| AM/PM | Title Poster + remarks | Authors | Institution | Abstract |
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| AM | LS-SVM based solution for Partial differential equations | Siamak Mehrkanoon, Johan A.K. Suykens | KU Leuven, ESAT/STADIUS, Leuven | This poster presents an approach based on Least Squares Support Vector Machines (LS-SVMs) for learning the solution of partial differential equations (PDEs) with variable coefficients. Contrary to most existing techniques, the proposed method provides a closed form approximate solution. The optimal representation of the solution is obtained in the primal-dual setting. The developed method is well suited for problems involving singular, variable and constant coefficients as well as problems with irregular geometrical domains. |
| AM | Noise Level Estimation for Model Selection in Kernel PCA Denoising | Carolina Varon, Carlos Alzate, and Johan A.K. Su ykens | KU Leuven, ESAT/STADIUS, Leuven | The main challenge in unsupervised learning is to find suitable values for the model parameters. In kernel principal component analysis (kPCA) for example, these are the number of components, the kernel and its parameters. This work presents a model selection criterion that can be used to find the number of components and the σ2 parameter of RBF kernels, by means of spectral comparison between information and noise. A new way to estimate the level of noise contained in the data is presented. It does not require rotations nor permutations, and it can handle low dimensionality. This new approach is called model selection based on distance distributions (MDD), and it uses the statistical properties of the distribution of distances of the input data to generate a noise distribution, based on the assumption that uniformly distributed data generate unimodal (Euclidean) distance distributions. This property has been already studied in the framework of visualization and exploration of high-dimensional data. After comparing the eigenvalues computed from the estimated noise with the ones of the input dataset, information is retained, and maximized by a set of model parameters. This model selection MDD was tested in toy data and real life applications and it was observed that the objective function has a global maximum for all the given examples. In addition, MDD outperforms other algorithms like kernel parallel analysis and the maximization of the Shannon entropy of the kernel matrix. |
| AM | Optimal Sparse Reduced Set for Kernel Spectral Clustering | Raghvendra Mall, Siamak Mehrkanoon, Rocco Langone, Johan A.K. Suykens | KU Leuven, ESAT/STADIUS, Leuven | Kernel spectral clustering (KSC) solves a weighted kernel principal component analysis problem in a primal-dual optimization framework. It results in a clustering model using the dual solution of the problem. It has a powerful out-of-sample extension property leading to good clustering generalization w.r.t. the unseen data points. The out-of-sample extension property allows to build a sparse model on a small training set and introduces the first level of sparsity. The clustering dual model is expressed in terms of non-sparse kernel expansions where every point in the training set contributes. The goal is to find reduced set of training points which can best approximate the original solution. A second level of sparsity is introduced as it is essential to reduce the time complexity of the computationally expensive out-of-sample extension. In this paper we investigate various reduced set techniques including the Group Lasso, L0, L1+L0 penalization and compare the amount of sparsity gained w.r.t. a previous L1 penalization technique. We showcase the effectiveness of the proposed approaches on several real world datasets and an image segmentation dataset. |
| AM | A forward simulation framework to predict the effect of increased length and velocity feedback during gait ***(Remark: Would it be possible to put this poster in the first poster session because it relates a lot with the plenary lectures 1 and 2)*** | Friedl De Groote (1), Karen Jansen (2), Wouter Aerts (1), Jacques Duysens (2), Jos Vander Sloten (1), Joris De Schutter (1) and Ilse Jonkers (2) | (1) Department of Mechanical Engineering, KU Leuven (2) Department of Kinesiology, KU Leuven | It has been suggested that a higher reflex excitability is at the origin of gait deficits in a subgroup of hemiparetic subjects [1]. The aim of this study was to develop a simulation framework to predict the effect of increased length and velocity feedback on gait kinematics. To this aim, we extended the musculoskeletal model with a model of length and velocity feedback and a ground contact model. Forward simulations were used to predict the effect of altered length and velocity gains on the joint kinematics. The outcome of the predictive simulations was compared to reported gait deviations of hemiparetic subjects. The predicted increased plantar flexion, knee flexion, and hip extension during terminal swing resulting from higher feedback gains for the gastrocnemii is in accordance with the foot-floor contact with foot flat or toes first often observed in hemiparetic subjects [1]. The predicted increased plantar flexion resulting from higher feedback gains for soleus, gastrocnemius, rectus femoris, and vasti is in accordance with the observations of Mulroy et al. [2] in one group (Extended) of hemiparetic subjects. The predicted increased knee extension resulting from higher feedback gains for soleus, vasti, and rectus femoris is in accordance with the knee hyperextension during stance and the decreased knee flexion during swing observed in a large number of hemiparetic subjects [1, 2]. Hence, our predictive simulations support the idea that higher reflex excitability might be at the origin of some of the gait deficits observed in spastic, hemiparetic subjects. REFERENCES<br>[1] Knutsson E, Richards C. Brain. 102:405-430, 1979.<br>[2] Mulroy S et al. Gait & Posture. 18:114-125, 2003. |
