Interuniversity Attraction Poles
phase VII/19 - DYSCO

Study day 12 november 2014

Het Pand - Ghent University

PLENARY TALKS

Dissipativity and Lyapunov Stability of Economic Model Predictive Control

Prof. Dr. Moritz Diehl
University of Freiburg & KU Leuven

Classical model predictive control (MPC) implementations rely on a quadratic, positive definite cost function. In contrast to this, in economic MPC, the stage cost can be any generic differentiable function. Recent research has focused on establishing the conditions for stability of economic MPC, where strict dissipativity has been shown to play an important role. In this talk, starting from the indefinite linear quadratic case and extending the analysis to the nonlinear case, we attempt at clarifying the relationship between strict dissipativity and the Lyapunov stability properties of economic MPC. The main practical result is that for any system and cost that are optimally operated at steady state, there is a tracking MPC formulation with positive definite quadratic cost that achieves asymptotically the same performance as economic MPC, but comes with stronger stability guarantees. The talk reports on joint work with Mario Zanon and Sebastien Gros.

To queue or not to queue - Rational Queueing

Prof. Dr. Refael Hassin
Tel Aviv University

``Rational Queueing'' refers to models of queueing systems with multiple decision makers aiming to optimize (in most cases) contradicting objectives. The research in this area characterizes the equilibrium outcomes of the resulting non-cooperative games. A book by Hassin and Haviv (2003) presents the topic and surveys the state of the art at that time. Since then the area has been developing rapidly and the talk will mention an on-going project that surveys about 650 papers that are not included in the book, almost all of them published after 2003. The talk will mention central contributions in this area with the emphasis on qualitative insights that are unique to queueing theory.

Paper review - Fast Laplacian Solvers

Prof. Dr. Jean-Charles Delvenne
UC Louvain

Dan Spielman and Shang-Hua Teng (2004,2013) showed how to solve Laplacian linear systems in a time nearly linear in the number of non-zero entries. The running time is otherwise independent of the entries of the matrices, e.g. does not depend on a condition number, spectral gap, etc. This result was later improved, simplified and extended to all symmetric diagonally dominant systems by Kelner et al, and Lee and al (2013). In this talk we overview the main ideas behind this breakthrough.
This is joint work with Maguy Trefois and Paul Van Dooren.

Novel actuators for human-robot interaction

Prof. Dr. Ir. Bram Vanderborght
Vrije Universiteit Brussel

Actuators are key components for moving and controlling a robot. Actuators underwent some fundamental changes. Where in classical industrial robotics the motto is the stiffer the better, for applications requiring interaction with an unknown and dynamic environment including humans, compliant actuators have several advantages. Several projects focus on the development of variable impedance actuators for increased safety, energy-efficiency and allow highly dynamic motion, which permit the embodiment of natural characteristics, found in biological systems into a new generation of mechatronic systems. In the research group we work on several applications powered by compliant actuators including manipulators, legged robots, prostheses, exoskeletons and social robots. However, the torque and efficiency of the current state-of-the-art actuators are still insufficient and much lower than in humans. There are several applications where the unavailability of suitable actuators hinders the development of well-performing machines with capabilities comparable to a human. Remarkably, the power density and efficiency of electric motors are higher than a human muscle, so the problem of insufficient torque and efficiency resides in the transmission of the power and in that the motors are not used at their highest efficiency. In order to cope with these problems we are exploring a novel actuation paradigm, which we call Series-Parallel Elastic Actuation (SPEA). This new actuation paradigm is inspired by the series-parallel organization of the muscle fibers. A SPEA consists of a bundle of multiple parallel compliant elements, each of the compliant elements can be contracted separately so that only a fraction of the torque on the joint remains to be delivered by the motor, while the main part of the torque is delivered by the parallel springs. First prototypes show that Series-Parallel Elasticity has high potential to achieve high torque capacity and improved energy efficiency.

