Nonlinear Science Working Group

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Nonlinear Science Working Group

21st International Symposium
on
Disordered Systems: Theory and Its Applications

12 December 2021, Online

Abstract Booklet

Purpose of the Symposium

This scientific event will provide a good opportunity for complexity, nonlinear science & multidisciplinary field scientists and participants who are interested for information exchange. The objective of this symposium organized by Nonlinear Science Working Group which was founded 2001 is to bring together leading specialists and young scientists working on various aspects of complexity and nonlinear science, to discuss the most recent developments in that area.

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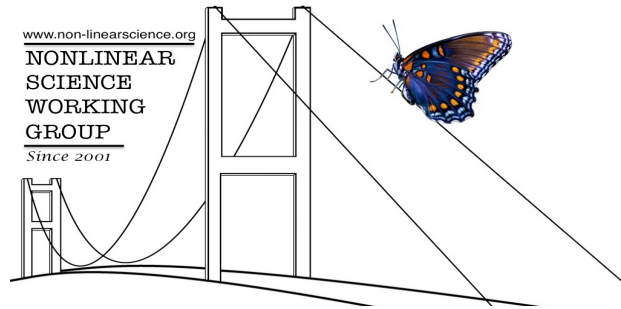www.non-linearscience.org
www.complexityscience.net

SYMPOSIUM PROGRAM

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21st International Symposium on
"Disordered Systems: Theory and Its Applications" (DSS-2021)

12 December 2021, Online meeting

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ATTENTION: All times reported for the DSS-2021 are Turkey time (GMT+3).

SYMPOSIUM PROGRAM

13:00 Welcome and Opening /Online group photo

13:00-13:20 *From Murray Gell-Mann to the Nobel Prizes and the Communities in Complexity Science*
G.Cigdem Yalcin
Istanbul University, Istanbul Turkey.

13:20-13:45 *Analytical Approach to the Generalized Friendship Paradox in Networks with Correlated Attributes*
Hang-Hyun Jo
The Catholic University of Korea, South Korea.

13:45-14:10 *Persistent Homology for Flood Early Warning Systems*
Fatimah Abdul Razak
Universiti Kebangsaan Malaysia, Malaysia.

14:10-14:35 *Analysis of Volatility, Asymmetry Effect and Long-Term Memory on Foreign Exchange Rate using GARCH Asymmetry Model*
Acep Purqon
Physics of Earth and Complex Systems, Institute of Technology Bandung, Bandung, Indonesia.

14:35-15:00 *Coexistence of Explosive Synchronization and Chimera in Multilayer Networks: Key Lies in Random Pinning*
Sarika Jalan
Indian Institute of Technology Indore, India.

15:00-15:25 *Generalized Entropies for Complex Systems Modeling: an Overview and Characterization*
Velimir Ilic
Mathematical Institute of the Serbian Academy of Sciences and Arts, Belgrade, Serbia.

15:30-15:40 Discussion and Closing /Online group photo

ABSTRACTS

From Murray Gell-Mann to the Nobel Prizes and the Communities in Complexity Science

G.Cigdem Yalcin
Istanbul University, Physics Department, Istanbul, Turkey

In this talk, we present Nobel Laureate Prof. Dr. Murray Gell-Mann known as Father of Quarks, as co-founder of the Santa Fe Institute, his key role in spreading complexity and encouraging scientists triggered the Nobel committee in recognizing complexity science today for the 2021 Nobel Prize in Physics. And with the light of these we consider how Murray Gell-Mann initiate in the era of complexity science as a new age of science.

We will also refer to the communities that provide platforms to discuss and share studies on complexity science over the years.

Analytical Approach to the Generalized Friendship Paradox in Networks with Correlated Attributes

Hang-Hyun Jo
The Catholic University of Korea, South Korea.

One of the interesting phenomena due to the topological heterogeneities in complex networks is the friendship paradox, stating that your friends have on average more friends than you do. Recently, this paradox has been generalized for arbitrary nodal attributes, called a generalized friendship paradox (GFP). In this paper, we analyze the GFP for the networks in which the attributes of neighboring nodes are correlated with each other. The correlation structure between attributes of neighboring nodes is modeled by the Farlie-Gumbel-Morgenstern copula, enabling us to derive approximate analytical solutions of the GFP for three kinds of methods summarizing the neighborhood of the focal node, i.e., mean-based, median-based, and fraction-based methods. The analytical solutions are comparable to simulation results, while some systematic deviations between them might be attributed to the higher-order correlations between nodal attributes. These results help us get deeper insight into how various summarization methods as well as the correlation structure of nodal attributes affect the GFP behavior, hence better understand various related phenomena in complex networks.

