XVI. International Symposium on

“Disordered Systems: Theory and Its Applications”

May 25 - 27, 2016,
İstanbul University, İstanbul, Turkey

Abstract Booklet

Purpose of the Symposium

This scientific event will provide good opportunity for complexity, nonlinear science & multidisciplinary field scientists and participants who are interested for information exchange. The objective of this symposium organized by Turkish 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.

Coordinator of the Symposium

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Sponsors: Istanbul University
Celal Bayar University
Turkish Nonlinear Science Working Group

SYMPOSIUM PROGRAM

May 25, 2016 – Wednesday

09:30-10:00 Registration
Welcome Meeting

10:00-10:20 Opening

10:20-11:05 "Human intelligence: a chaotic system at work"
Kemal Türker, *Koç University, Istanbul, Turkey*

11:05-11:50 "Recent developments in superstatistics"
Christian Beck, *Queen Mary, University of London, UK*

11:50 Symposium Group Photo

12:00-13:30 Symposium Lunch

14:00-14:45 "Simple chaotic systems and jerky systems of physical interest"
Avadis Hacinliyan,*Yeditepe University, Istanbul, Turkey*

14:45-15:15 "The role of scale index method in determining weak periodic signals"
Nazmi Yılmaz, Mahmut Akıllı and K. Gediz Akdeniz
Istanbul University and Koç University, Istanbul, Turkey

15:15-16:00 Visiting to Beyazıt Tower in the Main Campus of Istanbul University

16:00-16:15 Tea-Coffee Time

16:15-18:00 Discussion Time in the Main Campus of Istanbul University

May 26, 2016 – Thurday

10:00-10:45 "History of QCD"
Harald Fritzsch, *Ludwig Maximilian University of Munich, Germany*

10:45-11:30 "Ageing at the edge of chaos"
Alberto Robledo, *National Autonomous University of Mexico*

11:30-11:45 Tea-Coffee Time

11:45-12:30 "Tangent map intermittency as an approximate analysis of intermittency in a high dimensional fully stochastic dynamical system"
Henrik Jensen, *Imperial College London, UK*

12:30-13:30 Symposium Lunch

14:00 Golden Horn Trip
Guided and Operated by **K. Gediz Akdeniz**
(www.gedizakdeniz.com)

May 27, 2016 – Friday

10:00-10:45 "Extreme reduction of configuration space and occurrence of q-statistics in rank distributions"
G.Cigdem Yalcin, *İstanbul University, Istanbul, Turkey*

10:45-11:30 "Freeman's nonlinear dynamics of cortical phase transition dynamics in beta-gamma transitions in perception"
R.Murat Demirer, *Üsküdar University, Istanbul, Turkey*

11:30-11:45 Tea-Coffee time

11:45-12:30 "Correlation functions in non-crystalline structures"
Hasan Tatlıpınar, *Yıldız Technical University, Istanbul, Turkey*

12:30-13:30 Symposium Lunch

14:00-14:30 "Is it physiological or pathological to be chaotic?"
Tamer Zeren, *Celal Bayar University, Manisa, Turkey*

14:30-15:00 "The self-orginizing and autonomous behaviors practice as metis"
Alp Yağız Tangün, *Political culture researcher, Istanbul, Turkey*

15:00-17:00 Advisory Committee Meeting
Closing Remarks

HUMAN INTELLIGENCE: A CHAOTIC SYSTEM AT WORK

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Intelligence is described as "the ability to adapt to change" and thought to exist in all creatures from a simple worm to primates. It is thought also that the limitation of intelligence may rest in the characteristics of the brain of the animal; these characteristics can be:

- Size of the brain
- Thickness of the cortex
- Density of the neurons in the brain
- Limitation of intelligence via the chaotic work in the ion channels

It is becoming clear that all the above dot points are important in determining how intelligent the animal is and also puts limits on further development on the size and the density of neurons in the brain. Especially the limitation of the cell size due to the chaotic work in the ion channels on the cell membrane places a solid boundary to any further change in the brain size. Therefore, if our present intelligence needs to change, it would depend upon some other developments other than the change in the size of the neurons and hence size of the brain.

RECENT DEVELOPMENTS IN SUPERSTATISTICS

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Many complex driven nonequilibrium systems are effectively described by a superposition of several statistics on different time scales, in short a `superstatistics'[1,2]. A simple example is a Brownian particle moving in a spatially inhomogeneous medium with temperature fluctuations on a large scale, but the concept is much more general. Superstatistical systems typically have marginal distributions that exhibit fat tails, for example power law tails or stretched exponentials. In most applications one finds three relevant universality classes: Lognormal superstatistics, chi-square superstatistics and inverse chi-square superstatistics. Recent applications include e.g. rainfall statistics in environmental systems [3] and quantum turbulence [4,5].

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[3] C. Yalcin, P. Rabassa, C. Beck, J. Phys. A Math. Theor. 49, 154001 (2016)

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SIMPLE CHAOTIC SYSTEMS AND JERKY SYSTEMS OF PHYSICAL INTEREST

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In this work simple three variable non Hamiltonian chaotic systems studied by Sprott[1] and four variable Hamiltonian systems[2] derived from truncations of cyclically interacting three body next neighbor (Toda) systems will be introduced because of the recent physical interest generated by their application. Their transition to chaotic behavior, dynamical invariants and their attractors will be analyzed.