| AM | Distance problems and eigenvalue optimization for nonlinear eigenvalue problems | Roel Van Beeumen, Dries Verhees, Karl Meerbergen, Wim Michiels | Department of Mechanical Engineering, KU Leuven | A continuous dynamical system is stable if all eigenvalues lie strictly in the left half of the complex plane. However, this is not a robust measure because stability is no longer guaranteed when the system parameters are slightly perturbed. Therefore, the distance to instability is often computed, because it is a robust measure for stability against perturbations. We present algorithms for computing distance to instability and eigenvalue optimization for nonlinear eigenvalue problems |
| AM | A Relaxation Method with Projective Integration for Solving Nonlinear Systems of Hyperbolic Conservation Laws. ***(Remark : can this poster be included to the morning session ? The author doesn't come in the afternoon)*** | Pauline Lafitte, Ward Melis, Giovanni Samaey | Department of Mechanical Engineering, KU Leuven | Hyperbolic conservation laws are present in numerous physical applications as a basis for the modeling of a system or process of interest. Many examples can be found in several domains such as fluid dynamics, plasma physics, traffic modeling and electromagnetism. The goal of our work is to construct a high-order solution strategy for solving generically a system of nonlinear hyperbolic conservation laws. A kinetic equation from kinetic theory is put forward and numerically integrated instead of the given hyperbolic problem. The purpose of this relaxation-based approach is to convert the initial possibly nonlinear flux function into a linear one by introducing a relevant consistent source term. Next, the design and analysis of a numerical method - a so-called projective integration method - was treated. These methods consist of two embedded integrators which employ a different time step. They guarantee that on the one hand the fast modes are sufficiently damped by using a small time step and that on the other hand the slow modes of interest are adequately perceived by using a large time step. Projective integration methods offer very appealing properties in practice such as their explicit nature and the ability of attaining an arbitrary order in time. In addition, they are surprisingly simple to implement even if the given problem is drastically altered. The proposed technique was applied to the linear advection equation, Burgers' equation and the Euler equations in compressible fluid dynamics both in one and two dimensional domains. |
| AM | Time scaling using Tikhonov's theorem in a submerged membrane bioreactor | Guilherme Araujo Pimentel, Jérôme Harmand, Alain Vande Wouwer, Alain Rapaport | Université de Mons (UMons) | Submerged membrane bioreactors have been used in several water treatment areas, i.e. domestic, industrial and drinking water. Hence, there is a growing need for reliable models and simulation tools that could be used to improve their design and operation. However, process modeling is still an open problem, especially with regard to the fouling dynamics. In this study, we consider a simplified model that could be used for control purposes, yet with a biological and physical interpretation. The application of Tikhonov's theorem allows reducing system complexity through suitable approximations. In particular, the possibility of decoupling a system in different time scales facilitates the process analysis |

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| **AM** | Mixing times on slightly perturbed cycles | Gerencsér Balázs | Université catholique de Louvain (UCL) | Consider a cycle graph but with a negligible number of additional edges. We investigate the mixing time of Markov chains defined on such graphs, and we would like to understand the effect of the added edges. The extreme cases are already known: on a cycle of n nodes without any added edges the best mixing time is cn2, when αn random edges are added this drops to c log2 n. We show that the mixing time in the current case properly interpolates those of the extreme cases. We also demonstrate the additional speedup effect when nonreversible Markov chains are allowed. |