POSTERS

* second session

TRANSFER FUNCTION ESTIMATION VIA GAUSSIAN PROCESSES REGRESSION

John Lataire *and Tianshi Chen, VUB*

Recently, the interest in regularisation techniques for system identification has seen a major growth. Regularisation allows for the incorporation of prior knowledge about the system into the identification procedure, allowing for a well considered bias-variance trade-off. This poster demonstrates how this can be applied to the estimation of transfer functions. It is shown how the estimation of finite impulse responses via kernel based regression is transformed to the frequency. A spectral interpretation is provided for kernels which have been crafted especially for dynamic systems. Advantages are highlighted, like the possibility to select the frequency band of interest.

A FIRST ATTEMPT TO OPTIMAL EXPERIMENT DESIGN FOR SYSTEM IDENTIFICATION UNDER REGULARIZED PARAMETER ESTIMATION *

Georgios Birpoutsoukis *and Johan Schoukens, VUB*

This work constitutes a first attempt to investigate the optimal input that must be applied to a dynamic system when regularization is used during the identification procedure. Regularization for parameter estimation has been widely used in function characterization and machine learning techniques. It has been recently shown that the regularized estimation can be very useful in the field of system identification. The key idea lies in manipulating the bias-variance trade-off of the estimated model parameters by introducing a penalty term in the cost function under minimization. Since the penalizing term in the cost function depends on the input-output measured data it is important to investigate which input is going to deliver the optimal bias-variance trade-off measured through the Mean Square Error (MSE) of the estimated parameters. The fact that the regularization penalty can be considered as prior information about the unknown system incorporated in the cost function, can be exploited during the design of the optimal input. Since the penalty depends on the system input under optimization, the problem of optimal input design under regularized estimation boils down to optimizing both the input and the penalty introduced in the cost function.

RETRIEVING STRUCTURAL NONLINEAR INFORMATION USING THE BEST LINEAR APPROXIMATION

Alireza Fakhrizade Esfahani*, Johan Schoukens and Laurent Vanbeylen, VUB*

Since nonlinear (NL) identification is often very time consuming, it is highly desirable to carefully select a well suited model structure prior to the actual identification. In this study the focus is on the detection of the presence of NL feedback. Therefore, the frequency response function (FRF) of the best linear approximation (BLA) is measured at different excitation signal settings. Two properties of the excitation are varied to analyze the nonlinear behavior: 1. Amplitude (RMS value) level 2. DC level (offset or set points). The goal of the study is to find out what is the best strategy to vary the excitation signal, in order to obtain information about the structure of the system. Two case studies will be presented on different NL-feedback systems.

MODELING A BROADBAND DOHERTY POWER AMPLIFIER USING A PARALLEL WIENER-HAMMERSTEIN MODEL *

***Maarten Schoukens**, M. Özen, C. Fager, M. Thorsell, G. Vandersteen, Y. Rolain, VUB*

Microwave Doherty power amplifiers exhibit some nonlinear distortion behavior. This poster proposes to use a parallel Wiener-Hammerstein model to explain the in-band and spectral regrowth nonlinear effects that are present in the output of the system. The model is compared with some state of the art modeling techniques on measured data.

MATRIX FACTORIZATION TECHNIQUES APPLIED TO FMRI-EEG COUPLED DATASETS

***Matthieu Genicot**, UCL **

My project aims to develop matrix factorization algorithms to analyze bi-modal datasets composed of EEG and fMRI data. While fusion of various neuro-imaging modalities is more and more widespread to investigate brain function and structure, there is a lack of numerical methods to analyze multi-modal datasets, hampering the progress of neurosciences. Matrix factorization is an increasingly popular tool to analyze large datasets that has the property to model the various sources of variation affecting these datasets. Adaptation of matrix factorization technique to multi-modal datasets has already been performed for ICA (independent component analysis), giving rise to joint ICA and parallel ICA, which has been successfully used in the context of EEG-fMRI coupled data. My work focuses on the use of different constraints, such as non-negativity and sparsity that could provide an easier interpretation of the results.

