by the two different hyperchaotic signals of the transmitter and is transmitted through the channel to the receiver as well as used to drive the transmitter hyperchaotic systems using the concept of self-modulation. At the receiver end, suitable feedback loop is constructed for unmasking and then the subtraction rule is used to recover the information signal. By considering appropriate circuit configuration, the experimental results are presented.

Keywords*:* Hyperchaotic communication, Hyperchaotic modulation, Signal transmission, Performance analysis

INTRODUCTION

There has been a great deal of research on hyperchaotic communication system. Following these approaches, different methods have been developed in order to make the content of a message using hyperchaotic signals[1]. The problem of unmasking the information message from the different two hyperchaotic carrier signals, different approaches for designing cryptosystems based on hyperchaos have been recently introduced[2]. In these schemes both conventional cryptographic method and synchronization of hyperchaotic systems are combined so that the level of security of the transmitted hyperchaotic signal is enhanced.

So, presently, we have shown the effective usage of different two hyperchaotic system to generate hyperchaotic digital transmission signal by employing suitable thresholding mechanism on one of the state variables of the different two hyperchaotic systems at the transmitter. Then the modulo-three addition (op-amp adder) is performed between the digital information signal and the threshold hyperchaotic digital transmission signal. A small amplitude version of the transmitted signal is further masked by the different two hyperchaotic signal of the transmitter and is transmitted through the channel to the receiver as well as used to drive the transmitter hyperchaotic system using the concept of self-modulation[3]. For receiver, at the receiver module upon synchronization, the modulo-subtraction is performed with the regenerated hyperchaotic transmission analog

key signals with the reproduced transmitted signal to recover the digital information signal.

EXPERIMENTAL SET-UP AND RESULTS

The actual circuit realization of the different two hyperchaotic system based on signal transmission scheme for the case of autonomous third order Chua's circuit and simple 4D hyperchaotic oscillator circuit is shown in Fig. 1.

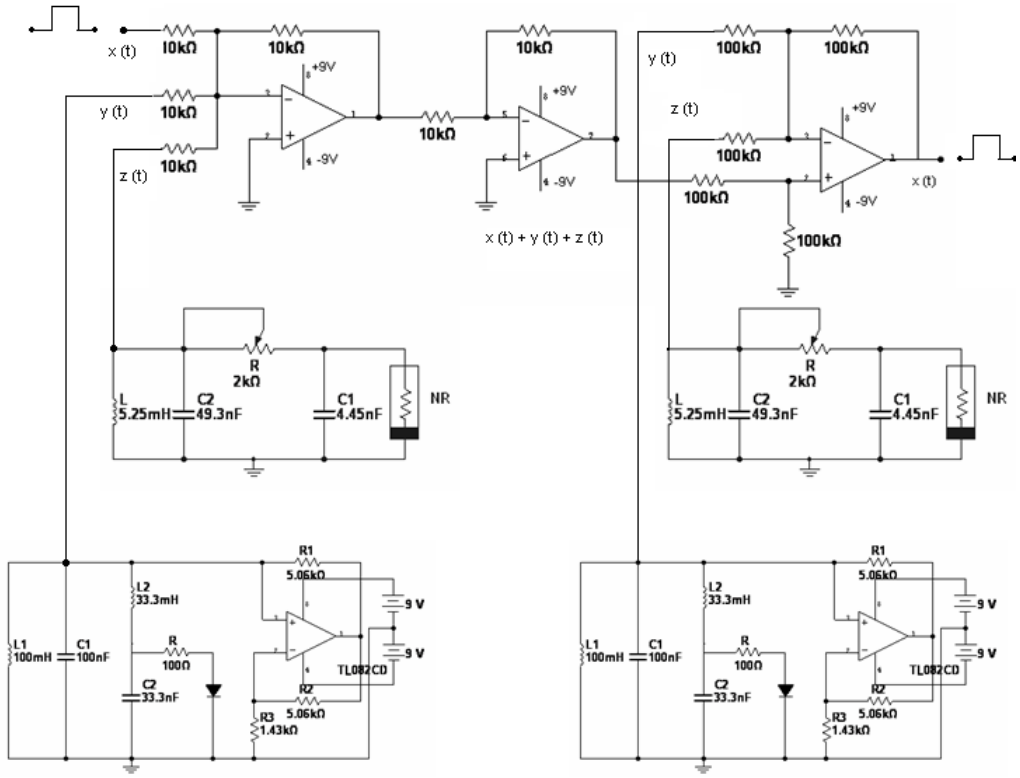

Fig. 1 - Circuit realization of the secure communication using a hyperchaos based signal transmission scheme

