



Centre for Systems Engineering and Applied Mechanics



ACTIVITY REPORT

2002

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Contents

1. PERSONNEL	1
1 Academic staff	2
2 Academic and post-doctoral visitors	3
3 Scientific staff	4
4 Administrative and technical staff	5
5 Short-term visitors	6
2. RESEARCH	9
1 Research activities	10
1.1 Matrix theory and applications	10
1.2 Linear system theory	12
1.3 Linear control systems	13
1.4 Numerical simulation of fluids and flows	13
1.5 Rheology and Non-Newtonian fluid mechanics	14
1.6 System identification	15
1.7 Nonlinear control design	17
1.8 Control of distributed parameter systems	18
1.9 Biotechnological processes	19
1.10 Micromechanics of solid materials	22
2 Research programmes and contracts	23
2.1 European Programmes	23
2.2 Belgian Federal Programmes	26
2.3 Regional Programmes	27
2.4 Special Research Fund (UCL)	29
2.5 Industrial Contracts	30
2.6 Other international contracts	31
3. PUBLICATIONS	33
1 PhD Theses presented in 2002	34
2 Publications 2002	34

4. TEACHING	49
1 Undergraduate and Graduate Teaching	50
1.1 Applied Mathematics	50
1.2 Mechanics	50
1.3 Systems and Control	51
2 Post-Graduate Training	52
2.1 The Graduate School in Systems and Control	52
2.2 The Graduate School in Neuroscience	55
2.3 The Graduate School in Computational Mechanics (GRASMECH)	55
3 Mini courses	57
4 Other teaching activities	59
5. SEMINARS AND WORKSHOPS	61
1 CESAME colloquium	62
2 Seminars	62
3 Workshops	65
3.1 Workshop on “Dynamics and computation”	65
3.2 Workshop on “Initiatives locales du développement durable en Wal- lonie : Identification, rencontre et analyse”	65
3.3 Meeting of the Belgian Group of Rheology “Rheology as a Characterization tool”	66
6. SCIENTIFIC AWARDS AND RESPONSIBILITIES	68
1 Scientific Award	69
2 Responsibilities	69
7. SCIENTIFIC MISSIONS	72

1. PERSONNEL

1 Academic staff

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MUND Ernest
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WERTZ Vincent
WILLEMS Pierre Yves
WINCKELMANS Grégoire
WINKIN Joseph

2 Academic and post-doctoral visitors

DUFRESNE Louis	13/08/02 - 31/12/02	Postdoctoral researcher, QuÈbec, Canada
ACHHAB Elarbi	01/08/02 - 30/08/02	Visiting professor, Univ. Chouaib Doukkali, El Jadida, Maroc
ATALIK Kunt	01/01/02 - 31/12/02	Postdoctoral researcher, Bosphorus Univ., Istanbul, Turquie.
CANTERINI Vincent	01/02/02 - 30/06/02	Chercheur libre , Univ. de la MÈditÈrranÈe, Marseille, France
DELANNAY Laurent	01/10/02 - 31/12/02	Postdoctoral researcher F.N.R.S.
FIBRIANTO Hadyan	01/06/02 - 31/12/02	Postdoctoral researcher, Inst. National Polytechnique de Grenoble, France
GAJARDO Anahi	01/01/02 - 28/02/02	Postdoctoral researcher, Univ. of Chile
GEUBELLE Philippe	01/06/02 - 25/12/02	Visiting professor, Univ. of Illinois, USA
GROGNARD FrÈdÈric	7/10/02 - 31/12/02	Postdoctoral researcher , INPG, Grenoble, France
HILDEBRAND Roland	01/01/02 - 31/08/02	Postdoctoral researcher, Freie Univ. Berlin, Germany
HOCHEREAU Dominique	01/01/02 - 31/12/02	Researcher, First enterprise, Univ. Paris-Sud, France
LECCHINI Andrea	01/01/02 - 31/12/02	Postdoctoral researcher, Univ. of Brescia, Italy
SCHOEFS Olivier	01/02/02 - 31/12/02	Postdoctoral researcher, Ecole Polytechnique de MontrÈal, Canada
TITICA Mariana	01/01/02 - 31/12/02	Postdoctoral researcher, Lab. d' Automatique, INPG, Grenoble, France
VLADIMIROV Alexander	25/02/02 - 20/04/02	Visiting professor, Russian Academy of Sciences, Moscow, Russia
WOERDEMAN Hugo	01/01/02 - 31/01/02	Visiting professor, The College of William and Mary Williamsburg, VA, USA.
WU Xuekui	01/01/02 - 06/06/02	Postdoctoral researcher, University of Shanghai, China

3 Scientific staff

ABBAD Omar	01/01/02 - 31/12/02
AKSIKAS Ilyasse	01/01/02 - 31/12/02
ALSTEENS Bernard	01/01/02 - 31/12/02
BEGUIN Sophie	03/12/02 - 31/12/02
BIOUL François	01/09/02 - 31/12/02
BLOHM Gunnar	01/01/02 - 31/12/02
CAPART Raphaël	15/09/02 - 31/12/02
CHAHLAOUI Younes	01/01/02 - 31/12/02
DAENINCK Goeric	01/01/02 - 31/12/02
DAVID Benoît	01/01/02 - 31/03/02
de BROUWER Sophie	01/01/02 - 31/08/02
de HALLEUX Jonathan	01/01/02 - 31/12/02
DELATTRE Cédric	01/01/02 - 31/12/02
DELSAUTE Brieux	01/01/02 - 31/12/02
DELVENNE Jean-Charles	01/10/02 - 31/12/02
DUQUESNE Thomas	01/04/02 - 31/12/02
FIBRIANTO Hadyan	01/06/02 - 31/12/02
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GEORGES Laurent	01/09/02 - 31/12/02
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HACHEZ Yvan	01/01/02 - 31/12/02
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JANKOVIC Dejan	01/01/02 - 31/12/02
JEANMART Hervé	01/01/02 - 30/09/02
JEGGY Cécile	01/01/02 - 31/12/02
LEGRAND Sébastien	01/01/02 - 31/12/02
LEMONNIER Damien	02/09/02 - 31/12/02
LENDASSE Amaury	01/01/02 - 31/12/02
LEYGUE Adrien	01/01/02 - 31/12/02
LOIX Fabrice	01/01/02 - 31/12/02
MAGOTTE Olivier	01/01/02 - 31/12/02
MENVIELLE Sylvaine	01/02/02 - 31/12/02
MOENS Luc	01/01/02 - 31/12/02
MOTTE Isabelle	01/01/02 - 31/12/02
NDIAYE Mariama	01/01/02 - 31/12/02

ONDERBEKE David	01/01/02 - 31/12/02
ORBAN de Xivry Jean-Jacques	01/09/02 - 31/12/02
OUAAR Amine	01/01/02 - 31/12/02
PIERARD Olivier	01/10/02 - 31/12/02
PROVOST AgnÈs	01/01/02 - 31/12/02
REDAELLI Silvia	01/01/02 - 27/03/02
REGNIER Vincent	01/01/02 - 31/12/02
ROLINSKY Roman	01/01/02 - 31/12/02
RONSSSE Renaud	01/09/02 - 31/12/02
SCHOEFS Olivier	01/02/02 - 31/12/02
SCHREIBER CÈline	01/01/02 - 31/12/02
SOLARI Gabriel	01/01/02 - 31/12/02
THEYS Jacques	01/01/02 - 31/12/02
TITICA Mariana	01/01/02 - 31/12/02
THIRIFAY FranÁois	01/01/02- 31/12/02
TREVE Vincent	01/09/02 - 31/12/02
TUDOR Angela	01/01/02 - 30/06/02
VANDENDORPE Antoine	01/01/02 - 31/12/02
VAN GOETHEM Nicolas	01/01/02 - 31/12/02
VAN RUYMBEKE Evelyne	01/01/02 - 31/12/02
WHITE Olivier	01/09/02 - 31-12/02
WU Liang	01/01/02 - 31/12/02