PIECEWISE-BÉZIER C^1 INTERPOLATION ON RIEMANNIAN MANIFOLDS WITH APPLICATION TO 2D SHAPE MORPHING

***Pierre-Yves Gousenbourger**, Chafik Samir, Pierre-Antoine Absil, UCL*

Nowadays, more and more problems are solved through specific manifold formulation. This often allows important reduction of computation time and/or memory management compared to classical formulations on the classical Euclidean space (because of non-linear constraints like restricting the solutions to a certain subdomain of a larger embedding space). We propose a new general framework to fit a path through a finite set of data points lying on a Riemannian manifold. The path takes the form of a continuously-differentiable concatenation of Riemannian Bézier segments. This framework is illustrated by results on the Euclidean space, the sphere, the orthogonal group and the shape manifold.

A RIEMANNIAN OPTIMIZATION TECHNIQUE FOR RANK INEQUALITY CONSTRAINTS *

***Wen Huang**, Guifang Zhou, Kyle A. Gallivan, Paul Van Dooren, Pierre-Antoine Absil, UCL*

In recent years, substantial progress has been made on the theory, design and efficient implementation of effective algorithms to solve optimization problems with constraints that specify a Riemannian manifold. Such problems are found in a wide variety of areas, but of particular interest in this poster are those involving matrix manifolds. There are many important matrix-based optimization problems that have an additional constraint related to the rank of the optimal solutions. These problems have been solved, for the most part, in an ad hoc manner. The poster investigates optimization problems that involve a rank inequality constraint on Riemannian manifolds. New algorithms and theoretical properties that describe their convergence are presented and the efficiency and effectiveness of careful implementations on the weighted low-rank approximation problem are demonstrated.

AN UNBIASED SPATIOTEMPORAL ICA TO CAPTURE CONFOUNDING SOURCES OF VARIATION IN GENOMIC DATASETS

Emilie Renard*, Pierre-Antoine Absil, Andrew E. Teschendorff, UCL*

We present recent work where we address the problem of clearing (as much as possible) large genomic datasets from confounding sources of variation, known as batch effects, without (too much) removing biological variations of interest. Batch effects occur in large-scale genomic datasets that aggregate measurements obtained under different technical conditions such as reagent quality, laboratory temperature, or chip. Removing those confounding factors is however of critical importance, as not doing so may adversely impact statistical inference. A popular approach to address batch effects is surrogate variable analysis (SVA) (Leek & Storey, 2007). Originally SVA uses a PCA in the factorization step, but recent developments have shown that replacing it by ICA improves identification of confounders and subsequent statistical inference. When applying ICA methods, the question arises whether one should maximize the independence among the samples or the genes. We investigated a continuum between the both options on DNA methylation datasets using a spatiotemporal ICA method based, and how this trade-off influences the recovering of confounding factors.

SWITCHING SYSTEMS ON AUTOMATA : WE NEED MULTIPLE LYAPUNOV FUNCTIONS

Matthew Philippe*, Raphaël Jungers, UCL*

Switching systems find application in various domains, from the study of viral mutations, networked control system,... Switching systems are dynamical systems described by a set of operating modes. They switch from one active mode to another during their evolution. Usually, there is some indeterminacy in the sequence of switches between modes, making stability analysis hard. In this work, we consider the situation where the possible switching sequences are constrained. We assume that the sequences are generated by an automaton. This allows for the expression of very general constraints that may occur in practice. The main results presented in this poster are that 1) any stable system has a multiple Lyapunov function and 2) by approximating these functions, we can develop algorithms to decide whether a system is stable or not.

SOLVING SDD LINEAR SYSTEMS IN NEARLY-LINEAR TIME *

Maguy Trefois*, Jean-Charles Delvenne, Paul Van Dooren, UCL*

Symmetric and diagonally-dominant (SDD) linear systems appear in many applications of computer science. These systems are usually of important size and solving them is the main computational task. Direct methods for solving linear systems are much too slow in the case of huge systems. In 2004, Spielman and Teng found out the first algorithm for solving SDD systems with a running time which is nearly-linear in the number of nonzero entries. In 2013, Kelner improved Spielman and Teng's running time and proposed a new approach for solving SDD systems in nearly-linear time. The original paper presents this method using a physical interpretation of the problem. From this approach, it is unclear how this method works in a matrix theoretic point of view. In this poster, we explain Kelner's algorithm using only matrix theoretic arguments.