The simple three variable chaotic systems with resonant characteristics and possible candidates for demonstrating Hopf Bifurcation will be emphasized. The derivation of jerky dynamical systems has also become of interest. Occasionally, the jerky systems involve discontinuous functions and calculation of dynamical invariants require approximation of these by two different continuous functions.[3] Chaotic invariants such as Lyapunov exponents and fractal dimensions will be studied. These invariants will be compared between the regular systems and the corresponding derived jerky systems.

The Toda lattice is exactly integrable but its truncations (except for the second order) all show chaotic behavior. Some of these truncations have been of interest in deriving semi classical solutions to gauge theories as demonstrated by Matinyan[4] et.al and results on their chaotic invariants and attractors[5] will be presented.

[1] J. C. Sprott, "Some simple chaotic jerk functions", Am. J. Phys.65 (6), 537-543 (1997)

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THE ROLE OF SCALE INDEX METHOD IN DETERMINING WEAK PERIODIC SIGNALS

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Scale index, a wavelet based method for studying non-periodicity, has recently beenintroduced by Benitez et al. and applied successfully to dynamical systems such as Henon map and Logistic map.

In this presentation, we will discuss the role of scale index method when using Duffing oscillator to determine the frequency components of weak periodic signals embedded in a chaotic signal. For this aim, firstly, this new method is used to determine the transition from critical chaotic state to periodic state in the Duffing oscillator.

Duffing oscillator is a clear example of a weakly nonlinear oscillators and is very sensitive to initial conditions in the critical chaotic state. Bifurcation value determines the state of the Duffing oscillator. At a critical bifurcation value, Duffing oscillator jumps from critical chaotic state to large scale periodic state. The fourth-order Runge–Kutta algorithm was used to solve the Duffing equation and the critical bifurcation value was obtained. At this critical bifurcation value, the transition from chaotic state to periodic state was successfully demonstrated by the calculated scale index parameters.

Key words: Scale Index, Wavelet, Duffing Oscillator, Lyapunov Exponent, Chaotic Behaviour, Scalogram

HISTORY OF QCD

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In the Standard Theory of particle physics the strong interactions are successfully described by the theory of quantum chromodynamics, introduced in 1972. I shall describe first the SU(3)-symmetry, introduced by Gell-Mann and Neeman in 1961. In 1964 the quarks were introduced by Gell-Mann and Zweig. Five years later the quarks were observed in deep inelastic scattering at SLAC.

In 1971 Fritzsch and Gell-Mann introduced the color quantum number of the quarks, which explained the bound state structure of the baryons and the decay rate of the neutral pion. One year later they discussed a gauge theory, based on the gauge group of the color transformations SU(3). This theory is similar to quantum electrodynamics, but the gauge bosons of QCD, the gluons, interact not only with the quarks, but also with themselves. This leads to the phenomenon of asymptotic freedom - the coupling constant decreases at high energies. This has been measured at SLAC, DESY, Fermilab and CERN.

In QCD the hadrons are color singlets. Besides the observed mesons and baryons there should also exist bound states of gluons ("gluonium"). Also there should exist mesons, consisting of two quarks and two antiquarks ("tetraquarks") and baryons, consisting of four quarks and and one antiquark ("pentaquarks"). At very high energies there should exist a new state of matter, the quark-gluon-plasma, e.g. inside massive neutron stars or in nucleus collisions at high energy.

Today the theory of quantum chromodynamics is considered to be the exact theory of the strong interactions, in particular also of the nuclear forces.

AGEING AT THE EDGE OF CHAOS

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A glass epitomizes a disordered system. Here we recall and update the striking parallels observed [1] between the dynamics at the noise-perturbed onset of chaos and the dynamics of glass formation. We characterize the dynamics at the onset of chaos via the period-doubling route in logistic maps when perturbed with additive noise in terms of the quantities normally used to describe glassy properties in structural glass formers. Following the recognition [1] that the dynamics at this iconic low-dimensional attractor exhibits analogies with that observed in thermal systems close to vitrification, we determine the modifications that take place with decreasing noise amplitude in ensemble- and time-averaged correlations and in diffusivity. We corroborate explicitly the occurrence of two-step relaxation, ageing with its characteristic scaling property, and slowed-down diffusion and arrest for this system [2].

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TANGENT MAP INTERMITTENCY AS AN APPROXIMATE ANALYSIS OF INTERMITTENCY IN A HIGH DIMENSIONAL FULLY STOCHASTIC DYNAMICAL SYSTEM

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In collaboration with Alvaro Diaz-Ruelas, Duccio Piovani and Alberto Robledo.

