



Nonlinear Science Working Group

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*Nonlinear Science Working Group*

*In Memory  
of  
Murray Gell-Mann*



**19<sup>th</sup> International Symposium  
on  
Disordered Systems: Theory and Its Applications**

**15-17 November 2019  
Şişli Municipality Nazım Hikmet Kültür ve Sanatevi  
İstanbul, Turkey**

**Abstract Booklet**

*The Nonlinear Science Working Group 19<sup>th</sup> International Symposium on "Disordered Systems: Theory and Its Applications" (DSS2019) has been dedicated to commemorate the great polymath Murray Gell-Mann.*

*Murray Gell-Mann (1929-2019)*

*Nobel Laureate and Complexity Giant, One of the 20<sup>th</sup> Century's Greatest Physicists – Pioneer, Father of Quarks, Santa Fe Institute Co-founder.*

### **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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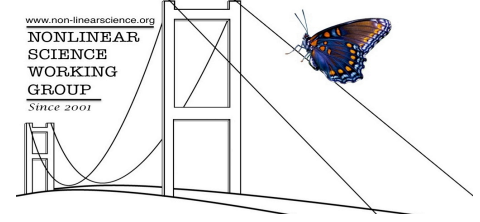
# *SYMPOSIUM PROGRAM*

# Nonlinear Science Working Group

*for exploring complex world*

*Since 2001*

[www.non-linearscience.org](http://www.non-linearscience.org)



*In Memory of Murray Gell-Mann*

## 19<sup>th</sup> International Symposium on

### Disordered Systems: Theory and Its Applications

**15-17 November 2019**

Şişli Municipality Nazım Hikmet Kültür ve Sanatevi, Abidin Dino Hall  
Şişli, İstanbul, Turkey

#### PROGRAM

##### **15 November 2019 - Friday**

- 12:00-13:00 Welcome - Registration (No registration fee)
- 13:00-13:15 Opening
- 13:15-14:15 **Murray Gell-Mann – his physics and his life**  
Harald Fritzsche  
Ludwig Maximilian University of Munich, Germany
- 14:15-14:45 **Photograph exhibition “Murray Gell-Mann”**  
G.Cigdem Yalcin  
Istanbul University, Istanbul, Turkey
- 14:45-15:00 Coffee break
- 15:00-15:30 **Ontogeny and chaos**  
Yelda Tarkan Argüden  
Istanbul University- Cerrahpaşa, Istanbul, Turkey
- 15:30-16:00 **Turbulence in magnetized fusion plasma**  
Özgür Gültekin  
Mimar Sinan University, Istanbul, Turkey

- 16:00-16:30 **Tritonet : A new approach to harmony**  
Tolga Zafer Özdemir  
İstanbul Bilgi University, Istanbul, Turkey
- 16:30-16:45 Coffee break
- 16:45-17:15 **From Aristotelian logic to Buddhist logic**  
Bora Ercan  
Hari Om Yoga Center, İstanbul, Turkey
- 17:15-17:45 **Chaos and framing of theatre and dance art**  
Selçuk Göldere  
Hacettepe University, Ankara, Turkey

**16 November 2019 - Saturday**

- 10:00-10:30 Welcome - Registration (No registration fee)
- 10:30-11:15 **Networks as highly non-linear systems and applications**  
Panos Argyakis  
Aristotle University of Thessaloniki, Greece
- 11:15-11:45 **The problems of neurocentrism**  
Tolga Esat Özkurt  
Middle East Technical University, Ankara, Turkey
- 12:00-13:30 Lunch break
- 13:30-14:15 **“to be announced”**  
Stefan Thurner  
Complexity Science Hub Vienna, Austria
- 14:15-14:45 **Comparison of generalized entropies by the wavelet entropic index**  
Nazmi Yılmaz  
Koç University, Istanbul, Turkey
- 14:45-15:00 Coffee break
- 15:00-15:30 **Formal and conceptual approaches related to entropy concept in postmodern art**  
Gökçe Hiçyılmaz  
Anadolu University, Eskişehir, Turkey