| **AM** | Decoding the visuomotor transformation of visual motion into a spatially accurate motor plan for the arm: an artificial neural network approach. ***(Remark : can this poster be included to the morning session ? The author may not be able to stay the whole day. )*** | G. Leclercq, S. Murdison, G. Blohm and P. Lefèvre | Université catholique de Louvain (UCL) | For visually guided arm movements, the brain transforms the visual input into a motor plan appropriate to drive the arm. Behavioral experiments have shown that the brain takes the 3D eye-head-shoulder kinematics into account when transforming retinal position or velocity signals in the case of reaching or manual tracking movements. How the CNS could implement such a transformation within a neural network is unknow. We investigate how a biologically inspired artificial neural network could perform the 3D visuomotor transformation of velocity and position signals for manual tracking of moving targets. We simulate electrophysiological methods to probe artificial neuron properties. The artificial feedforward neural network was able to learn the complex non-linear 3D visuomotor transformation of velocity signals for manual tracking. Visual and spatial motion tuning (preferred direction, tuning amplitude, gain field effects) was assessed on both layers of the network, under different eye-head configurations. In the smooth pursuit condition, results are consistent with observations in visual motion brain areas MT and MST. Predictions are made in the head roll condition. |
| **AM** | Global optimization strategies for the economic load dispatch problem | A. Lefèvre, Easter S. Suviseshamuthu, P-A Absil | Université catholique de Louvain (UCL) | We propose a new method to solve the well-known economic load dispatch (ELDP) problem with transmission losses and valve-point loading effect. The ELDP problem consists in minimizing the hourly production cost (in dollars/hour) of a set of n generating units, each producing an amount pi (in MW). Minimization of the cost is subject to bound constraints on the generating units, and a power balance constraints. In the power balance constraints, we take into account quadratic transmission losses incurred by the network, so the resulting equality constraint describes a nonconvex set. Moreover, the valve-point effect induces nonconvex fuel cost functions, which altogether makes it hard to find a global solution of the ELDP problem. Recent efforts in solving the ELDP are focussed towards combining a global heuristics with a local search algorithm that exploits the structure of the objective function. In this contribution, we propose a local search algorithm, presumably with faster convergence rate compared to a gradient descent approach, which can find a feasible local minimum in a few tens of iterations. This is in contrast with the sequential quadratic programming (SQP), where feasibility can only be guaranteed approximately. Our aproach relies on the ingredients of Riemannian optimization, which allow to construct feasible iterates from search directions using the concept of retraction. The search direction is determined with a method similar to trust-region. We discuss several strategies to combine this local search method with heuristics to find near-optimal feasible points: differential evolution, particle swarm optimization, and mixed-integer problems |
| **AM** | Could the brain be a Kalman filter? | JJ Orban de Xivry, Sébastien Coppe, Gunnar Blohm and Philippe Lefèvre | Université catholique de Louvain (UCL) | The brain makes use of noisy sensory inputs in order to produce eye, head or arm motion. In most instances, the brain combines this sensory information with predictions about future events. Here, we propose that Kalman filtering can account for the dynamics of both visually-guided and predictive motor behaviors within one simple unifying mechanism. Our model relies on two Kalman filters, one processing visual information about retinal input and one maintaining a dynamic internal memory of target motion. The outputs of both Kalman filters are then combined in a statistically optimal fashion, i.e. weighted with respect to their reliability. The model was tested on data from several smooth pursuit experiments and reproduced all major characteristics of visually-guided and predictive smooth pursuit. The model provides a general framework of how the brain can combine continuous sensory information with a dynamic internal memory and transform it into motor commands. |
| **AM** | Nonparametric system identification with missing data | Diana Ugryumova, Rik Pintelon, Gerd Vandersteen | Vrije Universiteit Brussel (VUB-ELEC) | System identification is a systematic way to describe the world around us using simple mathematical models and real measurement data. Due to imperfect sensors or data communication links some data could be missing. The simplest solution to this problem is to discard the missing data, but this usually leads to biased estimates. We extend the existing Local Polynomial Method (LPM) [Pintelon et al] by putting the missing values as unknown (global) parameters. LPM estimates a nonparametric frequency response of the system in the frequency-domain from time-domain input-output data, taking into account the difference between the initial and final conditions of the experiment (the transient effect). In this study, we present this extended LPM for a single-input-single-output method with an arbitrary input, with data missing on the noisy output of the system. Thus, without repeating the measurements, we can estimate a nonparametric frequency-domain model of the system together with the missing values and their uncertainties from input-output measurements with some data missing at the output. |