4 Administrative and technical staff

DE BOECK Lydia	Secretary (half-time)
DE RUYVER Michel	Technician (half-time)
DEWAN Michel	Technician
DONDERS Guido	Computer analyst
HISSETTE Isabelle	Secretary (half-time)
HUENS Etienne	Computer analyst
LOOCKX Edward	Technician
MAJOROS Yannick	Computer analyst
MULEMANGABO Edmond	Computer analyst
PIGEON Dominique	Secretary
SERGANT Michèle	Secretary
TERMOLLE Michèle	Secretary
VERMEULEN Victor	Technician

5 Short-term visitors

21/01/02	01/02/02	KLAN P.	Inst. of Computer Science, Prague, Czech Rep.
01/03/02		VAN BAREL M.	KULeuven, Belgium
07/03/02		GONZALO A.	UniversitÈ de Santiago, Chili
08/03/02	28/03/02	PERRIER M.	UniversitÈ de MontrÈal, Canada
11/03/02	13/03/02	GRAHAM B.	UMIST, Manchester, UK
15/03/02		WILLEMS Jan C.	KULeuven, Belgium
18/03/02	22/03/02	HUEPER K.	Universitaet Wuerzburg, Deutschland
22/03/02		KAASHOEK R.	Vrije Universiteit Amsterdam, Holland
22/03/02		WOERDEMAN H.	Dpt. Math. William and Mary, USA
25/03/02	25/04/02	BELKACEM A.	UniversitÈ de Biskra, AlgÈrie
25/03/02	26/03/02	PETIT N.	Ecole des Mines de Paris, France
29/03/02		BULTHEEL A. & P. Van Gucht	KULeuven, Belgium
16/04/02	15/05/02	ACHHAB E.	UniversitÈ El Jadida, Maroc
15/04/02	19/04/02	KOIRAN P.	Ecole nationale SupÈrieure de Lyon, France
15/04/02	19/04/02	JEANDEL E.	Ecole nationale SupÈrieure de Lyon, France
23/04/02		SCHOUKENS J.	VUB, Brussels, Belgium
29/04/02	10/05/02	KULCZYCKI P.	Polish Academy of Sc., Cracow University
02/05/02	22/05/02	BAKER Ch.	Florida State University, USA
06/05/02	24/05/02	ANDERSON BDO	ANU, Australia
07/05/02		WILLEMS Jan C.	KULeuven, Belgium
19/05/02	23/05/02	OPTICAN L.	NEI, Bethesda, USA
28/05/02		D' ANDRÈA NOVEL B.	Ecole des Mines de Paris, France
30/06/02		BODINI O.	UniversitÈ Paris 6, France
11/06/02	13/06/02	HARMAND J.	INRA/LBE, Narbonne, France
10/06/02	26/07/02	PERRIER M.	UniversitÈ de MontrÈal, Canada
20/06/02	27/07/02	Jun WANG J.	Chinese University of Hong Kong
24/06/02	27/06/02	SORENSEN D., ROJAS M.,	Rice university, Sweden
14/06/02	12/07/02	CHAROUKI N.,	UniversitÈ El Jadida, Maroc
19/06/02	20/06/02	MOUNIER H.,	Paris Orsay, France
05/07/02		CAMPI M.	UniversitÈ de Brescia, Italy
15/07/02	16/07/02	YURKOVICH S.,	Ohio State University, USA
15/07/02		SCORLETTI G.	Lab. d'Automatique et de ProcÈdÈs, Caen, France
18/07/02		WING A.	The University of Birmingham, U.K.
23/07/02		JONCKHEERE E.	University of Southern California, USA
01/08/02	30/08/02	ACHHAB E.	UniversitÈ El Jadida, Maroc
26/08/02	30/08/02	KLAN P.	UniversitÈ de Prague, TchÈquie
18/09/02		D' ANDRÈA NOVEL B.	Ecole des Mines de Paris, France
08/10/02		LEI F. , KORSHOLM L.	Novozymes, Denmark
11/10/02		VAN BAREL M.	KULeuven, Belgium

29/10/02		ERNST D.	Ulg, Liège, Belgium
04/11/02		LAUN M., RUELLMAN M.	BASF, Ludwigshafen
14/11/02	15/11/02	LEVENTE CSABA BODIZS	EPFL, Lausanne, Suisse
15/11/02		SCORLETTI G.	Lab. d'Automatique et de Procédés, Caen, France
15/11/02		VANDEWALLE J.	KULeuven, Belgium
29/11/02		JONCKHEERE E.	University of Southern California, U.S.A.

2. RESEARCH

1 Research activities

In this section, we give an overview of the research activities at Cesame during the period covered by the report. The abstracts of the full papers that have been prepared and submitted are listed hereafter. All the other papers published during this period as well as the conference communications can be found in the publication section.

1.1 Matrix theory and applications

STEWART M., P. VAN DOOREN, “On the factorization of hyperbolic and unitary transformations into rotations”, *Submitted to SIAM Journal on Matrix Analysis and Applications*, 2002.

This paper generalizes the CS decomposition of a partitioned unitary matrix to the case of a partitioned Σ -unitary matrix H . The hyperbolic rotations revealed by the decomposition are shown to be optimal in that among a broader class of decompositions of H into elementary hyperbolic rotations they are the smallest possible in a sum-of-squares sense. A similar optimality property is shown to hold for the sines in the CS decomposition of a unitary matrix.

HACHEZ Y., P. VAN DOOREN, “Self-adjoint quadratic eigenvalue problems and associated distance problems”, *Submitted to Linear Algebra and its Applications*, 2002

Two important classes of quadratic eigenvalue problems are composed by elliptic and hyperbolic problems. In [N.J. Higham, F. Tisseur, and P.M. Van Dooren, *Linear Algebra Appl.*, 351-352 (2002), pp. 455-474], the distance to the nearest non-hyperbolic or non-elliptic quadratic eigenvalue problem is obtained using a global minimization problem. This paper proposes explicit formulas to compute these distances and the optimal perturbations. The problem of computing the nearest elliptic or hyperbolic quadratic eigenvalue problem is also solved. Numerical results are given to illustrate the theory.

BLONDEL V., P. VAN DOOREN, “A measure of similarity between graph vertices”, *Submitted to SIAM Review*, 2002.