In this circuit, the modulo-three addition operation is realized experimentally with the op-amp circuit (adder and subtractor) for both the transmitter and receiver. By fixing the first carrier signal of he third order Chua's circuit parameters at $C_1 = 4.45nF$, $C_2 = 49.3nF$ and $L = 5.25mH$ and by reducing variable resistance R from 2000Ω towards zero, the system displays regular behavior to hyperchaos through boundary condition are shown in Fig. 2. For our present second carrier signal of the simple 4D hyperchaotic oscillator circuit parameter at $C_1 = 100nF$, $C_2 = 33.3nF$, $L_1 = 100mH$ and $L_2 = 33.3mH$ the system displays single band hyperchaotic attractor are shown in Fig. 3.

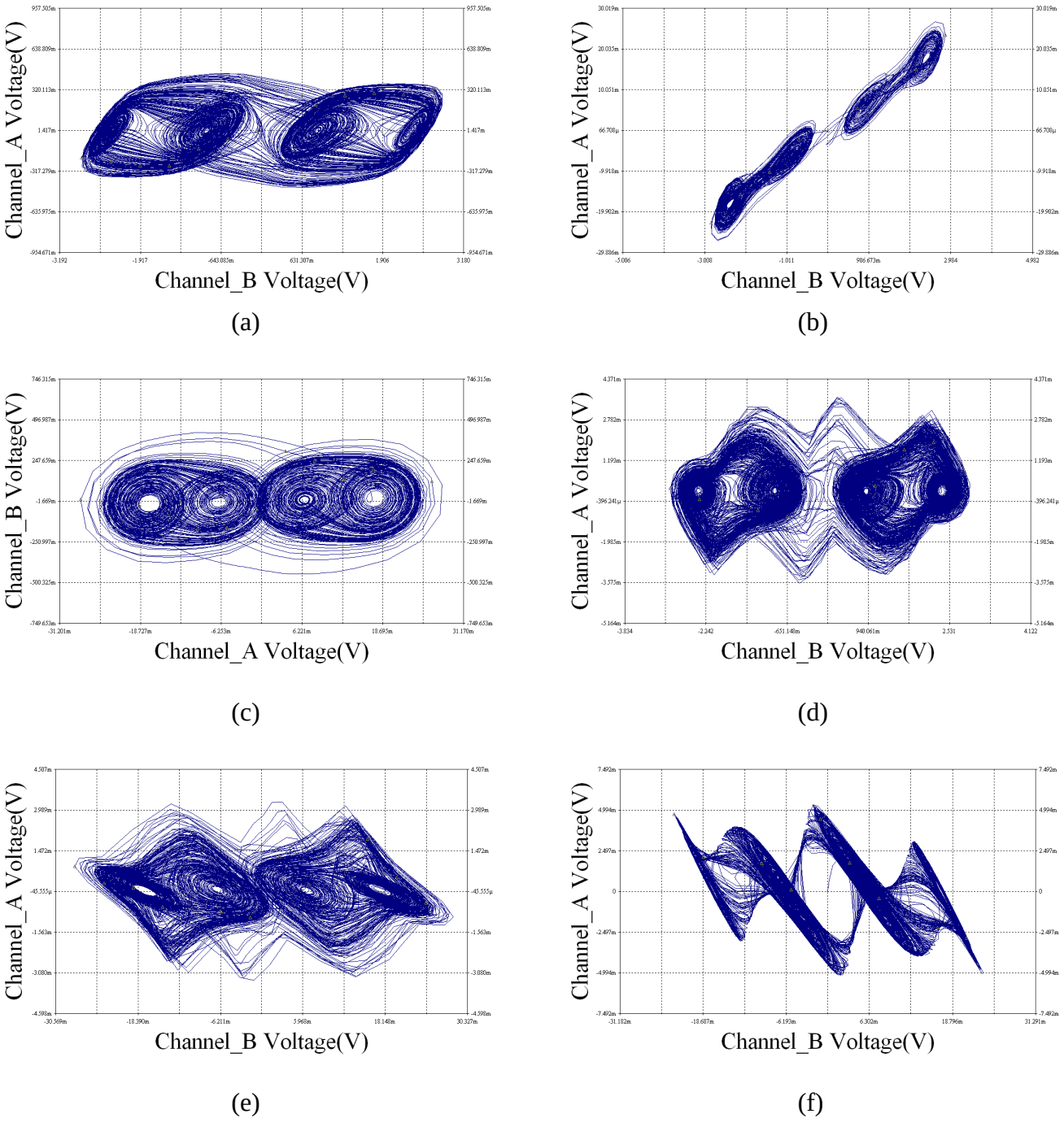

Fig. 2 - Chua's circuit realization of the hyperchaotic attractor onto different planes