15:30-16:00 **Enigma “-tic Man” in Lynch’s Lost Highway**

Taner Timarci

Trakya University, Edirne, Turkey

16:00-16:30 **An investigation of a major blackout: Turkish power grid example**

G.Cigdem Yalcin

Istanbul University, Istanbul, Turkey

**17 November 2019 - Sunday**

**“A complexity Istanbul Golden Horn tour”**

Guide : K.Gediz Akdeniz ([www.gedizakdeniz.com](http://www.gedizakdeniz.com))

Meeting point and departure time: to be announced

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# *ABSTRACTS*

## **Murray Gell-Mann - his physics and his life**

**Harald Fritzsch**

**Ludwig Maximilian University of Munich, Germany**

In 1953 Gell-Mann introduced the strangeness quantum number to describe the properties of the new particles, discovered in the cosmic rays. In 1961 he proposed the  $SU(3)$  symmetry and predicted a new baryon, the "omega minus". After the discovery of this particle Gell-Mann received the Nobel prize in 1969. In 1971 he and Harald Fritzsch introduced the color quantum number of the quarks. One year later they used the color in a new gauge theory of the strong interactions: quantum chromodynamics.

In 1975 Gell-Mann, Fritzsch and Minkowski wrote a paper on neutrino physics, where they introduced the "see-saw" mechanism to understand the small neutrino masses.

In 1979 Gell-Mann became a director at the MacArthur Foundation. Later he created the Santa Fe Institute. He also wrote a popular book: The Quark and the Jaguar.



## **Photograph exhibition about “Murray Gell-Mann”**

**G. Cigdem Yalcin**

**Department of Physics, Istanbul University, 34134, Vezneciler, Istanbul, Turkey**

Recently we lost Murray Gell-Mann (1929-2019) who is known as Father of Quarks and one of the 20th Century's Greatest Physicists – Pioneer.

He received the Nobel Prize in Physics as the sole recipient in 1969 "for his contributions and discoveries concerning the classification of elementary particles and their interactions."

He is also known as a Complexity Giant and Santa Fe Institute Co-founder.

In this exhibition presentation of honor of Murray Gell-Mann, it will be presented his life that full of scientific achievements that inspired lots of researchers, by using photographs of him.

## **Ontogeny and chaos**

**Yelda Tarkan Argüden**

**Istanbul University-Cerrahpasa, Cerrahpasa Faculty of Medicine,  
Department of Medical Biology, İstanbul, Turkey**

While we all have –almost- exactly the same genome as human beings, still every one of us is unique as a person. These individual differences originate in the first place from the negligibly small differences in our genomes, and further with the unique epigenetic patterns that we gain in every step of multiple cell differentiations which take place during our development and life. As a dynamic system which is dependent of the initial conditions (our specific genome), ontogeny of an organism can be considered as a chaotic event. And no matter how different we are, we all are still human beings, so every single choice in every differentiation step, will have to be in the range of a human cell/organism. This means, being a human genome, restricts the scope of our genome to let what kind of an organism to develop. Therefore, our genome's being a human genome, can be considered as the attractor for our chaotic ontogenetic development.

# **Turbulence in magnetized fusion plasma**

**Özgür Gültekin**

**Mimar Sinan Fine Arts University, Department of Statistics and  
Department of Mathematics, İstanbul, Turkey**

Today, nuclear fusion research is being carried out intensively in many countries for energy production. The fusion reaction was became a current issue at the first Geneva conference in 1955, that it was possible to use it for energy production, and at the second Geneva conference in 1958, the secrecy of all countries' secret fusion programs was completely abolished. Thus, the fusion programs became a research area for peaceful energy.