We introduce a concept of similarity between vertices of directed graphs. Let G_A and G_B be two directed graphs with respectively n_A and n_B vertices. We define a n_A by n_B similarity matrix S whose real entry s_{ij} expresses how similar vertex i (in G_A) is to vertex j (in G_B): we say that s_{ij} is their similarity score. In the special case where $G = G_A = G_B$, the score s_{ij} is the similarity score between the vertices i and j of G and the square similarity matrix S is the self-similarity matrix of the graph G . We point out that Kleinberg’s hub and authority method to identify web-pages relevant to a given query can be viewed as a special case of our definition in the case where one of the graphs has two vertices and a unique directed edge between them. In analogy to Kleinberg, we show that

our similarity scores are given by the components of a dominant vector of a non-negative matrix and we propose a simple iterative method to compute them. Potential applications of our similarity concept are manifold and we illustrate one application for the automatic extraction of synonyms in a monolingual dictionary.

HUEPER K., P. VAN DOOREN, “New algorithms for the iterative refinement of estimates of invariant subspaces”, *Submitted to The journal future generation computer systems, 2002*

New methods for refining estimates of invariant subspaces of a non-symmetric matrix are presented. We use global analysis to show local quadratic convergence of our method under mild conditions on the spectrum of the matrix.

LIN W.W., P. VAN DOOREN, Q.F. XU, “Equivalent characterizations of periodical deflating subspaces”, *Submitted to Linear Algebra and its Applications, 2002*

In this paper we present several different characterizations of invariant subspaces of periodic eigenvalue problems. We analyze their equivalence and discuss their use in control theory.

ABSIL P.A., R. MAHONY, R. SEPULCHRE, “Riemannian geometry of Grassman manifolds with a view on algorithmic computation”, *Submitted to Acta Applicandae Mathematicae*

We give simple formulas for the canonical metric, gradient, Lie derivative, Riemannian connection, parallel translation, geodesics and distance on the Grassmann manifold of p -planes of \mathbb{R}^n . In these formulas, p -planes are represented as the column space of $n \times p$ matrices. The Newton method on abstract Riemannian manifolds proposed by S. T. Smith is made explicit on the Grassmann manifold. Two applications –computing an invariant subspace of a matrix and the mean of subspaces– are worked out.

ABSIL P.-A. , P. VAN DOOREN, “Two-sided Grassmann Rayleigh quotient iteration”, *Submitted to Simax, 2002*

The two-sided Rayleigh quotient iteration proposed by Ostrowski computes a pair of corresponding left-right eigenvectors of a matrix C . We propose a Grassmannian version of this iteration, i.e. its iterates are pairs of p -dimensional subspaces instead of one-dimensional subspaces in the classical case. The new iteration generally converges locally cubically to the pairs of left-right p -dimensional invariant subspaces of C . Moreover, Grassmannian versions of the Rayleigh quotient iteration are given for the generalized symmetric eigenproblem, the Hamiltonian eigenproblem and the skew-Hamiltonian eigenproblem.

1.2 Linear system theory

GALLIVAN K., A. VANDENDORPE, P. VAN DOOREN, “Model reduction via truncation: an interpolation point of view”, *Submitted to Linear Algebra and its Applications*, 2002.

In this paper, we focus our attention on linear time invariant continuous time linear systems with one input and one output (SISO LTI systems). We consider the problem of constructing a reduced order system via truncation of the original system. Given a SISO strictly proper transfer function $\hat{T}(s)$ of Mc Millan degree $n < N$, we prove that $\hat{T}(s)$ can always be constructed via truncation of the system $T(s)$. The proof is mainly based on interpolation theory, and more precisely on multipoint PadÈ interpolation. Moreover, new results about Krylov subspaces are developed.

VARGA A., P. VAN DOOREN, “Computing the zeros of periodic systems”, *Submitted to Systems and Control Letters*, 2002.

We present an efficient and numerically reliable approach to compute the zeros of a periodic system. The zeros are defined in terms of the transfer-function matrix corresponding to an equivalent lifted time-invariant state-space system. The proposed method performs locally row compressions of the associated system pencil to extract a low order pencil which contains the zeros (both finite and infinite) as well as the Kronecker structure of the periodic system. The proposed algorithm belongs to the family of fast, structure exploiting algorithms and relies exclusively on using orthogonal transformations. For the overall computation of the zeros a certain form of numerical stability can be ensured.

BITMEAD R.R., B.D.O. ANDERSON, M. GEVERS, L.C. KAMMER, “Cautious controller tuning”, *Submitted to Automatica*, 2002.

Controller Tuning encapsulates a number of areas of control design in which closed-loop data and performance are used as a basis to modify the feedback control law. At the heart of such schemes is the generation of a sequence of controllers and the development of a logical process to attempt to improve performance based on closed-loop data. There are several methods which immediately fall into this category, such as Adaptive Control, Iterative Feedback Tuning, Direct Iterative Tuning, Iterative Identification and Control Design. The difference between schemes rests in their use (or avoidance) of plant models, their computation of adjustment direction from data, and their update rate. We shall treat systems with slow update, in which a large block of data is acquired before a tuning step is made. In this framework, many results from linear theories, both robust control and system identification, carry over.

1.3 Linear control systems

CAMPI M.C., A. LECCHINI, S.M. SAVARESI, “An application of the virtual reference feedback tuning (VRFT) method to a benchmark active suspension system”, *Submitted to European Journal of Control*, 2002.

Virtual Reference Feedback Tuning (VRFT) is a general methodology for the design of a controller when the plant transfer function is unknown, proposed by the same authors in previous contributions. It is a direct method that aims at minimizing a control cost of the 2-norm type by using a batch of data collected from the plant. The minimization is conducted in one-shot (the method is not iterative) and this makes VRFT particularly handy in many practical applications. This paper presents an application of VRFT to a benchmark active suspension system. As a by-product, this paper also delivers a new extension of VRFT that permits to cope with constraints on the input-sensitivity.

LECCHINI A., B.D.O. ANDERSON, M. GEVERS, “Virtual reference feedback tuning with guaranteed stability”, *Submitted to Automatica*, 2002.

In this paper we consider the stability issue in Virtual Reference Feedback Tuning (VRFT) design. Our contribution consists in providing a suitable modification of the VRFT procedure that guarantees the stability of the designed control system. The modified procedure is based on robust stability results in the v -gap.

HILDEBRAND R., A. LECCHINI, G. SOLARI, M. GEVERS, “Convergence analysis and optimal prefiltering in Iterative Feedback Tuning”, *Submitted to IEEE Trans. on Automatic Control*, 2002

Iterative Feedback Tuning (IFT) is a widely used procedure for controller tuning. It is a sequence of iteratively performed special experiments on the plant interlaced with periods of data collection under normal operating conditions. In this paper we derive the asymptotic convergence rate of IFT for disturbance rejection, which is one of the main fields of application. Further we present a method to improve the convergence of IFT by prefiltering the input data for the special experiment. At each iteration step the optimal prefilter is computed from data collected under normal operating conditions of the plant.

1.4 Numerical simulation of fluids and flows

JEANMART H., D. CARATI, G.S. WINCKELMANS, “Non universality and symmetry breaking in three-dimensional turbulent Kolmogorov flow”, *Submitted to Phys. Fluids*.

Direct numerical simulations of the Kolmogorov flow generated by a stationary unidirectional forcing sinusoidally modulated in a direction perpendicular to the forcing are pre-

sented for low Reynolds numbers. The influence of the computational domain is explored when using periodic boundary conditions. The symmetries expected from the forcing for the mean velocity and the Reynolds stresses are indeed observed when the minimal domain consisting of a cubic box with linear size equal to the forcing wavelength is used. However, when larger aspect ratios are used, symmetry breaking is observed in the streamwise direction and the turbulence statistics appear to be nonuniversal : they depend on the aspect ratio even for very large computational domains.