STUDYING SOCIAL CONSENSUS THROUGH ONLINE GAMING

Corentin Vande Kerckhove, *Samuel Martin, Jason Rentfrow, Vincent Blondel, UCL*

As illustrated by Wikipedia, collective intelligence allows to outperform the abilities that no single individual could reach alone. Our project aims to predict the evolution of opinions through online interactions. In order to study group influences, simple tasks are proposed on a self-designed website and adapted into interactive games. We collect players via crowdsourcing platforms and observe that we can predict their change of opinions by consensus models with decaying confidence. Moreover, we can improve these predictions by classifying the players into classes of influenceability.

INTEGRAL CONTROL ON LIE GROUPS *

Zhifei Zhang, *Zhihao Ling, Alain Sarlette, UGent*

We have extended the popular integral control technique to systems evolving on Lie groups. More explicitly, we provide an alternative definition of "integral action" for proportional(-derivative)-controlled systems whose configuration evolves on a nonlinear space, for which configuration errors cannot be simply added up to compute a definite integral. We have proved that the proposed integral control allows to cancel the drift induced by a constant bias in both first order (velocity) or second order (torque) control inputs for fully actuated systems evolving on abstract Lie groups. We here illustrate the approach on a simple application.

ACCELERATING CONSENSUS USING SECOND-ORDER NODES & SPECTRAL CLUSTERING

Simon Apers, *Alain Sarlette, UGent*

It is known that a polynomial-based approach, with local memories added at the nodes, can accelerate convergence towards average consensus in an undirected network. We analyze exactly how much acceleration is obtained by a second-order polynomial-based algorithm. In particular, we note that polynomial-based acceleration replaces the unique role of the graph spectral gap with a cost function based on spectral clusters. As a consequence the Fastest Mixing Markov Chain optimization of edge weights is exchanged for a more adapted Fastest Polynomial-Convergence network.

A SEQUENTIAL LOG BARRIER METHOD FOR SOLVING CONVEX-CONCAVE PROBLEMS WITH APPLICATIONS IN ROBOTICS

Frederik Debrouwere, *Goele Pipeleers, Jan Swevers, KULeuven*

We present a novel method to solve a convex-concave optimization problem. For this class of problems, several methods have already been developed. Sequential convex programming (SCP) is one of the state-of-the-art methods and involves solving a sequence of convex subproblems by linearizing the concave parts. These convex problems are e.g. solved by a log barrier method which solves a sequence of log barrier problems. To reduce the computational load we propose a sequential convex log barrier (SCLB) method where the main difference with SCP is that we search for an approximated solution of the convex subproblems by only solving one log barrier problem. We prove convergence of the proposed algorithm and we give some numerical examples that illustrate the decrease in computational load and similar convergence behaviour for a practical robotics application.

ROBUST MONOTONIC CONVERGENT ITERATIVE LEARNING CONTROL *

Son Tong Duy, *Goele Pipeleers, Jan Swevers, KULeuven*

This work presents a robust iterative learning control (ILC) approach against model uncertainty. The robust ILC input is computed by minimizing the worst-case value of a performance index under model uncertainty, yielding a convex optimization problem. The proposed robust ILC design is experimentally validated on a lab scale overhead crane system, showing the advantages of the approach over classical ILC designs in monotonic convergence and tracking performance.

MODELING OF EPIDEMIC SPREAD BY EIGENVALUE COMPUTATIONS

Zifan Liu, *KULeuven*

A parallel implementation based on implicitly restarted Arnoldi method (MIRAM) is proposed for calculating dominant eigenpair of matrices derived from very large real networks. Their high damping factor makes many existing algorithms less efficient, while MIRAM could be promising. Also, we apply this method in an epidemic application. We describe in this paper a stochastic model based on PageRank to simulate the epidemic spread, where a PageRank-like infection vector is calculated by MIRAM to help establish efficient vaccination strategy.