Most fusion research in the world today is based on the principle of confining plasma with the aid of a magnetic field in a vehicle called tokamak. An important physical event for fusion studies is the turbulence effects in plasma inside the tokamak. The instability and turbulence effects during the collective movements of the particles in tokamak cause the particles to get rid of the torus geometry over time. This incident means that the temperature required for fusion is lost. Although the complex behavior of plasma turbulence has been extensively studied over the last fifty years, it has not yet been fully understood. Solving the problems related to the nature of turbulence is an interdisciplinary field of research where numerical methods based on computer techniques are extensively used besides analytical approaches.

The most advanced technique for calculating the complex behavior of plasma under a strong magnetic field is the Gyrokinetic theory. In this speech, ITG (Ion Temperature Gradient) which is an important instability mechanism in fusion plasma and renormalization of Gyrokinetic equation based on statistical description of plasma will be discussed. Also we emphasize the importance of constituting theoretical background of this subject in Turkey for our contributing the worldwide researches.

## **Tritonet : A new approach to harmony**

**Tolga Zafer Özdemir**

**İstanbul Bilgi University, Department of Music, İstanbul, Turkey**

Tritonet is a calculator for harmony. It constitutes an interface based on ancient 'Circle of Fifths' with new additional components, which provides a ruler for musicians.

Symmetrical layout allows user to construct fundamental knowledge easily such as intervals, scales and chords and build their own harmonic structures. Easy metaphors help to perceive harmony, even for very young students. Harmony education with Tritonet also offers new musical concepts such as ResTens (modular voice leading) and Cyclic Music (Modal Cycles in various speed).

Tritonet is not only an education system but also a software which controls the tonality of Ableton, a music making software. It allows musician to construct, modulate and perform harmony. Harmonic templates can help to get inspired from famous songwriters and composers; it also gives an opportunity to MIDI instruments play in tune.

From a broader viewpoint, Tritonet can be seen as a map of ratios on a circle. The relationship in between the frequencies can be interpreted on some other parts of electromagnetic spectrum. From this point of view, the mechanism can be used in various scientific branches.

I would like to present Tritonet with a basic Music Theory for everyone to grab the fundamentals as well as demonstrate the software with a musical performance.

## **From Aristotelian logic to Buddhist logic**

**Bora Ercan**

**Hariom Yoga Center**

Ancient Greek Philosopher Aristotle (BC 384-322) who put the fundamentals of logic (Classical or Aristotelian logic) defines the syllogism as "a discourse in which certain things having been supposed, something different from the things supposed results of necessity because these things are so".

According to this the general (major) proposition (premise) comes first such as: All men are mortal (which is supposed true); The specific premise (minor) statement comes as a second line such as: Socrates is a man (whose truth value is also one). The result comes depending on deduction: Therefore, Socrates is mortal.

If the first two lines are true then the conclusion is true. There is no doubt.

This way of thinking simply is the base of 'Western Thought'. There has always been an effort to get the reality in the Western World. However, there are other possibilities to reach the truth or reality by reasoning in the different places of the world. Indian philosophy is primarily concerned with the inquiry of 'right knowledge' and 'the means to it', providing diverse aspects as per their believe system. These schools called darśana are divided into main two branches orthodox and heterodox.

One of the eldest orthodox schools of thought named Nyāya – Logic, has four methods of gaining knowledge (pramāṇa):

knowledge (pramāṇa): direct perception (pratyakṣa), inference (anumāna), comparison or analogy (upamāna) and verbal knowledge or testimony (śabda).

In comparison with the Aristotelian logic in Nyāya 'Inference' employs a five-step syllogism as followed:

1. here is fire on the hill (the pratijñā, thesis).
2. Because there is smoke on the hill (the hetu, reason or probans).
3. Wherever there is smoke, there is fire; like a kitchen hearth and unlike a lake (the udāharaṇa, illustration of concomitance).
4. This hill is likewise smoky (the upanaya, application of the rule).
5. Thus, there is fire on the hill (the nigamana, conclusion).