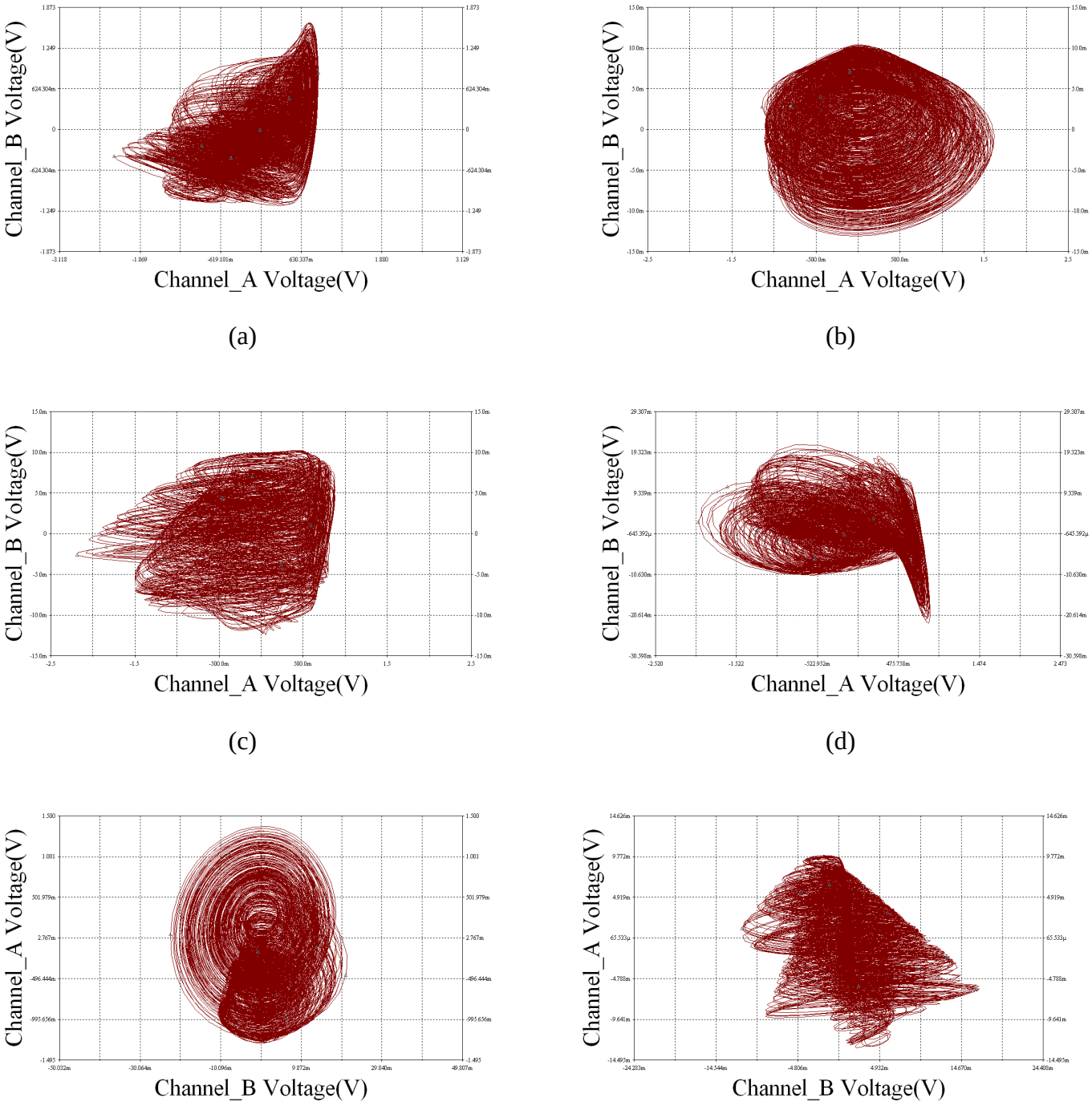

Fig. 3 - Simple 4D hyperchaotic circuit of the hyperchaotic attractor onto different planes