| **AM** | The concept of the Best LTI approximation of LTP systems | Ebrahim Louarroudi, Rik Pintelon, John Lataire | Vrije Universiteit Brussel (VUB-ELEC) | Many systems from different engineering fields show a periodically varying behavior over time. For example, think of wind turbines or helicopters with blade-to-blade manufacturing deviations, rotating machinery such as anisotropic shaft-bearing systems, the electrical impedance measurements of a living heart for cardio-vascular monitoring, or the production of time-periodic distortions in power distribution networks to name a few.These time-periodic observations are usually not taken into account when classical frequency response function (FRF) measurements are made. As the assumptions of linearity and time-invariance (LTI) are inherent to the concept of an FRF, it is meaningful to quantify the deviation from this ideal framework when measuring linear time-periodic (LTP) systems. This measure of discrepancy allows us to define the concept of the best linear time-invariant (BLTI) approximation, which yields the best -- in least square sense -- LTI description of an LTP system. In this poster a geometrical interpretation of the BLTI approximation is given, leading to a framework what is called vector FRF analysis. The presented concepts are demonstrated on the well-known Mathieu oscillator. |
| **AM** | Estimation of FRFs via Gaussian processes | John Lataire | Vrije Universiteit Brussel (VUB-ELEC) | A non-parametric estimate of the Frequency Response Function (FRF) of a measured system provides a lot of useful insight about that system. This poster presents a frequency domain implementation of Gaussian processes to obtain a smoothed estimate of the FRF while, simultaneously, suppressing the transient errors. The hyperparameters of the gaussian process (as for instance the optimal smoothness) are learned from the data via cross validation. A comparison with existing techniques, including the Local Polynomial Method (LPM) and a time domain regularised impulse response estimation, will be provided. |

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| AM | Modulation and robustness of neuronal spiking in two parameters charts | Guillaume Drion, Alessio Franci, Vincent Seutin, Rodolphe Sepulchre | Université de Liège (ULg) | The combined modulation and robustness properties of neuronal spiking remain a puzzle for neurophysiologists because of the diversity of ion channels and regulation mechanisms that contribute to it. Exploiting the parallel feedback loop structure of ionic currents in conductance based models, we find that most of neuron modulation/robustness properties can be extracted through the separation of the net transmembrane current into three components corresponding to three distinct timescales. Each component determines one specific feedback loop of the firing pattern and is regulated by a single parameter: an equivalent feedback gain modulated by the density of ion channels operating in the respective timescale. We show that many neuronal firing patterns can be reproduced with an abstract model that is a local normal form of the full model at a well chosen singularity. On the one hand, most firing pattern modulations observed physiologically such as routes to bursting can be interpreted as modulatory paths in two-parameter charts built on this abstract model. On the other hand, any ion channel combination that keeps the values of the equivalent feedback gains unchanged ensures a similar firing activity. These results highlight the equivalent feedback gains as prominent targets for neuromodulation and intrinsic homeostasis. |
| AM | Neural networks learning: application in robotics | Delphine Nicolay, Timoteo Carletti | Université de Namur (UNamur), naXys | A large number of biological networks have modular structures resulting from a Darwinian evolution on a varying environment. Our research question is to study the emergence of such structures. To get our goal we have chosen the framework of artificial neural networks trained, to achieve peculiar competing tasks, using genetic algorithms. Our preliminary analysis is mainly concentrated on the analysis of some characteristics such as redundancy, degeneracy and modularity. We look for the identification of networks behaviours and patterns, in order to unravel the mechanisms responsible for the learning process. The above mentioned framework is adapted to the case of "virtual" robots, i.e. robots living and moving in a virtual arena represented by the graph of a given function and presenting "dangerous zones". The robots are thus trained to reach such a global maximum and to avoid such zones where they lose energy. We performed several preliminary tests consisting in a comparison of different schemes of learning (parallel or sequential) using different multi-objective genetic algorithms (weighted GA or GA based on pareto-optimality). |