PLOUMHANS P., G. DAENINCK, G.S. WINCKELMANS, “Simulation of three dimensional bluff body flows using the vortex particle and boundary element methods” *Submitted to J. Flow, Turbulence and Combustion*.

Recent contributions to the 3-D vortex method for bluff body flows are presented. The numerical method—a vortex method combined with a boundary element method—is briefly reviewed. It is applied to direct numerical simulation (DNS) of the flow past a sphere ($Re=300$ and 1000). The on-going work to extend the method towards vortex-based large-eddy simulation (LES) for high Reynolds number flows is also presented. Preliminary results for the flow past a hemisphere are discussed.

1.5 Rheology and Non-Newtonian fluid mechanics

WAPPEROM P., R. KEUNINGS, G. IANNIRUBERTO, “Prediction of Rheometrical and Complex Flows of Entangled Linear Polymers Using the DCR Model with Chain Stretch”, *J. of Rheology, in press 2002*.

We study the rheometrical and complex flow response of the double-convection-reptation (DCR) model with chain stretch proposed recently by Ianniruberto and Marrucci (2001,2002) for entangled linear polymers. The single- and two-mode differential versions of the model are used, with parameter values identified by Ianniruberto and Marrucci (2002) for a nearly monodisperse polybutadiene solution. These authors found that the DCR model with stretch predicts well the rheometrical shear behavior of the fluid in the modest experimental range of deformation rates. Our calculations for the higher shear rates reached in the simulations of complex flow reveal anomalous or questionable behavior, namely shear-thickening over an intermediate range of shear rates and large chain stretch reached in fast shear flows. This behavior is shown to be shared by the original integro-differential DCR theory, of which the differential DCR model is actually a mathematical approximation. We also show that the original DCR theory with stretch predicts excessive shear-thinning at high shear rates, while its differential approximation remains stable for all shear rates. Using the Backward-tracking Lagrangian particle method (Wapperom et al., 2001), we investigate the response of the differential DCR model in start-up flow through an axisymmetric contraction/expansion geometry. We compare the single- and two-mode model predictions (in terms of steady-state vortex structure, chain stretch, and

overall pressure drop), and correlate these with the steady and start-up rheometrical responses in shear and extension. Significant chain stretch is predicted in the vicinity of the axis of symmetry and in thin boundary layers located at the constriction wall. As a result, the DCR predictions significantly depart from the stress-optical rule in these flow regions. Chain stretch also affects the flow kinematics, with the appearance of a large upstream steady-state vortex. Surprisingly, however, the predicted pressure drop is not much affected by these kinematical changes, and is qualitatively described by a simple inelastic, shear-thinning model.

KEUNINGS R., "Finite Element Methods For Integral Viscoelastic Fluids", *invited review chapter to appear in Rheology Reviews 2003, British Society of Rheology*.

We review the field of finite element techniques for solving complex flows of viscoelastic fluids described by a constitutive model of the integral type. The focus is mainly put on mathematical formulations and numerical approaches. A short guide to published simulations of non-trivial flow problems is offered.

VAN RUYMBEKE E., R. KEUNINGS, C. BAILLY "Determination of the Molecular Weight Distribution of Entangled Linear Polymers from Linear Viscoelasticity Data", *J. Non-Newt. Fluid Mech.*, Vol. 105, 153-175 (2002).

In a companion paper ["Evaluation of reptation models for predicting the linear viscoelastic properties of entangled linear polymers", E. van Ruymbeke, R. Keunings, V. Stephenne, A. Hagenars, C. Bailly, accepted for publication in *Macromolecules*], we have addressed the direct problem of predicting the linear viscoelastic response of entangled linear polymers from their molecular weight distribution, using a suitable model inspired by reptation theory. By comparing the theoretical results to experimental data for a variety of samples of different nature (polystyrene, polycarbonate, high-density polyethylene) and distribution (monomodal and multimodal), we found that the time-dependent diffusion reptation model proposed by des Cloizeaux, suitably modified to treat short chains and to include Rouse processes, is capable of quantitative predictions. In the present paper, we use the modified des Cloizeaux model to address the inverse problem of predicting molecular weight distribution from dynamic moduli. A parametric approach is implemented to deal with the ill-posedness of the problem. Results are given for most of the samples studied in the companion paper. They are in quantitative agreement with size-exclusion chromatography data. In particular, the proposed methodology is able to resolve small amounts of short chains in bimodal blends containing large amounts of long chains.

1.6 System identification

WU X., G. CAMPION, "An investigation on physical diagnosis for aircraft engines", *Sub-*

mitted to Automatica, 2002.

Directly related to an ongoing research and development project concerned with identification, diagnosis and control of aircraft engines, this paper focuses on the topic of physical diagnosis using the parametric statistical approach. Some fundamental issues of fault detectability and isolability are discussed within the framework of statistical approach. Necessary and sufficient conditions are provided to determine if the faults are detectable and isolable. These results are helpful in designing a proper FDI algorithm and in choosing the diagnosis points at which the FDI performs well. Some simulation experiments for aircraft engines are also given to illustrate these ideas.

LECCHINI A., M. GEVERS, “Explicit expression of the parameter bias in identification of Laguerre models from step responses”, *Submitted to Systems and Control Letters*, 2002.

This paper delivers an analysis of the least-squares estimation of the Laguerre coefficients of a linear discrete-time system from step response data. The original contribution consists in an explicit formula for the bias error on the estimated coefficients due to the under-modelling of the system. The formula, jointly with some a-priori information on the neglected dynamics, can be used to construct bounds on this error. The results presented in this paper are illustrated with a simulation example.

HILDEBRAND R., M. GEVERS, “Quantification of the variance of estimated transfer functions in the presence of undermodeling”, *Submitted to IEEE Transactions on Automatic Control*, 2002.

We study the effect of undermodeling on the parameter variance for prediction error time-domain identification with linear model structures. We restrict our consideration to linear time-invariant discrete time single input single output systems. We examine the asymptotic expression for the variance as the number of data tends to infinity. This quantity is known to depend in general on the fourth order statistical properties of the applied input. However, we establish a sufficient condition under which the asymptotic variance is a function of the input power spectrum only. For this case we deliver exact expressions. We show that for a stochastic input the undermodeling contributes to the parameter variance due to the correlation between the prediction errors and its gradients. As an additional contribution we investigate the parameter variance under the assumptions of the stochastic embedding procedure. We show by means of a counterexample that in the framework of stochastic embedding the parameter variance is not necessarily monotonic with respect to the input power spectrum.

BOMBOIS X., G. SCORLETTI, P. VAN DEN HOF, M. GEVERS, , B.D.O. ANDERSON, “A new robust control design procedure based on a PE identification uncertainty set”, *Submitted to Automatica*

This paper proposes a new robust control design procedure based on a model and an uncertainty region deduced from classical PE identification. The key step in the procedure

is a quality assessment procedure for the pair “model-uncertainty region” taking into account the prescribed performance level.

