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Perspective

# Study on Chaotic Systems using Learning Methods

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## ABOUT THE STUDY

This study aims to identify various chaotic systems by classify graphic pictures of their time series using deep learning techniques for the first time in the literature. To achieve this, a data collection made up of the graphical representations of time series for the three most well-known chaotic systems are the Lorenz, Chen, and Rossler systems. Different parameter values, initial circumstances, step sizes, and period lengths are used to obtain the time series. After creating the data set, the transfer learning approach is used to accomplish a high-accuracy classification. The study makes use of the most widely used transfer learning methods and deep learning models. Squeeze Net, VGG-19, Alex Net, ResNet50, ResNet101, DenseNet201, Shuffle Net, and Google Net are some examples of these models.

According to the study findings, classification accuracy ranges from 96 to 97 percent depending on the issue. The coupling of real-time random signals with a mathematical system is thus made possible by this study. Nonlinear mathematical models called chaotic systems are used to describe chaotic behavior. Alternatively put, chaotic systems are nonlinear systems that behave chaotically. Recent years have seen the usage of chaotic systems in a wide range of engineering fields, including DC-DC converters, DC-image converters, image and audio encryption, secure communication, data security, random number generation, and digital signature applications. Deep learning has gained popularity in recent years as well.

There are many studies on deep learning, but the majority of these studies concentrate on categorization methods used in many fields. In this study, chaos and deep learning-two of the most popular topics are highlighted and time series of chaotic systems are categorized by using deep learning. Deep learning is a form of machine learning that applies multi-layer artificial neural networks to a variety of tasks, including object detection, speech recognition, and natural language processing. Deep learning differs from conventional machine learning algorithms in that it enables automatic learning from a database (including picture, audio, and video) as opposed to the use of predetermined rules.

As far as the author is aware, there hasn't been any work on classifying chaotic system photos using deep learning. However, there are studies that classify chaotic systems from signals using deep learning that are documented in the works. They classified time series of discrete and continuous time dynamic systems in their study using Shallow Net, Multilayer Perceptrons (MLP), Fully Convolutional Neural Networks (FCN), Residual Networks (Res Net), and Large Kernel Convolutional Neural Networks (LKCNN). They claimed that the LKCNN method produces the best organization results. They derived to the conclusion that LSTM effectively filters out noise to accurately forecast nonlinear dynamics.

## CONCLUSION

As can be seen from the above-mentioned works, classification of chaotic systems over graphic descriptions is absent, whilst there is an absence of study on deep learning-based classification of chaotic signals. However, it is believed that categorization of chaotic behaviors or random signal is necessary. The above-mentioned need, a method to categories time series of chaotic systems based on transfer learning methods Squeeze Net, VGG-19, Alex Net, ResNet50, ResNet101, DenseNet201, Shuffle Net, and GoogLeNet is described in this work. For the first time in the collected works, a unique study is provided by accurately classifying time series of two separate chaotic systems.

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