ICTP
SAIFR

International Centre for Theoretical Physics
South American Institute for Fundamental Research

School on Complex Systems and Applications to Neurosciences

Instituto de Física Teórica - UNESP, São Paulo, Brazil

ORGANIZERS

Stefano Boccaletti

(CNR- Institute of Complex Systems – Florence -Italy, and the Italian Embassy in Israel)

Javier M. Buldú

(Center for Biomedical Technology & U.R.J.C., Madrid, Spain)

Hilda Cerdeira

(Instituto de Física Teórica, UNESP, São Paulo, Brazil)

Jesús Gómez Gardeñes

(Universidad de Zaragoza, Spain)

Claudio Mirasso

(IFISC, Universitat de les Illes Balears, Spain)

Antonio Roque

(Universidade de São Paulo at Ribeirão Preto, Brazil)

OBJECTIVES

The School on **Complex Networks and Applications to Neurosciences** will cover theoretical aspects and current trends in **Network Science** including their structural properties, dynamical processes, and multiplex networks with applications to social, technological and biological systems.

The second half of the school will provide a detailed course on **Neurosciences** focused on the physiology of the cell and neuronal models, time series analysis and characterization, complex brain networks, collective phenomena and information processing in the brain, and neuroimage techniques and mental diseases.

LECTURERS

Stefano Boccaletti
(CNR- Institute of Complex Systems – Florence -Italy, and the Italian Embassy in Israel)
Javier M. Buldú
(Center for Biomedical Technology & U.R.J.C., Madrid, Spain)
Jesús Gómez Gardeñes
(Universidad de Zaragoza, Spain)
Claudio Mirasso
(IFISC, Universitat de les Illes Balears, Spain)
Antonio Roque
(Universidade de São Paulo at Ribeirão Preto, Brazil)
Edson Amaro Jr
(Hospital Israelita Albert Einstein, Brazil)
Nuno M. de Araujo
(Universidade de Lisboa, Portugal)
Mauro Copelli
(Universidade Federal de Pernambuco, Brazil)
Ernesto Estrada
(University of Strathclyde, U.K.)
Vincenzo Nicosia
(Queen Mary University of London, U.K.)
Adriano Tort
(Universidade Federal do Rio Grande do Norte, Brazil)

INVITED SPEAKERS

Tiago Pereira
(Imperial College London, U.K.)
Roberto Andrade
(Universidade Federal da Bahia, Brazil)
Ricardo Barros Sampaio
(Fundação Oswaldo Cruz – Brasília, Brazil)

STUDENTS

- 51 students coming from 12 different countries (Venezuela, Colombia, Israel, Bolivia, Germany, Sudan, Cameroon, Nigeria, Argentina, México, Iran and, of course, Brazil)

- Undergraduate, PhD students, PostDocs, Professors…

- Different backgrounds: Physicists, biologists, engineers…

- Different expertise.

ACTIVITIES

- **Lectures:** One and a half hour presentations (including original and review works) about different topics related to Network Science and Neuroscience.

- **Oral presentations by the students:** 10 minute talks by the students, who will introduce their on-going research to the rest of participants.

- **Work in groups:** Students, divided into 10 groups of around 5 people, will analyze different kind of networks.

- **Presentation of the results:** On Thursday 8th.

- **School dinner:** Friday 2nd.

- **Football match:** Monday 5th. Brazil vs rest-of-the-world

- Other activities are welcomed

PROGRAM: WEEK I

Fundamentals of Complex Networks						
Week 1	**Monday Sept. 28**	**Tuesday Sept. 29**	**Wednesday Sept. 30**	**Thursday Oct. 1**	**Friday Oct. 2**	**Saturday and Sunday Oct. 3 and 4**
8:00 - 9:00	**Registration**					FREE
9:00- 10:45	Welcome (H. Cerdeira, J. Buldú & S. Boccaletti)	Structure of Complex Networks (E. Estrada)	Random Walks (E. Nicosia)	Synchronization Transitions in the Kuramoto model (N. Araujo)	Percolation theory in networks (N. Araujo)	
10:30 - 10:45	Int. to Networks (E. Estrada) **(at 9:40)**	Coffee	Coffee	Coffee	Coffee	
10:45 - 12:15	Coffee **(at 11:15)**	Sructure of Complex Networks (E. Estrada)	Social Dynamics: Opinion Formation in Networks (E. Nicosia)	The Master Stability Function (S. Boccaletti) **by SKYPE**	Epidemic Models in Networks (J. Gardeñes)	
12:15 - 14:00	Int. to Networks (E. Estrada) **(at 11:30)** Lunch **(at 13:00)**	Lunch	Lunch	Lunch	Lunch	
14:00 – 15:15	Work in groups **(at 14:30)**	Network phase transitions (E. Nicosia)	*IFT/SAIFR Colloquium* TBA (Tiago Pereira)	Structure and robustness of network infrastructures (N. Araujo)	Student´s seminars	
15:15 – 15:45	Coffee **(at 16:30)**	Coffee	Coffee	Coffee	Coffee	
15:45 – 19:00	Work in groups **(at 17:00)**	Work in groups	Communicability in complex networks (E. Estrada) Work in groups **(at 17:15)**	Work in groups	Student's seminars	