STRUCTURAL IDENTIFIABILITY ANALYSIS OF LARGE SCALE BIOCHEMICAL MODELS *

Philippe Nimmegeers, *Joost Lauwers, Filip Logist, Jan Van Impe, KULeuven*

Structural identifiability is a necessary requirement for successful parameter estimation of a dynamic model. Structural refers to the possibility of estimating parameters successfully in idealized conditions, i.e. the measurements are perfect and continuous and the model is a perfect representation of the real process. The structural identifiability of the Anaerobic Digestion Model No. 1, the current state of the art in modeling of anaerobic digestion, is analysed as case in this research. Due to its large amount of parameters, the model is a good case study for the structural identifiability analysis of large scale biochemical models. The method used for this analysis is based on the investigation of the local algebraic observability. This is a sufficient condition for structural identifiability. Different measurement scenarios were tested.

FAULT CLASSIFICATION IN BATCH PROCESSES: A COMPARATIVE STUDY ON CONTRIBUTION PLOTS VERSUS PROCESS DATA

Sam Wuyts, *Geert Gins, Pieter Van den Kerkhof, Jan Van Impe, KULeuven*

In statistical process monitoring, experts and operators typically rely on contribution plots to diagnose the cause of abnormal events. However, contribution plots are subject to the fault smearing effect, which possibly masks the real cause of an upset. It is investigated whether automatic fault identification can be ameliorated by using process data instead of contributions. The benchmark penicillin fermentation process Pensim, implemented in RAYMOND, is used to test both approaches (i.e., using either sensor measurements or the contributions as input for the classification model). For each approach, classification performance is optimized by proposing different pretreatments of both process data and variable contributions based on the characteristics of the occurring faults. These manipulations turn out to influence classification performance to a large extent. Furthermore, it is demonstrated that fault smearing negatively influences classification based on contributions. The conclusion is that automatic fault identification is improved by using process data rather than variable contributions as model inputs.

ON-LINE VIDEO SEGMENTATION USING SEMI-SUPERVISED LEARNING *

Siamak Mehrkanoon, *Johan Suykens, KULeuven*

We propose an on-line semi-supervised learning algorithm formulated as a regularized kernel spectral clustering (KSC) approach for video segmentation. Given a few user-labeled pixels at the starting frame of a video sequence, the class membership of the remaining pixels in the current and subsequent frames are estimated and propagated in on-line fashion. In addition we will show how the tracking capabilities of the Kalman filter can be used to provide the labels of objects in motion. The performance of the proposed method is demonstrated on real-life videos.

POLYNOMIAL NUMERICAL LINEAR ALGEBRA: PRUNING THE CURSE OF DIMENSIONALITY *

Antoine Vandermeersch, *Bart De Moor, KULeuven*

In recent years, research has explored the link between realization theory and computational algebra [Hanzon and Hazewinkel, 2006]. Descriptor systems in particular play a prominent role in this setting, in which the regular and singular state parts of a dynamical system show a strong resemblance to the concepts of affine solutions and solutions at infinity respectively, commonly found in the field of algebraic geometry. The central point of interest in translating a system of multivariate polynomial equations into a nD descriptor system consists of determining its roots by means of an eigenvalue problem. Generalized data structures in these algorithms such as the Macaulay matrix bring about an aggravated curse of dimensionality. In this poster we outline a strategy to exploit the structure of the complement space associated with a system of polynomial equations. In doing so, a significant portion of the rows and columns of the Macaulay matrix are pruned, negating the otherwise combinatorial growth associated with its construction. In the practical domain of large scale systems, such a pruning method paves the way for keeping the memory and computational requirements under control.