LEE J., A. LENDASSE, M. VERLEYSEN, “Curvilinear distance analysis versus Isomap”, *Submitted to Neurocomputing, 2002*

Dimension reduction techniques are widely used for the analysis and visualization of complex sets of data. This paper compares two recently published methods for nonlinear projection : Isomap and Curvilinear Distance Analysis. Contrarily to the traditional linear PCA, these methods work like multidimensional scaling, by reproducing in the projection space the pairwise distances measured in the data space. They differ from the classical linear MDS by the metrics they use and by the way they build the mapping (algebraic or neural). While Isomap relies directly on the traditional MDS, CDA is based on a nonlinear variant of MDS, called CCA (Curvilinear component analysis). Although Isomap and CDA share the same metrics, the comparison highlights their respective strengths and weaknesses.

1.7 Nonlinear control design

MOUNIER H., G. BASTIN, “Compartmental modelling for traffic control in communication networks”, *submitted to IEEE Transactions on Automatic Control, 2002.*

A continuous time compartmental modelling approach for the global description of packet-switching communication networks is presented. On the basis of this model, a systematic procedure is formulated to derive local hop-by-hop feedback control laws that are able to guarantee a global network stabilisation, with the routed flow fractions as control action. The performance of the control is illustrated with a realistic simulation experiment.

GUAY M., D. DOCHAIN, M. PERRIER, “Adaptive Extremum Seeking Control of Non-isothermal Continuous Stirred Tank Reactors”, *Submitted to Chemical Engineering Science*

In this paper, we present an adaptive extremum seeking control scheme for non-isothermal continuous stirred tank reactors. We assume limited knowledge of the reaction kinetics. An adaptive learning technique is introduced to construct an optimum seeking algorithm that drives the system states to optimal equilibrium concentrations of the reaction mixture. Lyapunov’s stability theorem is used in the design of the extremum seeking controller structure and the development of the parameter learning laws. Under mild assumptions, the resulting controller is an output-feedback controller

1.8 Control of distributed parameter systems

DE HALLEUX, J., C. PRIEUR, J.M. CORON, B. D'ANDRÈ-NOVEL, G. BASTIN, "Boundary feedback control in networks of open channels", *Submitted to Automatica*, 2002.

This article deals with the regulation of water flow in open-channels modelled by Saint-Venant equations. By means of a Riemann invariants approach, we deduce stabilizing control laws for a single horizontal reach without friction. The approach is extended to general networks of canals and is illustrated with a simple case study : two reaches in cascade. To prove control stability of the canal network, we use a consequence of a previous result from Li Ta-t sien concerning the existence and decay of classical solutions of hyperbolic systems. An extension of the control law is proposed for channels with slope and friction.

LAABISSI M., M.E. ACHHAB, J.J. WINKIN, D. DOCHAIN, "Multiple equilibrium profiles for nonisothermal tubular reactor nonlinear models", *Submitted to IEEE Transactions on Automatic Control*, 2002.

The multiplicity of the equilibrium profiles is shown for axial dispersion nonisothermal tubular reactors described by Arrhenius type nonlinear models. It is proved that there is at least one steady state among the physically feasible states for such models. Moreover physically meaningful conditions which ensure the multiplicity of equilibrium profiles are given.

DELATTRE C., D. DOCHAIN, J. WINKIN, "Sturm-Liouville systems are Riesz-spectral systems", *Submitted in Systems and Control Letters*, 2002.

The class of Sturm-Liouville systems is defined. It appears to be a subclass of Riesz-spectral systems, since it is shown that the opposite of a Sturm-Liouville operator is a Riesz-spectral operator on $L^2(a, b)$ and the infinitesimal of a C_0 -semigroup of bounded linear operators.

DELATTRE C., D. DOCHAIN, J. WINKIN, "Observability analysis of Sturm-Liouville systems : application to a bioreactor model", *Submitted to Automatica*, 2002.

The observability of Sturm-Liouville systems is studied. It is reported that the associated linear infinite-dimensional system dynamics are described by a Riesz-spectral operator which generates a C_0 -semigroup. Then, assuming some particular boundary conditions, it is shown that any finite number of dominant modes of the system can be made observable by an approximate point measurement. This result is applied to the analysis of the tangent linearized model of an axial dispersion tubular bioreactor that involves one nonlinear growth reaction.

1.9 Biotechnological processes

ZHANG T., M. GUAY, D. DOCHAIN, “Adaptive extremum seeking control of continuous stirred tank bioreactors”, *Submitted to AICHE Journal*, 2002.

In this paper, we present an adaptive extremum seeking control scheme for continuous stirred tank bioreactors. The proposed adaptive extremum seeking approach utilizes the structure information of the kinetics of the bioreactors to construct a seeking algorithm that drives the system states to the desired set-points that extremize the value of an objective function. Lyapunov’s stability theorem is used in the design of the extremum seeking controller structure and the development of the parameter learning laws. Simulation experiment is given to show the effectiveness of the proposed approach.

PETERSEN B., K. GERNAEY, M. DEVISSCHER, D. DOCHAIN, P. VANROLLEGHEM, “A simplified method to access structural identifiable parameters in Monod activated sludge models”, *Submitted to Water Research*, 2002.

The first step in estimation of parameters of models applied for data interpretation should always be an investigation of the identifiability of the model parameters. In this study the structural identifiability of the model parameters of Monod model was studied. It was assumed that respirometric (dissolved oxygen or oxygen uptake rates) and titrimetric (cumulative proton production) measurements were available for characterisation of nitrification as an illustrative example. Two model structures including presence and absence of significant growth for description of long- and short-term experiments respectively were considered. The structural identifiability was studied via the series expansion method. It has proven that the autotrophic yield becomes uniquely identifiable when combine respirometric and titrimetric data are assumed for the characterisation of nitrification. The most remarkable result of the study was however that the identifiability results could be generalised by applying a set of ASM1 matrix based generalisation rules. It appeared that the identifiable parameter combinations could be predicted directly based on knowledge of the process model under study (in ASM1-like matrix representation), the measured variables and the biodegradable substrate considered. This generalisation reduced the time-consuming task of deriving the structurally identifiable model parameters significantly and helps the user to obtain these directly without the necessity to go too deeply into the mathematical background of structural identifiability.

MARCOS N., M. GUAY, D. DOCHAIN, T. ZHANG, “Adaptive Extremum-Seeking Control of a Continuous Bioreactor”, *Submitted to Journal of Process Control*, 2002.

In this paper, we present an adaptive extremum seeking control scheme for continuous stirred tank bioreactors. The proposed adaptive extremum seeking approach utilizes the structure information of the kinetics of the bioreactors to construct a seeking algorithm that drives the system states to the desired set-points that extremize the value of an objective

function. Lyapunov's stability theorem is used in the design of the extremum seeking controller structure and the development of the parameter learning laws. Simulation experiment is given to show the effectiveness of the proposed approach.

TITICA M., D. DOCHAIN, M. GUAY, "Adaptive Extremum seeking control of fed-batch bioreactors", *Submitted to European Journal of Control*, 2002.

In this paper, we present an adaptive extremum seeking control scheme for fed-batch bioreactors with Haldane kinetics. The proposed adaptive extremum seeking approach utilizes the structure information of the process kinetics to derive a seeking algorithm that drives the system states to the desired set-points that maximizes the value of the biomass production. Lyapunov's stability theorem is used in the design of the extremum seeking controller structure and the development of the parameter learning laws. The performance of the approach is illustrated via numerical simulations.

SCHOEFS O., A. ELLERT, M. PERRIER, R. SAMSON, "Characterizing the kinetics of biodegradation of hydrophobic pollutants by indigenous soil microorganisms", *Submitted to Journal of Environmental Engineering*, 2002.