It is well known that tangent maps exhibit intermittency and they have e.g. been used by Procaccia and Schuster [PRA 28, 1210 (1983)] as a general theory of 1/f spectra. This suggests it is interesting to study to what extend one can establish a description in terms of a one-dimensional tangent map when dealing with a high dimensional stochastic systems. The Tangled Nature (TaNa) Model of evolutionary ecology is an ideal candidate for such a study. The fact that the model reproduces a broad range of the phenomenology of macroevolution and ecosystems indicates the relevance of the model. The model exhibits strong intermittency reminiscent of Punctuated Equilibrium and, like the fossil record of mass extinction, the intermittency in the model is found to be non-stationary – a typical feature of many complex systems. We derive a mean field map for the evolution of the likelihood function controlling the reproduction and find a tangent map. This mean field map is only able to describe qualitatively the intermittent dynamics of the full TaNa model. A situation we would expect to be typical for many high dimensional systems. Nevertheless, the description in terms of a one-dimensional tangent map appears to be illuminating.

EXTREME REDUCTION OF CONFIGURATION SPACE AND OCCURRENCE OF q-STATISTICS IN RANK DISTRIBUTIONS

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In this presentation we shall focus on systems that experience a drastic contraction of their configuration space such that the measure of available configurations vanishes with respect to that of the un-contracted space. We argue that the statistical-mechanical descriptionof these systems makes use of dual Tsallis-like entropy expressions. This circumstance arises for attractors at the transitions to chaos in unimodal maps, such as the tangent bifurcation that finds application in the study of ranked data. For these data sets one entropy expression relates to the rank distribution's power-law exponent whereas the other ensures entropy extensivity. We argue that phase-space contraction is farthest for ranked data of the Zipf type, for which we provide a solid bridge between experimental data and theory [1,2].

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FREEMAN'S NONLINEAR DYNAMICS OF CORTICAL PHASE TRANSITION DYNAMICS IN BETA-GAMMA TRANSITIONS IN PERCEPTION

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We explain the nonlinear dynamics by postulating phase transitions in cortical neuropil based on Freeman's approach and theory [1]. We can explain the dynamics with a thermodynamic cycle at three successive levels of complexity in hierarchically organized brain as primary sensory cortices; limbic system; global neocortex. We replace the thermodynamic state variables of pressure, volume and temperature with neurodynamic variables, respectively mean beta-gamma power, pattern stability, and neural feedback gain (mean interaction strength). It is found nonconvergent and chaotic sequences of spatiotemporal oscillations based on Freeman's EEG analysis [1], which gave spatiotemporal amplitude modulation (AM) patterns. Each AM pat- tern was followed by a spatial pattern of phase modulation (PM) in a geometrical cone shape which is phase resetting. This indicates the possibility of phase discontinuities that are necessary for the emergence of spatial patterns over a cone shape. This may be related to cognition [3]. We implement Freeman data analysis approach with some theoretical measures [4-7].

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CORRELATION FUNCTIONS IN NON-CRYSTALLINE MATERIALS

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Structural properties of the non-crystalline materials can be studied by using various theoretical and experimental techniques. Theoretical studies may classified as analytical, semi-analytical and numerical methods. Technological improvements in experimental techniques give opportunities to do researches on very broad class of non-crystalline materials from simple fluids to more complex systems. To analysis the outcome of this experimental researches, the theoretical modeling become very important. The advancing in the computer technology and the computing techniques also gives more advantages to do modeling studies. The aim of this presentation is to discuss the structure of non-crystalline materials and give brief definition of the correlation functions such as direct, indirect and pair correlation functions. By choosing the appropriate model pair interactions the local structural properties of the non-crystalline systems may be obtained from this correlation functions.

IS IT PHYSIOLOGICAL OR PATHOLOGICAL TO BE CHAOTIC?

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Nonlinear analysis methods can be used to explain biological dynamics of physiological systems such as cardiorespiratory and neurological systems. These methods can also determine the normal and pathological structure of the biological systems. The sensitivity to initial conditions is a primary characteristic of chaotic systems. The Lyapunov exponent is a quantitative measurement method of the sensitive dependence on initial conditions and can determine the chaotic level of a system. This value closer to "1" indicates the chaotic behavior of the time series. The pneumocardiography (PNCG) means the recording of cardiac induced air flow or pressure oscillations in the external airways. The nonlinear parameters of PNCG signals might be used as vitality indicators. Also that there is a variability loss in the brain's electrical activity with the epileptic seizure. Nonlinear analyses of EEG signals may be new approach for the diagnosis of epileptic seizure. Nonlinear parameters might be useful to evaluate the patient' progression in intensive care units. If the value of Lyapunov exponent goes under zero, the patient may get progressively worse.

THE SELF-ORGINIZING AND AUTONOMOUS BEHAVIOURS PRACTICE AS METIS

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Scientific research the effort cannot be reduced to the concretization of dialectical activity. Science is taking the initiative and responsibility. Researchers have to ask about "Who are produced knowledge", "For whom are produced knowledge?" and "How are produced knowledge?" Answer of this questions prepares the ground for the discussion of methods of providing a social need.

The structure that provides the needs of social systems is self-organization constitute the practices ofMétis self-organizing and autonomous behaviours as a reading practice offers. Therefore modernity asscientific strategy ignored métis. This presentation revive professional scientific researcher but it openknowledge up for discussion on pragmatic of métis.