The founder of the heterodox school Gautama Buddha was concerned more to end suffering. Criticizing the emphasis on metaphysics, Buddha questioned the authority of the Veda. Buddhists prefer to rely upon pragmatic experience and individual reasoning rather than relying upon Vedic authority. Their interest in arriving at the correct understanding of reality makes them interested in questions relating to logic and epistemology.

Buddhism follows the inference “whatever exists is momentary, like a cloud” hence the inquiry of knowledge and the means of knowledge is subjective.

In the Suñña Sutta, part of the Pāli canon, mentions that Buddha’s disciple Ānanda asked,

"It is said that the world is empty, the world is empty, lord. In what respect is it said that the world is empty?" The Buddha replied, "Insofar as it is empty of a self or of anything pertaining to a self: Thus it is said, Ānanda, that the world is empty. This system is consisted of four premises so that it is called as *catuṣkoti* (tetralemma). On the one hand there is no conclusion deducted from all these premises, on the other hand there is certain conclusion, which is hidden, unseen, unexpressed.

The basic example could be as following according the previous Aristotelian propositions.

All men are mortal (affirmative)

All men are immortal (negative)

Men are both mortal and immortal (affirmative and negative)

Men are neither mortal and immortal (neither affirmative nor negative)

The final is emptiness (*śūnyata*) depending the readers’ personal experience.

Kōan, a Zen Buddhist practice can be found in the form of story, dialogue or question. The main aim of the kōan is to understand the great doubt and provoke the critical thinking.

That is one of the tool for the Zen practitioner to get the satori or Nirvana so that there is a direct correlation between *Çatoṣkoti* and Kōans: To say the unsayable! This way is also called the ‘gateless gate’, ‘effortless effort’ or so...

These ancient schools of logic and reasoning are still kindling the attraction and drawing many Eastern and Western scholars for inspiration and understanding.

# **Chaos and framing of theatre and dance art**

**Selçuk Göldere**

**Hacettepe University Ankara State Conservatorium Stage Arts Departments  
Theatre and Ballet Department, Ankara, Turkey**

Chaos theory, in mechanics and mathematics, the study of apparently random or unpredictable behaviour in systems governed by deterministic laws. A more accurate term, deterministic chaos, suggests a paradox because it connects two notions that are familiar and commonly regarded as incompatible. But in this small presentation is directed to questions about the ontology, that is, the material and conceptual structures, of art. Especially on theatre directing and acting or contemporary dancing and choreography include some structures those could followed by the principles of chaos theory. Gilles Deleuze, in his own writings as well as in his collaborations with Felix Guattari, is the second major intellectual resource I have relied on here and everywhere in our art work. Without his, and their, major concepts—chaos, the planes of immanence and composition, territorialization, deterritorialization, and many others—I would have had nothing to say about art, at least nothing philosophical. Taken together, Irigaray and Deleuze, alone and in his collaborations with Guattari, generate a tension, their concepts do not fit together well, they produce an uneasiness that I have found exhilarating, problematic, and inspiring. Taken together— and mediated through the writings of Darwin—they enable us to understand the productive and artistic interactions between living sexed bodies, and a dynamic, unpredictable and eventful world, Many others, more personally accessible to me than Irigaray or Deleuze, have enabled me to prepare and complete this current project While I am not just trained in the visual or spatial arts, there are, nonetheless, many points of overlap, regions of co-occupation, that concern art and philosophy, and it is these shared concerns that I want to explore here. Art, according to Gilles Deleuze, does not produce concepts, though it does address problems and provocations. It produces sensations, affects, intensities as its mode of addressing problems, which sometimes align with and link to concepts, the object of philosophical production, which are how philosophy deals with or addresses problems. Thus philosophy may have a place not so much in assessing art (as aesthetics has attempted to do) but in addressing the same provocations or incitements to creation as art faces—through different means and with different effects and consequences.