| AM | Optimal experiment design for discrimination in predictive microbiology models | I. Stamati, F. Logist, J.-P. Gauchi, J. Van Impe | KULeuven - BioTeC | abstract? |
| AM | Stability, Passivity, and Feedback Stabilization for a Class of Mixed Potential Systems Arising in Non-equilibrium Thermodynamics | N. Hudon, N.H. Hoang, and D. Dochain | Université catholique de Louvain (UCL) | This contribution presents some results on the problems of stability analysis, passivity properties, and (passive) feedback stabilization design for a class of control affine systems where the drift dynamics is generated by a metriplectic structure. Those systems are composed of a conserved part and a dissipative part and appear, for example, as dynamical models representing non-equilibrium thermodynamics time evolutions. From a control perspective, those systems can be viewed as an extension of generalized (or dissipative) Hamiltonian systems, where the gradient of two potentials, interpreted as generalized energy and entropy, associated with particular structures, are generating the dynamics. The proposed approach consists in constructing, by homotopy centered at an equilibrium of the system, a potential for the metriplectic system that can be used as a Lyapunov function candidate for the system, and in using the obtained potential to construct damping state feedback controllers. Stability of the closed-loop system is then considered. Using the same function as storage function, it is possible to study the KYP properties for a metriplectic where a measure of the energy is available, and to construct a stabilizing output feedback control. An example is proposed to illustrate the proposed constructions and an effort is given to connect the proposed analysis to other non-equilibrium thermodynamically-based representations of process control systems |
| PM | A singularity-free dual Newton-CG method for convex QPs | Attila Kozma, Emil Klintberg, Sebastien Gros, Moritz Diehl | KU Leuven, ESAT/STADIUS, Leuven | We consider the problem of solving Quadratic Programs (QP) arising in the context of distributed optimization and optimal control. A dual decomposition approach is used, where the QP subproblems are solved locally, while the constraints coupling the different subsystems in the time and space domains are enforced by performing a distributed non-smooth Newton iteration on the dual variables. The iterative linear algebra method Conjugate Gradient (CG) is used to compute the dual Newton step. A constraint relaxation strategy is proposed which prevents the dual Hessian singularity. |
| PM | Two-level $\ell_1$ Minimization for Compressed Sensing | Xiaolin Huang, Yipeng Liu, Lei Shi, Sabine Van Huffel, and Johan A.K. Suykens | KU Leuven, ESAT/STADIUS, Leuven | Compressed sensing using the l1 minimization has been widely and successfully applied. To further enhance the sparsity, a non-convex and piecewise linear penalty is proposed. This penalty gives two different weights according to the order of the absolute value and is hence called two-level l1-norm. The two-level l1-norm can be minimized by an iteratively reweighted l1 method. Moreover, its piecewise linearity corresponds to a new soft thresholding algorithm. The shrinkage operator for the two-level l1-norm is expansive and its convergence is proved by investigating a surrogate function. In numerical experiments, the proposed algorithms achieve good sparse signal estimation performance, which makes the two-level l1 minimization a promising technique for compressed sensing. |
| PM | Robust Model Predictive Control Formulation for Systems with Polytopic Uncertainty | Adeleh Mohammadi, Moritz Diehl | KU Leuven, ESAT/STADIUS, Leuven | In this poster, we consider a min-max model predictive Control (MPC) problem with convex cost and constraints for a linear system with polytopic uncertainty. The controller is designed to be able to control all the possible systems with parameters that can vary inside a polytope. The problem is formulated as Quadratically Constrained Quadratic Program (QCQP). Since this approach is based on a scenario tree formulation, the number of variables grows exponentially with the horizon length. The QCQP is then solved using an interior-point method. The simulation result is then compared to a nominal MPC formulation. It is observed that the nominal MPC results in infeasibility of the optimization problem while the robust MPC controller can deal with uncertainties and the system has a stable closed-loop response |
| PM | An online coupled state/input/parameter estimation approach for structural dynamics | Frank Naets, Jan Croes, Wim Desmet | Department of Mechanical Engineering, KU Leuven | In many practical structural applications, unknown states, inputs and parameters are present. However, most methods require one or more of these variables to be known in order to estimate the other(s). In this research an estimation technique which employs physical models is proposed to perform coupled state/input/parameter estimation. In order to obtain a modeling technique which allows the estimation of a wide range of parameters in a generic fashion at a minimal computational cost (even real-time), a nonlinear model reduction technique is proposed. This reduced model is coupled to an extended Kalman filter (EKF) with augmented states for the unknown inputs and parameters. This leads to a very efficient framework for estimation in structural dynamics problems. Special attention is also given to the measurement requirements in order to obtain an adequate observability of all unknown quantities and the necessity for at least one displacement level measurement is shown. The proposed methodology is validated experimentally on a beam with unknown length. The approach is shown to be easy to tune and provides good results with different measurement methods. |