Microbial bioavailability of pollutants has been largely studied using enriched cultures or single strains, but its characterization becomes more complex in the presence of soils containing mixed microbial populations. An experimental approach was therefore developed to characterize the kinetics of biodegradation of hydrophobic pollutants by indigenous soil microorganisms. Biomass is extracted from soil and transferred into an aqueous phase. Biodegradation assays in liquid-phase microcosms are then performed using ^{14}C -labeled and non-radioactive hexadecane. Mineralization into CO_2 is determined using a CO_2 -trap consisting of a KOH solution. Hexadecane depletion and pollutant-degrader population are monitored using sacrificed microcosms, by centrifuging the liquid phase so that the supernatant and the residue contain residual hexadecane and microbial population, respectively. This experimental method has led to the identification of key biokinetic parameters for soils containing mixed microbial populations. During the exponential phase, the CO_2 /hexadecane and hexadecane/biomass yield coefficients were respectively estimated as 0.35 g CO_2 -C/g hexadecane-C and 0.65 g biomass-C/g hexadecane-C. During the microbial-decay phase, the CO_2 /biomass yield coefficient was equal to 1.36 g CO_2 -C/g biomass-C. The pollutant and total soil mineralization, biodegradation, and microbial growth and decay rates were simultaneously monitored so that growth-based biodegradation models could be developed. Such models are significant for microbial bioavailability studies in natural soils.

SCHOEFS O., M. PERRIER, R. SAMSON, "Development of a biocontact model for the biodegradation of hydrophobic pollutants in unsaturated soils", *Submitted to Environmental Science and Technology*, 2002

The objective of this study was to develop and calibrate a phenomenological model of

biodegradation in unsaturated soil that minimizes the number of parameters to be determined by preliminary tests or fitted to experimental data. Hexadecane was chosen as a model compound for petroleum hydrocarbons. A two-compartment model was developed, decoupling the intrinsic biodegradation kinetic from limiting factors imposed by field conditions such as oxygen transfer and pollutant bioavailability. Two new experimental protocols (one for the liquid phase and the other for the solid phase) were developed to monitor hexadecane depletion, hexadecane mineralization, total mineralization, and evolution of the degraders. Using the liquid-phase experiment, parameters of a Haldane kinetic model and yield coefficients were identified and used in the complete model of biodegradation in soil. Using the carbon dioxide production curve, a biocontact kinetic model was identified so that, despite the high sensitivity of the model outputs to variations in the parameters, hexadecane depletion could be correctly predicted with an average error on the removal percentage of less than 18 %. Moreover, the ratio between hexadecane mineralization and total mineralization remained constant after a brief transient period, indicating that the hexadecane mineralization could be deduced from the total carbon dioxide measurement. Finally, the new model developed in this study allows considering real-time monitoring of pollutant biodegradation using on-line carbon dioxide measurement.

SCHOEFS O., M. PERRIER, D. DOCHAIN, R. SAMSON, "On-line estimation of biodegradation in an unsaturated soil", *Submitted to Bioprocess and Biosystems Engineering*, 2002.

The objective of the study described in the present paper was to develop a model-based estimator of biodegradation in unsaturated soil. This would allow real-time assessment of the efficiency of treatment bioprocesses, such as bioventilation and biopile, and eventually permit optimization through the implementation of control strategies. Based on a reduced-order-model, an asymptotic observer has been designed to estimate on-line the contaminant concentration, using carbon dioxide measurement. Two observer-based estimators have been built to approximate : (1) the specific microbial grow rate; and (2) the biocontact kinetics representing the soil resistance to contaminant biodegradation. State observers and parameter estimators have been confronted with the experimental results of biodegradation in microcosms. Hexadecane was used as the model compound, representing petroleum hydrocarbons. Three water contents, corresponding to 20 %, 50 % and 80 % of the water holding capacity, were tested. The asymptotic observer is able to predict hexadecane depletion for the two higher water contents with an error on the overall time trajectories of less than 10 %. However, the error for the dry soil is 30 %, mainly due to an unexplained overstepping in the observation curve. The observer-based estimator of the specific microbial growth rate, based on the CO_2 measurement, has been successfully calibrated using the off-line measurements of hexadecane as validation data, and allows estimation of the time when biodegradation switches from a microbial to a biocontact limitation. The biocontact kinetics has also been identified on-line, using an estimator based on the hexadecane not in biocontact. These results are very encouraging with re-

spect to the potential for on-line assessment of the performance of treatment bioprocesses in unsaturated soils.

1.10 Micromechanics of solid materials

NIKOLOV S., I. DOGHRI, O. PIERARD, L. ZEALOUK, A. GOLDBERG, “Multi-scale constitutive modeling of the small deformations of semi-crystalline polymers”, *Journal of the Mechanics and Physics of Solids*, vol. 50, pp. 2275-2302, 2002.

A multi-scale constitutive model for the small deformations of semi-crystalline polymers such as high density Polyethylene is presented. Each macroscopic material point is supposed to be the center of a representative volume element which is an aggregate of randomly oriented composite inclusions. Each inclusion consists of a stack of parallel crystalline lamellae with their adjacent amorphous layers. Micro-mechanically based constitutive equations are developed for each phase. A viscoplastic model is used for the crystalline lamellae. A new nonlinear viscoelastic model for the amorphous phase behavior is proposed. The model takes into account the fact that the presence of crystallites connects the amorphous phase in extremely thin layers where the concentration of chain entanglements is very high. This gives rise to a stress contribution due to elastic distortion of the chains. It is shown that the introduction of chains' elastic distortion can explain the viscoelastic behavior of crystalline polymers. The stress contribution from elastic stretching of the tie molecules linking the neighboring lamellae is also taken into account. Next, a constitutive model for a single inclusion considered as a laminated composite is proposed. The macroscopic stress-strain behavior for the whole RVE is found via a Sachs homogenization scheme (uniform stress throughout the material is assumed). Computational algorithms are developed based on fully implicit time-discretization schemes.

2 Research programmes and contracts

2.1 European Programmes

Training and Mobility of Researchers (April 1998 - March 2002)

- *Project title* : Dynamics of Polymeric Liquids : The relation between fluid structure, Properties and Performance
- *Promoter* : R. Keunings
- *Partners* : Delft University of Technology, Eindhoven University of Technology, University of Stuttgart, University of Wales (Aberystwyth and Swansea), Cambridge University, Université Joseph Fourier Grenoble, Technical University Denmark, University of Naples.

Training and Mobility of Researchers (March 1998 - March 2003)

- *Project title* : European Research Network on System Identification (ERNSI)
- *Promoter* : M. Gevers
- *Partners* : University of Groningen, The Netherlands - Technische Universität Wien, Austria - INRIA, Sophia Antipolis, France - University of Cambridge, U.K. - CNR, Padova, Italy - University of Linköping, Sweden - Royal Institute of Technology, Stockholm, Sweden - INRIA, IRISA, Rennes, France.

Cooperation and Coordination in the Field of Scientific and Technical Research (COST)

- *Project title* : Optimal Management of Wastewater Systems (COST action 624)
- *Promoter* : D. Dochain
- *Partners* : Technical Univ. Denmark, DTH, Denmark - Helsinki Univ. of Technology, Espoo, Finland - Water Research Institute C.N.R., Rome, Italy - Aquateam-Norwegian Water Technology Center, Oslo, Norway - C.E.I.T. Research Center, San Sebastian, Spain - E.A.W.A.G., Dübendorf, Switzerland - Lund Institute of Technology, Lund, Sweden.