RANDOM FORESTS WITH RANDOM PROJECTIONS OF THE OUTPUT SPACE FOR HIGH DIMENSIONAL MULTI-LABEL CLASSIFICATION

Arnaud Joly, *Pierre Geurts, Louis Wehenkel, ULg*

We adapt the idea of random projections applied to the output space, so as to enhance tree-based ensemble methods in the context of multi-label classification. We show how learning time complexity can be reduced without affecting computational complexity and accuracy of predictions. We also show that random output space projections may be used in order to reach different bias-variance tradeoffs, over a broad panel of benchmark problems, and that this may lead to improved accuracy while reducing significantly the computational burden of the learning stage.

SIMPLE CONNECTOME INFERENCE FROM PARTIAL CORRELATION STATISTICS IN CALCIUM IMAGING *

Antonio Sutera, *Arnaud Joly, Vincent François-Lavet, Zixiao Aaron Qiu, Gilles Louppe, Damien Ernst, Pierre Geurts, ULg*

In this work, we propose a simple yet effective solution to the problem of connectome inference in calcium imaging data. The proposed algorithm consists of two steps. First, processing the raw signals to detect neural peak activities. Second, inferring the degree of association between neurons from partial correlation statistics. This paper summarises the methodology that led us to win the Connectomics Challenge, proposes a simplified version of our method, and finally compares our results with respect to other inference methods.

ACTIVE MANAGEMENT OF LOW-VOLTAGE NETWORKS FOR MITIGATING OVER-VOLTAGES DUE TO PHOTOVOLTAIC UNITS

Frédéric Olivier, *Petros Aristidou, Damien Ernst, Thierry Van Cutsem, ULg*

In this work, the problem of integrating photovoltaic panels into low-voltage distribution networks is addressed. A distributed scheme is proposed that modulates the active and reactive power output of inverters to prevent overvoltage problems. The proposed scheme is model-free and makes use of limited communication between the controllers, in the form of a distress signal, only during emergency conditions. It prioritizes the use or reactive power, while active power curtailment is performed only as a last resort. The performance of the scheme is tested using dynamic simulations, first on a single low-voltage feeder, then on a larger network composed of 14 low-voltage feeders. Its performance is compared to a centralized scheme based on the solution of an Optimal Power Flow problem, whose objective function is to minimize the active power curtailment. The proposed scheme successfully mitigates overvoltage situations due to high photovoltaic penetration and performs almost as well as the Optimal Power Flow based solution with significantly less information and communication requirements.

FEASIBILITY ORIENTED BRANCHING STRATEGIES FOR GLOBAL OPTIMIZATION *

Damien Gerard, *Matthias Köppe, Quentin Louveaux, ULg*

We study the spatial Branch-and-Bound algorithm for the global optimization of nonlinear problems. In particular we are interested in a method to find quickly good feasible solutions. Most spatial Branch-and-Bound-based solvers use a non global solver at a few nodes to try to find better incumbents. We show that it is possible to improve the branching rules and the nodes priority by exploiting the solutions from the non global solver. We also propose several smart adaptive strategies to choose when to run the non global solver. We show that despite the time spent in solving many more NLP problems in the nodes, the new strategies enable the algorithm to find the first good incumbents much faster and to prove the global optimality faster. NLP instances from the COCONUT library are benchmarked. All experiments are run using the open source solver Couenne.

CRAFTING NETWORKS TO ACHIEVE (OR NOT) CHAOTIC STATES *

***Sarah de Nigris**, Xavier Leoncini, UNamur*

The influence of networks topology on collective properties of dynamical systems defined upon it is studied in the thermodynamic limit. A network model construction scheme is proposed where the number of links and the average eccentricity are controlled by rewiring links of a regular one dimensional chain according to a probability p within a specific range r, that can depend on the number of vertices N. We compute the thermodynamical behavior of a system defined on the network, the XY-rotors model, and monitor how it is affected by the topological changes. We identify the network dimension d as a crucial parameter: topologies with $d<2$ exhibit no phase transitions while ones with $d>2$ display a second order phase transition. Topologies with $d=2$ exhibit states characterized by infinite susceptibility and macroscopic chaotic/turbulent dynamical behavior. These features are also captured by d in the finite size context.