PROGRAM: WEEK II

Week 2	Fundamentals of Complex Networks			Applications to Neuroscience		Saturday and Sunday Oct. 10 and 11
	Monday Oct. 5	Tuesday Oct. 6	Wednesday Oct. 7	Thursday Oct. 8	Friday Oct. 9	
9:00- 10:30	Multilayer Networks: Structure (E. Nicosia)	Evolutionary Game Theory I (J. Gardeñes)	Applications to Biology: from RNA to Brain Networks (J. Buldú)	An overview of single-cell and neural network models I (A. Roque)	Detecting and tracking cell assemblies II (A. Tort)	FREE
10:30 - 10:45	Coffee	Coffee **(at 10:00)**	Coffee	Coffee	Coffee	
10:45 - 12:15	Multilayer Networks: Dynamics (E. Nicosia)	Evolutionary Game Theory II (J. Gardeñes) **(at 10:15)** Applications to Social Networks: Music Networks (J. Buldú) **(at 11:15)**	Applications to Biology: from RNA to Brain Networks (J. Buldú)	Detecting and tracking cell assemblies I (A. Tort)	An overview of single-cell and neural network models II (A. Roque)	
12:15 - 14:00	Lunch	Lunch	Lunch	Lunch	Lunch	
14:00 – 15:15	Complex Network Analysis on Neglected Diseases: A solution for Public Health (R. Sampaio)	Connecting networks (J. Buldú)	*IFT/SAIFR Colloquium* Recovering evolutionary history by complex network modularity analysis (R. Andrade)	Student´s presentations I Coffee **(at 4:00)** Student´s presentations II	Discussion new set of works	
15:15 – 15:45	Coffee	Coffee	Coffee		Coffee	
15:45 – 19:00	Work in groups	Work in groups	Work in groups		Work in groups	

PROGRAM: WEEK III

Week 3	Applications to Neuroscience				
	Monday Oct. 12	**Tuesday Oct. 13**	**Wednesday Oct. 14**	**Thursday Oct. 15**	**Friday Oct. 16**
9:00- 10:30	Collective neuronal phenomena I (M. Copelli)	Neuroimages techniques and mental illnesses I (E. Amaro Jr.)	Using machine learning to explore neural data sets (R. Vicente)	Collective neuronal phenomena II (M. Copelli)	Collective neuronal phenomena III (M. Copelli)
10:30 - 10:45	Coffee	Coffee	Coffee	Coffee	Coffee
10:45 - 12:15	Cross-frequency coupling between brain rhythms (A. Tort)	Neuroimages techniques and mental illnesses II (E. Amaro Jr.)	Magnets, machines, brains (R. Vicente)	Sustained Activity in a layered spiking cortical model (A. Roque)	Deep learning (R. Vicente)
12:15 - 14:00	Lunch	Lunch	Lunch	Lunch	Lunch
14:00 – 15:15	Zero lag and anticipated synchronization in neuronal circuits (C. Mirasso)	Neuroimages techniques and mental illnesses III (E. Amaro Jr.)	***ICTP/SAIFR Colloquium*** Information Processing with neuro-inspired delay-based nonlinear systems (C. Mirasso)	Students seminars	Student´s presentations I Coffee **(at 4:00)** Student´s presentations II
15:15 – 15:45	Coffee	Coffee	Coffee	Coffee	
15:45 – 19:00	Work in groups	Students seminars	Work in groups	Work in groups	

FINALLY…

Please, **participate** in all lectures.

Interact with all other participants (students or lecturers) as much as possible.

And also **enjoy** your time in São Paulo!