The ring structure confirmation autonomous third- order Chua's circuit and simple 4D hyperchaotic oscillator is adapted for the present study to implement the self-modulation of the information signal into the different two hyperchaotic circuit to minimize the signal recovery error [4-10]. Upon synchronization and after the reception rule, the information signal *x(t)* is recovered, as shown in Fig. 4. In this figure, [*x(t)+y(t)+z(t) = d(t)*] and [*(x(t)+y(t)+z(t))-(y(t)+z(t))*] = *x(t)* = *r(t)* corresponds to the digital information signal, output digital transmission from the op-amp adder circuit, actual transmitted hyperchaotic signal to receiver, recovered digital transmission signal from the op-amp subtractor circuit at the receiver and the recovered information signal *r(t)*. Thus the above secure communication scheme using hyperchaos based signal transmission can be experimentally achieved with minimal circuit configurations.

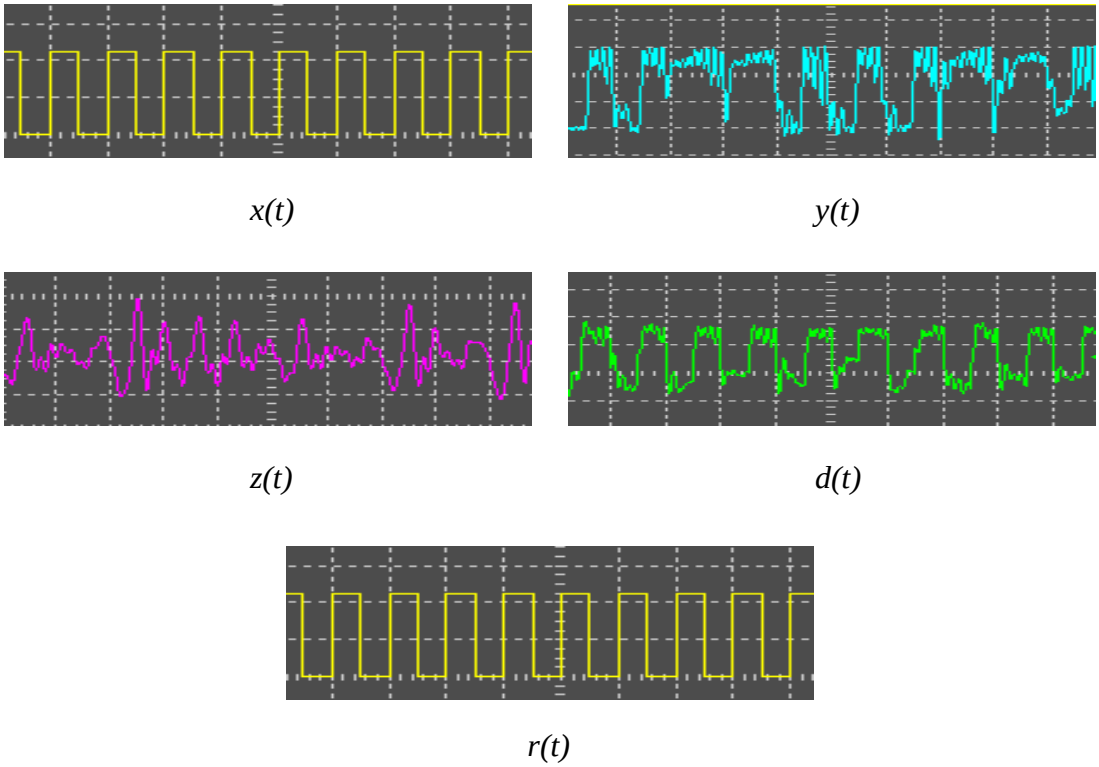

Fig. 4 - Signal transmission and recovery with autonomous third order Chua's circuit and simple 4D hyperchaotic oscillator circuit systems. Here *x(t)* = information signal, *y(t)* = first carrier signal, *z(t)* = second carrier signal, *d(t)* = modulated signal and

CONCLUSIONS

We present here a new hyperchaos based secure communication system by combining the strength of conventional signal transmission scheme and hyperchaos based communication methods. Further the hyperchaotic signals from the same transmitter and receiver pair have been utilized to transmission and receiving the information signal respectively. The security of the system is potentially increased due to the op-amp arithmetic operation between the digital information signal and the hyperchaotic digital transmission signal as op-amp addition operation mask the information of both the hyperchaotic transmitter and the message efficiently. The effect of perturbing factor like channel noise and parameter mismatch is investigated and their corresponding performance analysis are discussed.

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