UCL Faculté des sciences appliquées

FSA

INMA2361	NONLINEAR SYSTEMS

[30h+22.5h exercises] 5 credits

This course is taught in the 1st semester

Teacher(s):	Rodolphe Sepulchre
Language:	french
Level:	2nd cycle course

Aims

An increasing number of engineering applications either exploit or have to deal with nonlinear dynamical phenomena. The course presents the basic mathematical tools used in the modelling and analysis of such phenomena.

Main themes

The course is an introduction to the analysis and synthesis of nonlinear dynamical systems. The mathematical tools are illustrated on different applications, preferentially in the fields of neurodynamics, nonlinear control, and physics. Further specific illustrations are presented by the students at the end of the course.

Content and teaching methods

- Introduction to nonlinear dynamical phenomena
- Introduction to dynamical models in neuroscience
- Multiple equilibria and planar models
- Simple models of neural computation, Hopfield networks
- Gradient systems, Lyapunov functions, stability
- Feedback stabilization of equilibria
- Limit cycles
- Hopf bifuractions, asymptotic methods
- Coupled oscillators, synchronization phenomena
- Input-output tools for the analysis of nonlinear systems
- Introduction to chaos and strange attractors

Other information (prerequisite, evaluation (assessment methods), course materials recommended readings, ...)

Information about the course and a copy of the slides are available at
http://www.montefiore.ulg.ac.be/systems/SYST017/syst017.htm
References :
"Nonlinear Dynamics and Chaos", S. Strogatz, Perseus Books Publishing, 1994.
"Spikes, decisions, and actions. Dynamical foundations of neuroscience", H.R. Wilson, Oxford University Press, 1999.
"Nonlinear Oscillations, Dynamical Systems, and Bifurcation of Vector Fields", Guckenheimer, Holmes, Springer-Verlag, 1983.
"Introduction to the theory of neural computation", J. Hertz, A. Krogh, R. Palmer.
Evaluation :
- A final project by groups of two students. The project includes bibliographical research, computer simulations, and an oral presentation.
- A few homeworks during the academic year

Other credits in programs

ELEC22	Deuxième année du programme conduisant au grade d'ingénieur civil électricien	(5 credits)
ELEC23	Troisième année du programme conduisant au grade d'ingénieur civil électricien	(5 credits)
FSA3DS/TO	Diplôme d'études spécialisées en sciences appliquées (automatique)	(5 credits)
INCH23	Troisième année du programme conduisant au grade d'ingénieur civil chimiste	(5 credits)
MAP23	Troisième année du programme conduisant au grade d'ingénieur civil en mathématiques appliquées	(5 credits)