Exponential Chaotic Model for Generating Robust Chaos

By

Hua, ZY (Hua, Zhongyun) [1]; Zhou, YC (Zhou, Yicong) [2]

View Web of Science ResearcherID and ORCID (provided by Clarivate)

Source

IEEE TRANSACTIONS ON SYSTEMS MAN CYBERNETICS-SYSTEMS

Volume: 51 Issue: 6 Page: 3713-3724

DOI: 10.1109/TSMC.2019.2932616

Published

JUN 2021

Indexed

2021-06-12

Document Type

Article

Abstract

Robust chaos is defined as the inexistence of periodic windows and coexisting attractors in the neighborhood of parameter space. This characteristic is desired because a chaotic system with robust chaos can overcome the chaos disappearance caused by parameter disturbance in practical applications. However, many existing chaotic systems fail to consider the robust chaos. This article introduces an exponential chaotic model (ECM) to produce new one-dimensional (1-D) chaotic maps with robust chaos. ECM is a universal framework and can produce many new chaotic maps employing any two 1-D chaotic maps as base and exponent maps. As examples, we present nine chaotic maps produced by ECM, discuss their bifurcation diagrams and prove their robust chaos. Performance evaluations also show that these nine chaotic maps of ECM can obtain robust chaos in a large parameter space. To show the practical applications of ECM, we employ these nine chaotic maps of ECM in secure communication. Simulation results show their superior performance against various channel noise during data transmission.

Keywords

Author Keywords: Chaotic communication; Electronic countermeasures; Logistics; Bifurcation; Orbits; Degradation; Chaotic behavior; chaotic system; nonlinear system; robust chaos; secure communication

Keywords Plus: SYSTEM; SCHEME; MAP
Author Information

Corresponding Address: Hua, Zhongyun (corresponding author)
Harbin Inst Technol Shenzhen, Sch Comp Sci & Technol, Shenzhen 518055, Peoples R China

Corresponding Address: Zhou, Yicong (corresponding author)
Univ Macau, Dept Comp & Informat Sci, Macau 999078, Peoples R China

Addresses:
1. Harbin Inst Technol Shenzhen, Sch Comp Sci & Technol, Shenzhen 518055, Peoples R China
2. Univ Macau, Dept Comp & Informat Sci, Macau 999078, Peoples R China

E-mail Addresses: huazyum@gmail.com; yicongzhou@um.edu.mo

Categories/Classification

Research Areas: Automation & Control Systems; Computer Science

Citation Topics:
4 Electrical Engineering, Electronics & Computer Science
4.101 Security, Encryption & Encoding
4.101.1713 Image Encryption

Web of Science Categories

Automation & Control Systems; Computer Science, Cybernetics

Funding

<table>
<thead>
<tr>
<th>Funding agency</th>
<th>Grant number</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Key Research and Development Program of China</td>
<td>2018YFB1003800</td>
</tr>
<tr>
<td></td>
<td>2018YFB1003805</td>
</tr>
<tr>
<td>National Natural Science Foundation of China (NSFC)</td>
<td>61701137</td>
</tr>
<tr>
<td>Shenzhen Science and Technology Program</td>
<td>JCYJ20170307150704051</td>
</tr>
<tr>
<td></td>
<td>JCYJ201708111160212033</td>
</tr>
</tbody>
</table>

Journal information

IEEE TRANSACTIONS ON SYSTEMS MAN CYBERNETICS-SYSTEMS

ISSN 2168-2216

eISSN 2168-2232

Current Publisher
IEEE-INST ELECTRICAL ELECTRONICS ENGINEERS INC, 445 HOES LANE, PISCATAWAY, NJ 08855-4141

Journal Impact Factor™ (2022) 8.7
Journal Citation Indicator™ (2022) 2.18