BRITE-EURAM (January 1998 - June 2002)

- *Project title* : Numerics in Control Network (NICONET)
- *Promoter UCL* : P. Van Dooren

- *Partners* : KUL-SISTA(BE), TU-Eindhoven(NL), TU-Delft (NL), DLR(DE), NAG(GB), TU-CZ(DE), U-Bremen(DE), INRIA(FR), U-Leicester(GB), TBZ-Pariv(DE), LMS(BE), UP-Valencia (ES), U-Umea(SE), Aspentech(NL), SFIM-EA(FR), Omron(ES).

BRITE-EURAM (February 1998 - February 2002)

- *Project title* : On-board diagnosis and control of gas turbine engines
- *Promoters* : G. Champion, M. Gevers, P. Willems
- *Partners* : NTUA (Greece), TU M_unchen (D), Chalmers University (SW), Snecma (F), Rolls Royce (GB), MTU (D), Volvo (SW), Fiat Avio (I), Techspace Aero (B), Lufthansa (D).

GROWTH-ROTOR (February 2001 - January 2005)

- *Project title* : Computer optimised rotors for internal mixers : an innovative way of enhancing the quality of rubber part and tyres
- *Promotor* : V. Legat
- *Partners* : Krupp(GE), SNECMA Moteurs (FR), Polyflow (BE), UniversitÈ Catholique de Louvain (BE), Ecole des Mines Paris - Armines (FR), Otigrade (SW), Technical University of Lodz (PL).

RESEARCH & TRAINING NETWORKS (January 2000 - December 2003)

- *Project title* : Knowledge-driven Batch Production (BATCHPRO).
- *Promoter* : D. Dochain
- *Partners* : DTU, Lyngby (Denmark), University of Newcastle-upon-Tyne (UK), Universidade de Porto (Portugal), ETM Zurich®(Switzerland), EPEL Lausanne (Switzerland), Novozyraacs (Denmark), Dupont (Switzerland)

EOLI (November 2002 - October 2005)

- *Project title* : Efficient operation of Urban Wastewater treatment plants.
- *Coordonator* : D. Dochain
- *Partners* : INRA (Paris-FR), Gradient (CompiÈgne-FR), Polimi (Italie), SPES (Italie), UNAM (Mexico), Universidad de la Republica (Uruguay), IBtech (Mexico)

TELEMAC (September 2001 - August 2004)

- *Project title* : Telemonitoring and advanced telecontrol of high yield wastewater treatment plants.
- *Promoter* : D. Dochain
- *Partners* : European Research Consortium for informatics and mathematics - ERCIM (France), INRIA (France), Institut National de la Recherche Agronomique (France), Applitek SA (Belgium), Universiteit Gent (BIOMATH/RUG-Belgium), Council for the central laboratory of the research councils (CCLRC-Belgium), Societa di progettazione elettronica e software S.C.R.L. (SPES-ITALY), Universidade de Santiago de Compostela (Spain), ENEA - Ente per le nuove tecnologie, l'energia e l'ambiente (ENEA-Italy), Agralco, S. Coop Ltda (Agralco-Spain), Pierre Lemaire (France), Tequila Sauza S.A. de C.V. (Sauza- Mexico), Universidad de Guadalajara (UDG-Mexico), Allied Domecq Spirits and wine (Domecq-UK), Allied Domecq Brasil Industria e Comercio Limitada (DOMECQ BR-Brazil)

European Space Agency (ESA) (2002-2004)

- *Project title* : Experimental study and modelling of the effects of a change in gravity on the eye-hand coordination during circular arm movements with a hand-held load
- *Promoter* : P. Lefèvre
- *Partners* : University of Birmingham, CNRS (collège de France), University of Montreal, University of Twente.

CENAERO (Centre for Research in Aeronautics)

- *Funds* : The center benefits of the support of the Region Wallonne and of the structural funds FEDER and FSE of the European Community.
- *Representative* : G. Winckelmans for UCL, also member of the Board of Directors (with A. Dangoisse of Administration de la Recherche) and member of the Scientific Committee
- *Partners* : Belgian industrials active in aeronautics (members of EWA, Entreprises wallonnes de l'aéronautique, universities (UCL, ULB, Ulg) and VKI.

RTD project, 5th Framework Programme - Competitive and Sustainable Growth (GRD1-2001-40176) (April 02 - April 05)

- *Project title* : I-WAKE : Instrumentation systems for on-board WAKE-vortex and other hazards detection, warning and avoidance.
- *Promoter UCL* : G. Winckelmans
- *Partners* : Thales Avionics, NLR, DLR, Airbus-D, Univ. of Hamburg, LISA laser, Fraunhofer Gena, UCL-TERM, UCL-TELE.

RTD project, 5th Framework Programme - Information technologies (IST-2001-34729) (July 02 - July 05)

- *Project title* : ATC-WAKE : Integrated Air Traffic Control WAKE vortex safety and capacity optimisation system
- *Promoter UCL*: G. Winckelmans
- *Partners* : NLR, DLR, Eurocontrol Experimental Center (EEC), Thales Air Defence, Thales Avionics, UCL

Technology Platform (TP) project, 5th Framework Programme - Competitive and sustainable growth (GRD1-2001-40160), (July 02- July 06)

- *Project title* : AWIATOR : Aircraft Wing with Advanced Technology Operation
- *Promoter UCL*: G. Winckelmans
- *Partners* : Airbus-D, Airbus-F, Airbus-UK, Airbus, DLR, ONERA, NLR, Alenia, IAI, Sener, Others (Cerfacs, NTUA, UCL, SONACA, etc.)

2.2 Belgian Federal Programmes

Interuniversity Attraction Pole V/22 (2002-2006)

CESAME is the pilot team of IAP V/22.

- *Project title* : Dynamical systems and control : computation, identification and modelling
- *Promoter* : M. Gevers
- *Partners* : KUL/ESAT, Dept Elektrotechniek, Groep SISTA, (B. De Moor) - KUL/CS, Dept of Computer Science, (D. Roose) - RUG, Group Systems (D. Aeyels) - VUB, Department ELEC (R. Pintelon), ULg SYST (R. Sepulchre) - KUL/BioTeC (J. Van Impe)

Interuniversity Attraction Pole P.5/08

- *Project title* : From microstructure towards plastic behaviour of single and multi-phase materials
- *Promoter* : P. Van Houtte KUL

- *UCL Partners* : F. Delannay (principal UCL partner), I. Doghri, T. Pardoën, P. Jacques

Deuxième plan d'appui scientifique ‡ une politique de développement durable (PADD II)(2001-2004)

- *Project title* : Sustainable effects of traffic management systems
- *Promoters* : G. Bastin, G. Campion
- *Partners* : R.U.G. Comp. Systems (R. Boel) - KUL/ESAT, Group SISTA (B. De Moor, S. Marivoet)

2.3 Regional Programmes

Action de Recherche concertée ARC97/02-210 (1997-2002)

- *Project title*: Micro-Macro Approach in Computational Rheology
- *Promoters* : R. Keunings, V. Legat

