Deep Learning Approach for Noise Detection in Chaotic Dynamics

Lyudmyla Kirichenko, Sergiy Yakovlev, Mykyta Avsitidiiskyi

Chaotic dynamics manifests itself in a variety of natural, technical, and information systems. Examples include financial markets, weather systems, chemical reactions, ecological interactions, biological processes, and more. These systems are characterized by complex, unpredictable behavior, sensitive to initial conditions. One of the methods for modeling and studying such systems is through iterative mappings with chaotic dynamics, among which the most well-known is the logistic map.

The complex dynamics of chaotic systems can be affected by various sources of noise, leading to data distortions and complicating their analysis. It is important to timely detect the presence of noise in the data, as it can lead to incorrect conclusions and erroneous forecasts. There are a number of data analysis techniques capable of determining the presence of additive noise in chaotic realizations.

In this work, we propose to use machine learning methods to detect the level of noise in short chaotic realizations of the logistic map. For this purpose, a method for assessing the degree of noise in chaotic realizations using deep convolutional neural networks is proposed. Time realizations are represented as images, which are then classified using a neural network. The obtained classification results demonstrate high accuracy in recognizing various types of noise in temporal realizations of chaotic systems.

References

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First Author: Lyudmyla, Kirichenko
Affiliation: *Instytut Matematyki, Lodz University of Technology, 90–924, Lodz, Poland*
e-mail: lyudmyla.kirichenko@p.lodz.pl
Department of Applied Mathematics Kharkiv National University of Radio Electronics, 61166, Kharkiv, Ukraine
e-mail: lyudmyla.kirichenko@nure.ua

Second Author: Sergiy, Yakovlev
Affiliation: *Institute of Information Technology, Lodz University of Technology, 90–924, Lodz, Poland*
e-mail: *sergiy.yakovlev@p.lodz.pl*
National Aerospace University "Kharkiv Aviation Institute", Department of Mathematical Modeling and Artificial Intelligence, 61070 Kharkiv, Ukraine
***e-mail**: svsyak7@gmail.com*

Third Author: Mykyta Avsitidiiskyi
Affiliation: *Department of Applied Mathematics Kharkiv National University of Radio Electronics, 61166, Kharkiv, Ukraine*
e-mail: mykyta.avsitidiiskyi@nure.ua