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| PM | Pre-stabilized Energy-optimal Model Predictive Control | Xin Wang and Jan Swevers | Department of Mechanical Engineering, KU Leuven | Pre-stabilized Energy-optimal Model Predictive Control is developed based on Energy-Optimal Model Predictive Control (EOMPC) approach. EOMPC is a control method to realize energy-optimal point-to-point motions within a required motion time. Energy optimality is achieved by setting the object function of the MPC optimization problem equal to the system's energy consumption. An application of the EOMPC approach on a badminton robot shows its practical applicability. The EOMPC optimization problem is a convex quadratic program (QP) and the size of which dependents on the number of decision variables. The number of decision variables depends on the length of the prediction horizon which has to be limited in order to solve the optimization problem within the chosen sampling time. However, if large point-to-point motions have to be performed, the total prediction time have to be sufficiently large in order to have a feasible solution. Non-equidistant time intervals over the prediction horizon are introduced such that a sufficiently large prediction time horizon can be achieved with a limited number of decision variables. This approach is called 'blocking'. However blocking yields non-smooth optimal solutions and as a result energy-optimality is achieved only approximately. In order to overcome this drawback, we proposes a pre-stabilization strategy to reduce the computational load of EOMPC. Pre-stabilization uses deadbeat state feedback to modify the system models employed in the formulation of MPC and yields a much sparser optimization problem such that computational load is much less dependent on the number of decision variables. Numerical validation results show that both EOMPC and pre-stabilized EOMPC are capable of realizing time-constrained energy-optimal point-to-point motions. Using pre-stabilized EOMPC, smooth energy-optimal solutions are achieved and the computational efficiency is significantly improved. |
| PM | Mandelbrot Polynomials and Matrices | Piers Lawrence | Department of Mechanical Engineering, KU Leuven - Université catholique de Louvain (UCL) | We explore a family of polynomials whose roots are related to the Mandelbrot set. The roots correspond to the $k-$periodic points of the iteration defining the Mandelbrot set. The Mandelbrot polynomials are defined by $p_0(\zeta)=0$ and $p_{j+1}(\zeta)=\zeta p^2_{j}(\zeta)+1$. These polynomials give rise to a novel family of recursively constructed zero-one matrix family whose eigenvalues are the roots of $p_k(\zeta)$. The LU decomposition of the resolvent of these matrices is highly structured, and one linear solve can be performed in $O(n)$ operations. Krylov based eigenvalue solvers can then be used to compute the eigenvalues of these matrices in an efficient manner. |
| PM | Structural identifiability of the Anaerobic Digestion Model No. 1 | Joost Lauwers, Filip Logist, Lise Appels, Raf Dewil, Jan Van Impe | KULeuven - BioTeC | abstract? |
| PM | Assessing activated sludge stability with Statistical Process Control techniques | Pieter Van den Kerkhof, Geert Gins, Rob Van den Broeck, Jan Van Impe | KULeuven - BioTeC | abstract? |
| PM | Quasi-LPV gain-scheduled observer for Microalgal Cultures | Micaela Benavides Castro, Daniel Coutinho, Anne-Lise Hantson, Jan Van Impe, and Alain Vande Wouwer | Université de Mons (UMons) | Monitoring of microalgal processes is delicate due to the lack of on-line sensors. In this study, software sensors are designed to reconstruct variables such as the internal nitrogen quota, whose follow-up is important when considering the production of lipids. The software sensors make use of one of the simplest models, i.e. Droop model, and are extended Luenberger observers. In the design procedure, uncertain parameters and model nonlinearities are formulated as time varying parameters, resulting into a quasi-Linear Parameter Varying (quasi-LPV) system. Lyapunov arguments and Linear Matrix Inequalities (LMI) techniques are used to develop the proposed software sensors, which are then tested in simulation, showing promising results. |
