



Course announcement

Complex Network Theory: a new perspective in the analysis of hydraulic and hydrogeological systems

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University of Chieti- Pescara



15 hours

Classes will be in English
Compulsory attendance (online)

Final essay based on a series of questions and exercises

ABSTRACT

The advent of Complex Network Theory (CNT) involved a large part of the scientific community in recent years by proposing new approaches and metrics, often going beyond traditional analysis tools, in order to model and interpret an impressive number of natural and anthropic phenomena. This because CNT models in an efficient way the most part of the real world as networks, composed of vertices (nodes) connected by edges (links), that indicate the interactions among them.

The integration of both mathematical and technical tools, as well as the growing availability of data, make it possible to study and interpret an enormous number of complex systems, where the main component is topology, that is, the way in which elements are connected and interact with each other.

This course offers an overview of all the CNT tools and their use in the study and analysis of real systems from a topological perspective. The focus will be mainly on water systems, which represent complex networks composed of several interconnected components, structured in non-trivial configurations, whose behaviour is largely influenced by their connective structure, spatial limits, and interactions between components.



OBJECTIVES

This course aims to address the following points:

- Introduction to CNT. Euler and the problem of the Königsberg bridges. Graphical representation and adjacency matrix. Basic concepts and study of topological properties.
- Centrality metrics as tools to identify the most important elements in complex real systems. Degree, Betweenness, Closeness and Harmonic.
- Construction of predictive models for understanding complex real systems. How the connective structure is fundamental to determine vulnerability and robustness. Regular, random, small-world (principle of six degrees of separation) and scale-free networks.
- Communities and clustering for system analysis and management. Detecting the presence of communities is essential for discovering the internal connections of complex structures and facilitating practical applications in many disciplines.
- Time series and their representation in CNT: Visibility algorithms.
- Overview of the different fields of application: social systems, road networks, distribution systems, biological organisms, technological networks, computer networks, epidemiology, etc.
- Applications to your research topic.

✉ **Register by April 17, 2024** sending email to:

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For those not at University of Chieti-Pescara it is possible to follow the short course online: specify request when you register.

TIMETABLE			
THURSDAY	18/04/2024	13:30	17.30
FRIDAY	19/04/2024	9:00	13:30
MONDAY	22/04/2024	14:00	17:00
TUESDAY	23/04/2024	9:00	12:00