# **Networks as highly non-linear systems and applications**

**Panos Argyakis**

**Aristotle University of Thessaloniki, Greece**

Networks are a modern tool to explain the behavior of several systems in practically all sciences, engineering, and humanities today, helping us to understand practical problems of everyday life. As such, it is an inter-disciplinary method combining techniques from Mathematics, Physics, Computer Sciences, and other fields of research. They are characterized by strongly non-linear behavior. The origin of this approach will be explained in detail, as it comes out at the same time as the birth of the Internet. Several examples will be described from many fields, including Physics, Chemistry, Biology, Transportation, Entertainment, Sociology, Economics, Linguistics, and more. Recent results will be described for spreading processes in networks, such as spreading of diseases, spreading of an economic crisis, spreading of innovation in sciences, etc.



# **The problems of neurocentrism**

**Tolga Esat Özkurt**

**METU Graduate School of Informatics, Department of Health Informatics,  
Ankara, Turkey**

According to the current mainstream paradigm in neuroscience, there are three essential components considered in an experimental research (Buzsáki, 2019): the observer (the neuroscientist), the brain (the organ) and the outside world (the environment). A well-known Turkish neurophilosopher summarized this paradigm in a concise statement in his book (Tura, 2018): “The world is a huge Penfield experiment”. Due to this empiricist view that currently drifts the whole field, there exist material brains and all other is neural projections of the material world surrounding them. In this picture, the world embedded in space-time is conceived as if it is an object of a grand omnipotent scientist.

The world is supposed to convey sensory information (stimulus) for the brains to be encoded and subsequently for the necessary motor actions to be decided upon. Thereafter, the observing experimenting scientist interprets how that projected information, i.e., the neural code, represents the outer world. If both the brains and the outside world of things are material beings made from the same stuff, how can the former material thing represent the latter material thing in a privileged way but not the other way around? Unless there is a magical element in the brains, the idea of some material more or less veridically representing some other material seems to be inherently problematic. Like the structure of famous barber paradox introduced by Bertrand Russell, “the barber who shaves all who cannot shave themselves”, the brain is assumed to represent all who cannot represent itself, but this time with a twist, unlike the helpless poor barber, the brain of the experimenter neuroscientist can somehow also represent other brains, thanks to neuroimaging and data analysis techniques. Though, it follows that the experimenter’s brain who senses a brain, may also be sensed by another brain which would go on *ad infinitum*, leading to an infinite regress. This line of reasoning arises the question, what about the brain as a material thing to

be perceived? What does really yield the brain a privileged ontological status within the physical world? Some would say, perhaps the large scale small-world connectivity, nonlinear complexity or plasticity – though this does not assign, for instance, the atmosphere or a social media platform such as Facebook or a cancerous malignant tumor any mental property that the brain is presumed to possess or generate, particularly properties of consciousness. Thus, ironically, the monistic physicalist tendency of neurophilosophers, who are ardent opponents of Cartesian dualism of mind and matter, arrives to even a stranger dualistic cul-de-sac: dualism of the brain and the rest of the world.

However, one should not forget that there is no such a thing as “the brain” as well as “the chair”, as there is no such a “thing” being universal and normal. Both are our abstract useful constructs. Our own models conceptualize these natural and man-made things and take the abstractions to further our steps, both in daily life and scientific activities. The template common brain is hence an invention of neuroscientists. We scientists assume a common image of brain from our statistical analyses of many, while excluding the statistically marginal ones. Normalized brains are collected from groups of people that are almost always constrained by the political and cultural Zeitgeist. The vast majority of neuroimaging studies draw their results from the brains of Western psychology students as the Western researchers can access them rather easily and free of charge. For example, visual cortices of Australian Aboriginal brains are known to be quite different from the “normal” ones (Klekamp et al., 1987), in addition to the many reported cases of hugely lacking in material but all the same functioning pathological brains (e.g., Borgstein and Grootendorst, 2002). Though the template normalized brain does not exist as a thing, this obviously does no way negate its usefulness. On the contrary, it offers us an opportunity to intervene into the brains intelligently, such as in brain computer interfaces and electromagnetic brain stimulations.