| PM | Stability analysis of an adaptive control strategy for simulated moving bed chromatographic processes | Paul Suvarov, Alain Vande Wouwer, Achim Kienle | Université de Mons (UMons) | Simulated Moving Bed (SMB) chromatographic systems are continuous processes designed for the total or partial separation of complex chemical mixtures. These hybrid nonlinear processes are difficult to operate and very sensitive to disturbances. A simple adaptive controller that can be applied with minimum prior knowledge about the process parameters has recently been proposed by our research group. In this work, A stability analysis is performed considering two different plant/sensor configurations. |
| PM | On the use of human mobility proxy for the modeling of epidemics | Michele Tizzoni, Paolo Bajardi, Adeline Decuyper, Guillaume Kon Kam King, Christian M. Schneider, Vincent Blondel, Zbigniew Smoreda, Marta C. González, Vittoria Colizza | Université catholique de Louvain (UCL) | Human mobility is a key component of large-scale spatial-transmission models of infectious diseases. Correctly modeling and quantifying human mobility is critical for improving epidemic control policies, but may be hindered by incomplete data in some regions of the world. Here we explore the opportunity of using proxy data or models for individual mobility to describe commuting movements and predict the diffusion of infectious disease. We consider three European countries and the corresponding commuting networks at different resolution scales obtained from official census surveys, from proxy data for human mobility extracted from mobile phone call records, and from the radiation model calibrated with census data. Metapopulation models defined on the three countries and integrating the different mobility layers are compared in terms of epidemic observables. We show that commuting networks from mobile phone data well capture the empirical commuting patterns, accounting for more than 87% of the total fluxes. The distributions of commuting fluxes per link from both sources of data - mobile phones and census - are similar and highly correlated, however a systematic overestimation of commuting traffic in the mobile phone data is observed. This leads to epidemics that spread faster than on census commuting networks, however preserving the order of infection of newly infected locations. Match in the epidemic invasion pattern is sensitive to initial conditions: the radiation model shows higher accuracy with respect to mobile phone data when the seed is central in the network, while the mobile phone proxy performs better for epidemics seeded in peripheral locations. Results suggest that different proxies can be used to approximate commuting patterns across different resolution scales in spatial epidemic simulations, in light of the desired accuracy in the epidemic outcome under study |
| PM | Exact nonnegative matrix factorization and application to extension complexity of polytopes | Julien Dewez, Nicolas Gillis, François Glineur | Université catholique de Louvain (UCL) | The nonnegative rank of a nonnegative matrix is the minimum number of nonnegative rank-one factors needed to reconstruct it exactly. Computing this rank and a related factorization is difficult; however it can be used to describe an extension of a convex polytope with minimum number of facets with applications in combinatorial optimization. On this poster, we present a computational geometry algorithm which computes an exact factorization for rank-three matrices, and provides an upper bound for the nonnegative rank in time polynomial in the dimensions of the input matrix. The algorithm uses the fact that a nonnegative matrix can be represented by two nested polytopes. We also introduce a new lower bound on the extension complexity of a polytope. This quantity is the minimum number of facets of any extension of the polytope, and is equal to the nonnegative rank of the slack matrix representing the polytopes. Our new bound relies on the monotone behaviour of the f-vector of a convex polytope under projections. It improves upon existing lower bounds and, in some cases, implies optimality of the best known extension. |
| PM | This looks like Fibonacci... But is it really? A combinatorial open problem | R. Hollanders | Université catholique de Louvain (UCL) | In this poster, we present a combinatorial open problem whose solution would enable to improve the state of the art upper bound on the complexity of the Policy Iteration algorithm for Markov Decision Problems, a close variant of the Simplex algorithm for Linear Programs. The problem has connections with lattice theory, partially ordered sets and acyclic unique sink orientations of cubes. It can be formulated in no more than two minutes. |

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| **PM** | Distortion Contribution Analysis by combining the BLA and MIMO noise analysis | Adam Cooman and Gerd Vandersteen | Vrije Universiteit Brussel (VUB-ELEC) | To be able to cope with ever stronger specifications in terms of linearity, designers of analog electronic circuits need tools to effectively reduce the distortion generated in their circuits. A first step in solving a problem is finding its source, so our goal is to develop a simulation-based method which shows the dominant sources of non-linear distortion in an electronic circuit. To be useful during the design stage, the analysis should be fast and should avoid the use of special simulation techniques and/or device models.We combine the Best Linear Approximation (BLA) with existing noise de-embedding techniques from the microwave measurement community to obtain our goal. The BLA allows to consider the distortion added by every stage as noise. Combining the BLA with a noise analysis allows to pinpoint the dominant source of non-linear distortion. At high frequencies, the input impedance and reverse gain of amplifier stages play an important role. Taking these effects into account requires a port representation of the stages and the interconnection network. This leads to the distortion contribution analysis based on the MIMO BLA. This new analysis can be used hierarchically from the system level, down to the transistor level. |
