Four Lectures:
February 27, February 29,
March 3, and March 5
3:30-5:00 p.m.
Hamerschlag D210

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dergree in Computer and Automation Engineering
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II”, Italy. He is currently Assistant Professor of
Systems and Control Theory at the University of
Magna Græcia, Catanzaro, Italy. His research
interests are focused on finite-time stability of
linear systems, stability of quadratic systems,
modeling and reconstruction of biological net-
works.

Outline of the lectures:

■ Introduction to Systems Biology
  o Biology in a nutshell
  o Getting experimental data
  o Modeling biochemical reactions
    ♦ Deterministic models
    ♦ Stochastic models
■ Biological Networks
  o Types of biological networks
  o Dynamical models of biological
    networks
  o Inference of biological networks
■ Analysis and Simulation of Biological
  Systems
  o A case-study: The cell cycle
  o Modeling the cell cycle
  o Analysis of biological models
  o Software tools

Systems biology is concerned with the study of
biological functions and mechanisms, underpinning
inter- and intra-cellular dynamical networks, by
means of signal- and system-oriented approaches.
The application of mathematical and engineering
concepts to biology is not a novelty, indeed the first
works in this area can be traced back to several
centuries ago (e.g. population models, dynamics of
infectious diseases). Nonetheless, only recently the
need for a more systematic view of biological
processes, as opposed to the reductionist approach
that has played a dominant role in the past centuries,
has yielded to the widespread and interdisciplinary
research field that is now referred to as systems
biology.

This renewed interest is largely based on the
revolution of experimental techniques and
methodologies brought by biotechnologies (the
so-called omics). New high-throughput methods
allow measurement of the expression levels of all
genes of a cell at the same time and with suitable
time resolution. Fluorescence labeling and
sophisticated microscopy techniques enable us to
directly observe the spatio-temporal dynamics of
specific molecules within a single cell.

The potential benefits of systematic approaches
encompass a deeper understanding of biological
processes, thanks to the use of formal models and
reverse-engineering methodologies, and the
possibility to predict the response of complex
systems to exogenous and endogenous
perturbations (harmful compounds, drugs, genetic
mutations) by means of in silico experiments, thus
helping in overcoming the limits of classical in vitro/in
vivo experimentation.

This series of lectures will provide an overview of
some of the main topics in systems biology, starting
with a brief review of basic biological notions and
biochemical reaction modeling. The core of the
course will consist of an overview of different types of
models used for describing biological networks and
some of the methods that exploit such models to
infer biological knowledge from experimental
observations. Finally, some analysis methodologies
and simulation tools will be presented and illustrated
through a relevant case-study, namely the model of
cell division cycle.