DYNAMIC AND STATISTICAL CHARACTERISTICS OF CHAOTIC SEQUENCES SUBJECTED TO LINEAR TRANSFORMATIONS


Kharkov Air Force University, Ukraine

The paper presents the investigation results of dynamic and statistical characteristics of chaotic sequences subjected to linear transformations and formed by Chebyshev’s mappings of the second and third order. The paper shows the dependence of characteristics under investigation on the type of mapping and the number of elements in the sequences during their linear transformation. Also, the paper illustrates differences in evolution of distributions of the sequences transformed.

By the present time, a series of investigations devoted to usage of achievements of chaotic dynamics has been conducted. Their main purpose is to improve immunity of communications systems and networks to unsanctioned access during transmission, reception, and storage of confidential data. This problem was discussed, for example, in topical publications on the issue [1, 2]. In most cases it is assumed that the source of signals or the signal carrier represent chaotic sequences. The main technique of setting such sequences implies the use of nonlinear discrete mappings $T(x)$. The mapping (the operator of dynamic system evolution) can be specified in the form of a recurrent equation: a new value of the state of the dynamic system is determined by the previous one. Under the developed chaos conditions, the system state is difficult to predict, so it can be described at the current instant of time by the invariant probability distribution density.

In practice there are cases of signal transmission and reception, when the signals transmitted in the communication channel have been subjected to linear transformation. One of physical mechanisms bringing about the emergence of such transformations is related to multibeam propagation (interference) of a chaotic signal. To use appropriately the properties of such signals (sequences) in the problems of signal optimal processing, we have, first of all, to investigate the invariant probability distributions of individual elements of the signal received, its various statistical characteristics and behavior in the phase space. The importance of this problem is related to the fact that the number of such investigations thus far has been scarce enough.

This paper considers the sequences obtained by linear transformation of a chaotic sequence, henceforth called “generating”, and investigates their statistical and dynamic characteristics.

The invariant density can be calculated without additional assumptions for one important class of topologically conjugate one-dimensional mappings [3].

The mappings $T_1: X_1 \rightarrow X_1$ and $T_2: X_2 \rightarrow X_2$ are topologically conjugate or equivalent, if there is a homeomorphism $h: X_1 \rightarrow X_2$ such that the diagram

$$
\begin{array}{c}
X_1 \xrightarrow{T_1} X_2 \\
\downarrow h \\
X_2 \xrightarrow{T_2} X_2
\end{array}
$$

is commutative, i.e., $h \circ T_1 = T_2 \circ h$.

© 2007 by Allerton Press, Inc.

Authorization to photocopy individual items for internal or personal use, or the internal or personal use of specific clients, is granted by Allerton Press, Inc. for libraries and other users registered with the Copyright Clearance Center (CCC) Transactional Reporting Service, provided that the base fee of $50.00 per copy is paid directly to CCC, 222 Rosewood Drive, Danvers, MA 01923.
REFERENCES


8 November 2005