(Global) Optimization methods and their applications in bioprocesses and biological systems

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Mathematical optimization is at the core of many problems in bioprocess engineering and systems biology:

i) as the underlying hypothesis for model development, many systems in biology are modeled considering that their behavior is optimal in some sense. This is the underlying hypothesis of, for example, in dynamic flux balance analysis or the activation of enzymes in biochemical networks.

ii) in model parametric identification: mathematical models usually depend on parameters (kinetic constants, heat transfer coefficients, thermal conductivity, etc.) that are not accessible to experimentation and therefore must be computed by means of experimental data fitting. In this sense the objective is to compute model parameters to minimize the distance between model predictions and experimental data.

iii) in the computation of optimal control procedures to achieve a particular desired behavior (maximize production in a bioreactor, maximize quality while guaranteeing safety in food preservation, etc) off line but also on-line in the context of real time optimization.

These problems are usually formulated as non-linear programming problemswith dynamic and algebraic constraints whose solution will require the use of adequate numerical simulation techniques together with efficient and robust optimization methods.

This course will introduce the mathematical formulation of this type of problems together with the numerical techniques required for their solution. All concepts will be illustrated with a number of examples related to bioprocesses including food processing and biological systems.

The course is organized in 4 modules as follows:

ï*f*˜ Introduction to non linear optimization. Methods and examples.

ï*f*˜ Dynamic optimization. Methods and examples for off-line and on-line applications.

ï*f*˜ Parametric identification. Methods and examples.

ï*f*˜ AMIGO, a matlab toolbox for model identification. Software and examples. The course will take place at UMONS (Service d'Automatique, 31 Boulevard Dolez, 7000 Mons - 1rst floor to the left in the lecture room of the Control group).
Registration to the course is required by email to Mrs Veronique Piette (veronique.piette@umons.ac.be)

The time schedule of the course is:

- Wednesday 30 November 2011
9:30 welcome
10:00 - 12:30 : module 1
14:00 - 17:30 : module 2

- Thursday 1 December 2011
9:30 welcome
10:00 - 12:30 : module 3
14:00 - 17:30 : module 4