Persistent Homology for Flood Early Warning Systems

Fatimah Abdul Razak
Universiti Kebangsaan Malaysia, Malaysia.

The theory of critical slowing down (CSD) has been successfully used as a generic indicator of early warning signals in various fields. We propose the use of Persistent Homology (PH) as a preprocessing step to achieve a FLEWS through CSD. We test our proposal on water level data of the Kelantan River, which tends to flood nearly every year. The results suggest that the new information obtained by PH exhibits CSD and, therefore, can be used as a signal for a FLEWS. We manage to establish an early warning signal for ten of the twelve food events recorded in the river; the two other events are detected on the first day of the food. Finally, we compare our results with those of a FLEWS constructed directly from water level data and find that FLEWS via PH creates fewer false alarms compared to the conventional technique.

Analysis of Volatility, Asymmetry Effect and Long-Term Memory on Foreign Exchange Rate using GARCH Asymmetry Model

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Investment is one of the fields of passive income generation that is profitable. Investments can make someone rich, can also make an emergency fund, and retirement funds in old age. Two important factors influence an investment, namely returns and risks. One type of investment that can be used is an investment at a foreign exchange rate. Foreign exchange is the currency of other countries. One of the knowledge fields in physics to analyze stocks is Econophysics. Econophysics is a field of physics that applies concepts, methods, equations, and functions developed by a physicist in applying applications to economics. In making decisions in the world, a good analysis of volatility is needed. Volatility is the changes and fluctuations that occur in the stock price index. Long-term memory is a long-term correlation relationship found in time-series data. In this discussion, a time series of data modeling from the econophysics method can be used to analyze volatility, asymmetric effects, leverage effects, and long-term memory phenomena in time series data. The method used in this research are literature study, data collection in the form of daily foreign exchange rates, then modeling is done with a certain method. The models used to analyze stock prices are the ARIMA Model, the ARCH Model, the GARCH Model, the GJR-GARCH Model, and the EGARCH Model. The results of the modeling obtained a result in the form of only CAD/IDR foreign exchange rates which have asymmetric effects and leverage effects. The USD/IDR foreign exchange rate has an asymmetric effect but has no leverage effect. The JPY/IDR foreign exchange rate has an asymmetrical effect, but it is not significant. The EUR/IDR and CNY/IDR foreign exchange rates have no asymmetric effects and leverage effects. The EGARCH model is better than the GARCH and GJR-GARCH methods. Foreign exchange rates that have volatility from the largest to the smallest are JPY/IDR, CAD/IDR, EUR/IDR, CNY/IDR, and USD/IDR. Investment strategies for risk takers investors can invest in JPY/IDR, CAD/IDR, and EUR/IDR, while long-term investors can invest in CNY/IDR and USD/IDR. Investors must be careful when USD/IDR has a positive trend and when CAD/IDR has a negative trend. The five foreign exchange rates do not have long-term memory.

Coexistence of Explosive Synchronization and Chimera in Multilayer Networks: Key Lies in Random Pinning

Sarika Jalan
Indian Institute of Technology Indore, India.

The random pinning in interlayer interactions concerns the practical problems where the impact of dynamics of one network on other interconnected networks remains elusive, as is the case for many real-world systems. We, for the first time, investigate interlayer pinning in multilayer networks. Such inter-pinning brings two most intriguing behaviors manifested by coupled systems; explosive synchronization and chimera state. Random pinning induced chimera is so far observed for those setups in which one manually pins the nodes forming the incoherent part. Here, the chimera in multilayer networks emerges spontaneously without such arrangements. We provide rigorous analytical calculations on explosive synchronization and occurence of chimera state.

Generalized Entropies for Complex Systems Modeling: an Overview and Characterization

Velimir M. Ilic

Mathematical Institute of the Serbian Academy of Sciences and Arts,
Belgrade, Serbia

Over the past decades, there has been an unprecedented interest in statistical physics of complex systems that are typically non-additive, nonextensive in Boltzmann-Gibbs framework and that exhibit long-lived non-Boltzmann stationary states accessible to observations. These systems are often studied by means of information theory and statistical physics which are derived from additive and non-additive generalizations of the Shannon entropy.

The aim of this talk is to present a classification of the main entropic forms introduced in the past and to consider some of the applications for complex systems modeling. We will first focus on axiomatic approaches to the characterization of various generalizations of the Shannon entropy, such as the Renyi, the Tsallis, the Sharma-Mittal, and the Sharma-Mittal-Taneja entropies, as well as the more general classes of weakly pseudo-additive entropies. After that, we will explore their thermodynamical structure and, finally, we will point out their usefulness for characterization of a system complexity