A DERIVATIVE-FREE TRUST-FUNNEL METHOD FOR CONSTRAINED NONLINEAR OPTIMIZATION PROBLEMS

***Phillipe R. Sampaio**, UNamur*

A new derivative-free method is proposed for solving constrained nonlinear optimization problems. This method is of the trust-funnel variety and is also based on the use of polynomial interpolation models. In addition, it uses a self-correcting geometry procedure in order to ensure that the geometry of the set of interpolation points does not differ too much from the ideal one. Finally, some encouraging numerical results are presented.

RANDOM WALK CENTRALITY FOR TEMPORAL NETWORKS

***Luis E C Rocha**, Naoki Masuda, UNamur*

Nodes can be ranked according to their relative importance within a network. Ranking algorithms based on random walks are particularly useful because they connect topological and diffusive properties of the network. Previous methods have focused on static structures. However, several realistic networks are indeed dynamic, meaning that their structure changes in time. We propose a centrality measure for temporal networks based on random walks under periodic boundary conditions that we call TempoRank. We find that, in temporal networks, the stationary density is proportional to the in-strength of the so-called effective network, a weighted and directed network explicitly constructed from the original sequence of transition matrices.

WIKIPEDIA EDITION DYNAMICS *

***Y. Gandica**, F. Sampaio dos Aidos, J. Carvalho, UNamur*

In this poster, we discuss a simple agent-based model which is developed from real data, to reproduce the collaborative process of Wikipedia edition. With a small number of simple ingredients, our model recovers several features of real human behaviour, namely in the context of edit wars. We show that the level of conflict is determined by a tolerance parameter. This parameter measures the editors capability to accept different opinions and to change their own opinion. We propose to measure conflict with a parameter based on mutual reverts, which increases only in contentious situations. Using this parameter, we find a distribution for the inter-peace periods that is heavy tailed. Finally, we develop an analytical approach in which a model for the probabilistic function followed in Wikipedia edition is presented and compared with simulations and real data. We then reproduce the results obtained for Wikipedia edition dynamics for a collection of single page as well as the average results. A recursive equation is obtained for the average of the number of editions per editor that allows to describe the editing behaviour in Wikipedia.

DYNAMICAL MODELING AND PARAMETER ESTIMATION OF ANAEROBIC DIGESTION PROCESSES

__G. Giovannini__, M. Sbarciog, G. Ruiz-Filippi, A. Vande Wouwer, UMons

Recent increases in environmental pollution and regulations for pollutant minimization have raised the need for new and effective methods to treat waste. In this context, Anaerobic Digestion (AD) is an environmentally sustainable technology of great interest since it converts a variety of wastes into energy in the form of biogas. In spite of the many advantages the AD technology provides, it is still not used at its full potential, due to the high complexity of the AD process and its dependence on many operational variables. Under certain circumstances the stability of the AD process can be disturbed, which may lead to either a not effective waste treatment or even a failure in the treatment and the associated biogas production. Therefore, an important step towards an optimal operation is a better understanding of the interplay between the process dynamics and the operational conditions, which may be achieved by means of a reliable model.
The most detailed model available for AD processes is the ADM1 model, which may be customized for a wide variety of wastes and plant configurations. From a control and optimization viewpoint however, ADM1 is not practical due to its complexity. The goal of this study is to obtain a simpler model of the AD process, which could be successfully used in the design of control and optimization strategies. The simple model is developed using model reduction techniques and a prerequisite in the model development is the inclusion of widely available measurements in real waste treatment plants. Moreover, this study proposes a simplified model which includes the hydrogen gas concentration as a key variable, which can give important information about the stability of the reactor in a fast and effective way.