Neurocentrism misses this point of the irreducible gap between abstract epistemic closures (knowledge) and concrete ontological openness (becoming). Being aware of it could enable and encourage the scientists to transform the scientific episteme and march to more effective interventions and technological innovations, instead of being dogmatically stuck under the weight of out-of-habit

but no-more-useful cumbersome assumptions held by the current paradigm. This presentation attempts to underline some of the common misleading ideological neurocentric assumptions.

- [1] Borgstein, J., Grootendorst, C., Half a brain, *The Lancet*, 359, 473, 2002.
- [2] Buzsáki, G., *The Brain from Inside Out*, Oxford University Press, 2019.
- [3] Klekamp, J., Riedel, A., Harper, C., Kretschmann, H. J., A quantitative study of Australian aboriginal and Caucasian brains, *Journal of Anatomy*, 150, 191-210, 1987.
- [4] Tura, S. M., *Zor Problem: Bilinç*, Metis Yayınları, 2018.

# Comparison of generalized entropies by the wavelet entropic index, $q \equiv 1 + 2i_{\text{scale}}$

Nazmi Yılmaz<sup>1</sup>, Mahmut Akıllı<sup>2</sup>, K. Gediz Akdeniz<sup>3</sup>,

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The scale index,  $i_{\text{scale}}$  is a wavelet based parameter for measuring aperiodicity of a dynamical system. The wavelet entropic index,  $q \equiv 1 + 2i_{\text{scale}}$  was suggested in a recent work [1] for the relation of the entropic index,  $q$  with the scale index,  $i_{\text{scale}}$ .

In this work, Boltzmann-Gibbs-Shannon, Tsallis, Abe and Landsberg-Vedral entropies of the Logistic Map and Hennon Map were calculated by normalized inner scalogram.  $q$ -dualities of the Tsallis entropies were determined using the infinite set of indices  $q \rightarrow q_a(q)$  recently proposed by Tsallis [2]. The results were compared to emphasize the effective use of the wavelet entropic index which was derived using the expression;  $q \equiv 1 + 2i_{\text{scale}}$ .

[1] Mahmut Akıllı, Nazmi Yılmaz and K.Gediz Akdeniz, Study of the  $q$ -Gaussian distribution with the scale index and calculating entropy by normalized inner scalogram, Physics Letters A, 383, 11, 1099-1104, (2019).

[2] Tsallis, C. Generalization of the possible algebraic basis of  $q$ -triplets. Eur. Phys. J. Special Topics 226, 455–466 (2017).

Keywords: Tsallis Entropies, Boltzmann-Gibbs-Shannon Entropy, Abe Entropy, Landsberg-Vedral Entropy, wavelet entropic index, wavelet analysis, scale index, normalized inner scalogram.

# **Formal and conceptual approaches related to entropy concept in postmodern art**

**Gökçe Hiçyılmaz**

**Anadolu University, Graduate School of Fine Arts, Department of Sculpture  
Eskişehir, Turkey**

According to the Modernist point of view, every problem can be identified and solved in every aspect of life by mere logic. This approach has resulted in the reduction of all phenomena, especially humans and the universe, to fixed rules over time. From the 20th century onwards, theories such as quantum mechanics, non-Euclidean geometry, uncertainty theory, relativity theory, and chaos theory have shown that the linearity, determinability, and predictability of classical science cannot be applied in all cases. At the same time, many problems of modernity surfaced in social life and began to be criticized loudly. By the second half of the 20th century, paradigms in science, philosophy, and art have changed. This new period is called postmodernism, which is referred to as 'after modern'. In postmodernism concepts such as uncertainty, skepticism, flexibility, contingency, pluralism, polyphony, eclecticism, decentralization and fragmentation have come to prominence. The importance of irregularity for emancipation is emphasized, rather than a standardized approach to establishing an ideal order. At this point, the concept of *entropy*, which refers to the disorder in increasing energy, which is the second law of thermodynamics, also led to the emergence of new expansions in sociology, economics, philosophy, literature and art.