| **PM** | : Identification of Latent Graphical Models | Mattia Zorzi, Rodolphe Sepulchre | Université de Liège (ULg) | Suppose we observe some statistics of a subset of components of a gaussian vector process. No information is provided about the number of latent variable, nor of the relationship between the latent and observed process. In this work we propose a penalized conditional ML method for discovering the number of latent components and learning a stochastic model over the entire collection of components. Furthermore, such a penalized method is connected to a new covariance extension problem. Finally, numerical simulations points out the effectiveness of the method |
| **PM** | Generalizing Grasps Across Partly Similar Objects | Renaud Detry | Université de Liège (ULg) | The paper starts by reviewing the challenges associated to grasp planning, and previous work on robot grasping. Our review emphasizes the importance of agents that generalize grasping strategies across objects, and that are able to transfer these strategies to novel objects. In the rest of the paper, we then devise a novel approach to the grasp transfer problem, where generalization is achieved by learning, from a set of grasp examples, a dictionary of object parts by which objects are often grasped. We detail the application of dimensionality reduction and unsupervised clustering algorithms to the end of identifying the size and shape of parts that often predict the application of a grasp. The learned dictionary allows our agent to grasp novel objects which share a part with previously seen objects, by matching the learned parts to the current view of the new object, and selecting the grasp associated to the best-fitting part. We present and discuss a proof-of-concept experiment in which a dictionary is learned from a set of synthetic grasp examples. While prior work in this area focused primarily on shape analysis (parts identified, e.g., through visual clustering, or salient structure analysis), the key aspect of this work is the emergence of parts from both object shape and grasp examples. As a result, parts intrinsically encode the intention of executing a grasp. |
| **PM** | Modelling, Analysis and LQ-Optimal Control of Boundary Control Systems with Boundary Observation | Jérémy R. Dehaye, Joseph J. Winkin | Université de Namur (UNamur), naXys | A model of boundary control system with boundary observation is described and analyzed, which involves no unbounded operator except for the dynamics generator. The resolution of the LQ-optimal control problem for this model provides a stabilizing feedback for a nominal system with unbounded operators. The model consists of an extended abstract differential equation whose state components are the boundary input, the state (up to an affine transformation) and a Yosida-type approximation of the output of the nominal system. Under suitable conditions, the model is well-posed and, in particular, the dynamics operator is the generator of a C0-semigroup and the model is observable. A LQ-optimal control problem is posed for the model and is solved numerically by using an algorithm based on a general method of resolution which relies on the problem of spectral factorization of a multi-dimensional operator-valued spectral density. It is expected that this approach will lead hopefully to a good trade-off between the cost of modelling and the efficiency of methods of resolution of control problems for such systems. |
| **PM** | Temporal patterns reveal missing links in ego networks | Lionel Tabourier, Anne-Sophie Libert, Renaud Lambiotte | Université de Namur (UNamur), naXys | Link prediction is an active field of research aiming at the prediction of new or missing links in networks by exploiting their topology. The main purpose of this study is to develop a framework for link prediction in the worst scenario when no topology is exploitable, as in the case of ego-networks where only the connections between an ego and its neighbours are known. Our main contribution is a careful study of this problem in the case of temporal networks, where we use the information associated to the timing of interactions in several ways: comparing to static benchmarks, we improve the prediction quality by analyzing either the moment when events occur or the time elapsed between events. We also develop a supervised machine learning method to merge different rankings in order to enhance predictions, and present potential applications of our work in social network analysis. |