METABOLIC FLUX ANALYSIS OF HYBRIDOMA CELLS: UNDERDETERMINED NETWORK AND INFLUENCE OF BATCH AND PERFUSION OPERATING MODES. *

__S. Fernandes__, G. Bastin, A. Vande Wouwer, UCL & UMons

Monoclonal antibodies are increasingly used for clinical diagnosis and therapeutics. Their production can be achieved using hybridoma cells cultures in bioreactors operated in perfusion mode rather than batch or fed-batch operating modes. The major advantage of the perfusion mode is high cell concentration, high productivity and the no accumulation of waste products (ammonia and lactate).
Knowledge of intracellular fluxes is of critical importance in the process of investigating and understanding cell metabolism. Metabolic Flux Analysis (MFA) appears as a tool solution to determine intracellular fluxes from extracellular measurements, such as cell density, substrates and products concentrations.
In this study, a metabolic network of 72 biochemical reactions is considered and MFA is applied in order to determine the intracellular fluxes. Due to an insufficient number of extracellular measurements, the pseudo-steady state assumption (no accumulation of internal metabolites) leads to an underdetermined system of algebraic

equations and a unique solution cannot be provided. To overcome this problem, convex analysis is used to compute a set of admissible positive bounds, which can be determined using the toolbox METATOOL.
This latter approach is applied here to sets of experimental data from hybridoma HB58 cell batch/perfusion cultures, in order to investigate the influence of the set of available extracellular measurements as well as the influence of the operating mode (batch and perfusion) on the determination of the metabolic flux intervals.

MODELLING THE INFLUENCE OF TEMPERATURE IN THE LONG-TERM FOULING PROCESS OF A SUBMERGED MEMBRANE BIOREACTOR

G. Araujo Pimentel*, D. Dalmau, A. Vargas, J. Comas, I. Rodriguez-Roda, A. Rapaport, A. Vande Wouwer, UMons*

The trans-membrane pressure (TMP) in submerged membrane bioreactors (sMBR) is often used as input in models that attempt to predict the long-term fouling behavior. Several such models have been developed, based on experimental studies with laboratory scale plants, where the ambient temperature is almost constant (and sometimes even regulated). It is important to remember that sMBR plants are exposed to daily temperature variations which have an influence on the apparent viscosity, and in turn, on the TMP. If the temperature influence onto TMP dynamics is not modelled, wrong actions could be taken when using a model-based control.
The present study considers data collected from a pilot plant facility, exhibiting significant temperature changes, and develops a model of the long-term fouling process. Direct and cross-validation results are discussed.

PARAMETER IDENTIFICATION OF THE DROOP MODEL USING OPTIMAL EXPERIMENT DESIGN *

M. Benavides*, D. Telen, J. Lauwers, F. Logist, J.Van Impe, A. Vande Wouwer, KUL & UMons*

Research and applications of microalgal cultivation have experienced a fantastic boom in the last two decades due to a renewed interest in alternative energy sources, and the potential of microalgae to produce large quantities of lipids. Besides, microalgae have a large spectrum of applications ranging from pigments, cosmetics, food to wastewater treatment.
Kinetic modeling of microalgal photosynthesis and growth allows the prediction of the process performance and optimization of operating conditions. The model parameters have to be estimated from experimental data, and in order to improve the accuracy of the estimated parameters, it is necessary to guarantee that the experimental data contains high quality information. This can be assured by using optimal experiment design approaches.
In the current work, we implement an optimal experiment design for microalgae cultures considering as input the dilution rate of a limiting nutrient, and considering the M-criterion. In our optimal experiment design, we choose which parameter (or parameters) will be mainly optimized over the other ones. The proposed procedure aims at a trade-off between the number of target parameters, and their accuracy.

Notes

Notes

internet UGentGuest

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Schedule:

09:50	Opening
10:00	Plenary Lecture 1 (prof. Moritz Diehl)
11:00	Plenary Lecture 2 (prof. Refael Hassin)
12:00	Poster spotlights 1
12:15	Lunch & Poster session 1
14:30	Paper review (prof. Jean-Charles Delvenne)
15:00	Plenary Lecture 3 (prof. Bram Vanderborght)
16:00	Poster spotlights 2
16:15	Poster session 2
18:00	End