The aim of this presentation is to provide an insight into the current relationship between contemporary art and contemporary science by addressing conceptual and formal approaches related to entropy in postmodern art with examples of works.

Keywords: Entropy, Postmodernism, Postmodern Art, Science

# **Enigma “-tic Man” in Lynch’s Lost Highway**

**Taner Tımarcı**

**Trakya University, Edirne, Turkey**

The films of David Lynch, with a non-linear, non-chronological, chaotic and circular narrative, very differently from conventional films, have attracted very much attention of film analysts and interpreters as well as the film theorists. One of this kind of his films, *Lost Highway* (1997) classified as also a ‘film noir’ is considered in this talk. There have been psychoanalytic, cognitive, existentialist, neuroscientific approaches in analysing and understanding/reading this film.

The film is about the transformations of the protagonist, between the worlds of real/desire and fantasy, in Lacanian terms.

At the beginning of the script, the characteristics of the film are given by Lynch as:

A 21st Century Noir Horror film

A graphic investigation into parallel identity crises

A world where time is dangerously out of control

A terrifying ride down the lost highway

After presenting the plot/story of the film, specifically by focusing on the scenes of an enigmatic character- mystery man- as it is named in the script, with his timelessness and spacelessness, his role/contribution on the flow of the story is tried to be examined mainly by use of Žižek’s approach based on Lacanian reading as well as by the other approaches mentioned above.

## **References**

-Slavoj Žižek, *The Art of Ridiculous Sublime: On David Lynch’s Lost Highway* The Walter Chapin Simpson Center for the Humanities, University of Washington, Seattle, 2000.

-Todd McGowan, *The Impossible David Lynch*. New York; Columbia UP, 2007.

-Robert Sinnerbrink, *Everything You always Wanted to Know About Lynch But Were Afraid to Ask Lacan*. South Atlantic Review, Vol 72, No 4, 128-132, 2007.

-Steffen Hven, *Facing The Lost Highway: Three approaches to the cinematic encounter* Speciale i Dramaturgi, MA Thesis, Aarhus University, 2010.

# **An investigation of a major blackout: Turkish power grid example**

**Benjamin Schäfer<sup>1</sup> and G. Cigdem Yalcin<sup>2</sup>**

**<sup>1</sup>Chair for Network Dynamics, Center for Advancing Electronics Dresden (cfaed)  
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**<sup>2</sup>Department of Physics, Istanbul University, 34134, Vezneciler, Istanbul, Turkey**

The complex systems studies have shown us that in many areas of life, we are surrounded by natural or man-made networks, either technologically or sociologically, will directly or indirectly affect to human being.

Although as growing our modern societies have getting higher technology with electricity, in contrary to this, every decade we are facing that it is getting have more major power blackouts in various locations. In 2015, the power blackout of Turkey was one of these major power blackouts and affected the entire country of about 75 million people due to one initially overloaded transmission line.

In this talk, it is investigated the dynamical and statistical properties of the Turkish power grid as a real-world system example and presented for the first time a model that focuses on the Turkish power grid as a complex network topology by investigating its cascading failures.

It is also discussed about an interesting and ideal future project that would be to test our predictions by using real node and edge properties.

[1] B. Schäfer, D. Witthaut, M. Timme, and V. Latora, Dynamically induced cascading failures in power grids, Nature communications, 9, 1975, 2018.

[2] Benjamin Schäfer and G. Cigdem Yalcin, Dynamical modelling of cascading failures in the Turkish power grid, Chaos 29, 093134, 2019.