CIUF/PIP Programme d'initiative propre

- *Project title*: Mathematical modelling, optimization and control systems. (May 1999 - May 2005)
- *Promoter*: V. Wertz
- *Partner*: : Université Chouaib Doukkali d'El Jadida (Maroc), promoteur : M. E. Achhab

FNRS (crédit aux chercheurs) (2001 - 2003)

- *Project title*: Experimental and modeling study of the interaction between fast and slow orienting eye movements.
- *Promoter* : P. Lefèvre

Service d'Etudes Hydrologiques (SETHY)(1994-2005)

- *Project title* : Application of mathematical models for riverflow forecasting
- *Promoters* : G. Bastin, L. Moens

Service d'Etudes Hydrologiques (SETHY)(2001-2003)

- *Project title* : Flow control in waterways : application to the Sambre river
- *Promoters* : G. Bastin, L. Moens

RW-SIVA (June 2000 - June 2003)

- *Project title* : Numerical simulation of vibro-acoustic problems
- *Promoter* : V. Legat
- *Partners* : ULB Service de MÈcanique des milieux continus, CESAME, Free Field Technologies

Project FIRST Entreprise (RÈgion Wallonne) with Dow Corning (October 2000 - September 2002)

- *Project title* : Understanding of the fundamental mechanisms of the dispersive mixing of calcium carbonate in double screw mixers.
- *Promoter* : D. Dochain

Project FIRST Entreprise (RÈgion Wallonne) with Free Field Technologies (FFT) (March 2001 - February 2003)

- *Project title* : Automotive aeroacoustics : lagrangian simulation of the large vortex structures in the wake of bluff bodies and prediction of the acoustic radiation.
- *Promoters* : J.L. Migeot (FFT), J.P. Coyette (FFT and UCL) and G. Winckelmans.

REGION BRUXELLOISE - MACQ ELECTRONIQUE (December 2002 - November 2004)

- *Project title* : Development of a temperature forecasting system
- *Promoters* : G. Bastin, V. Wertz

Project FIRST Entreprise (December 2002-November 2004)

- *Project title* : Numerical simulation of crack propagation using X-FEM method (December 2002 - November 2004)
- *Promoters* : SAMTTECH, I. Doghri

Project FIRST Spinoff (January 2003 - December 2004)

- *Project title* : Micro-Macro nonlinear numerical simulation of composite materials and products (SPIN4M)
- *Promoter* : I. Doghri

Fonds pour la Formation † la Recherche dans l'Industrie et dans l'Agriculture (October 2000 - September 2004)

- *Project title* : Turbulence modelisation in the lagrangian simulation of separated flows; application to vehicle unsteady aerodynamics.
- *Promoter* : G. Winckelmans, Ph.D. student : G. Daeninck

2.4 Special Research Fund (UCL)

- *Project title* : Développement d'un modèle de circulation générale océanique de seconde génération pour l'étude du climat terrestre. (October 2000 - October 2003)
- *Promoters* : V. Legat (MEMA/FSA), Eric Deleersnijder (ASTR/PHYS/SC)
- *Project title* : Experimental and modelling study of the interaction between vision and movement. (2001-2003)
- *Promoter* : P. Lefèvre
- *Project title* : Algorithmic complexity of dynamical systems. (2002-2004)
- *Promoter* : V. Blondel
- *Project title* : Prediction and optimization of the quality of single crystals growth by various processes. (2002 - 2004)
- *Promoters* : F. Dupret, N. Van den Bogaert
- *Project title* : Integrated dynamic simulation of the critical stages of the growth of single crystals (october 2001 - september 2003)
- *Promoters* : F. Dupret, N. Van den Bogaert
- *Project title* : Bilan et analyse des initiatives communales en Région Wallonne en matière de développement durable : extension de l'étude (15 march 2002 - 30 june 2003)
- *Promoter* : M. Installé

2.5 Industrial Contracts

- **WACKER-SILTRONIC (2002)**
 - *Project title* : Numerical simulation of silicon growth
 - *Promoter* : F. Dupret

- **TEROSIL Czech Republic (2002)**
 - *Project title* : Numerical simulation of silicon growth
 - *Promoter* : F. Dupret

- **KOMATSU - Japan (2001-2003)**
 - *Project title* : Numerical simulation of silicon growth
 - *Promoter* : F. Dupret

- **SHIN ET'SU HANDOTAI - Japan (2001-2003)**
 - *Project title* : Numerical simulation of silicon growth
 - *Promoter* : F. Dupret

- **MITSUBISHI MATERIALS - Japan (2001-2003)**
 - *Project title* : Numerical simulation of silicon growth
 - *Promoter* : F. Dupret

- **HANYANG UNIVERSITY - Korea (2001-2003)**
 - *Project title* : Numerical simulation of silicon growth
 - *Promoter* : F. Dupret

- **NIPPON STEEL CORP. - Japan (2001-2003)**
 - *Project title* : Numerical simulation of silicon growth
 - *Promoter* : F. Dupret

- **SCK-CEN, Belgium**

- *Project title* : Myrrha project: design, numerical modeling, and experimental modeling for a windowless design of the spallation target for new ADS-type reactors. Phase IV.
- *Promoters* : G. Winckelmans, J.-M. Seynhaeve.

- **USINOR-CARLAM** (February 2000 - January 2003)

- *Project title* : Modelling and control of cooling processes in hot rolling mills
- *Promoters* : G. Bastin, V. Wertz

- **BASF (Germany)** (2001 - 2006)

- *Project title* : Full-chain rheological modelling of polydisperse linear polymers
- *Promoters* : C. Bailly and R. Keunings

2.6 Other international contracts

- **NSF grant CCR-9912415**(September 2000 - September 2003)

- *Project title*: Lower order modelling and projection techniques in Scientific Computing
- *Promoter*: Paul Van Dooren (UCL)
- *Partners*: Kyle Gallivan (Florida State Univ.), Ahmed Sameh (Purdue University)

- **NATO International Scientific Exchange Programmes, Collaborative Research Grant**

- *Promoter*: V. Blondel (UCL)
- *Partners*: J. Tsitsiklis (MIT, Cambridge, USA), E. Asarin et V. Kozyakin (Academy of Science, Moscow)

3. PUBLICATIONS

1 PhD Theses presented in 2002

- 02.99** MOTTE ISABELLE, “Contribution to modeling and control design for wheeled mobile robots”, September 18, 2002.
- 02.100** HADJILI MOHAMMED, “Fuzzy logic in nonlinear modeling and control”, November 15, 2002.

2 Publications 2002

Book

- 02.102** DEVILLE M.O., P.F. FISCHER, E.H. MUND, “High-order methods for incompressible fluid flow”, *Cambridge University Press*, ISBN 0-521-45309-7, 2002.

Chapters in books

- 01.97** GEVERS M., “Modelling, Identification and Control”, in ‘Iterative Identification and Control Design’, P. Albertos and A. Sala Eds., Springer Verlag, pp. 3-16, 2002.
- 01.98** GEVERS M., “Identification and Validation for Robust Control”, in ‘Iterative Identification and Control Design’, P. Albertos and A. Sala Eds., Springer Verlag, pp. 185-208, 2002.
- 01.122** JEANMART H., G.S. WINCKELMANS, “VLES of aircraft wake vortices in a turbulent atmosphere : a study of decay”, *Advances in LES of Complex flows, Fluid mechanics and its applications*, vol. 65, pp. 311-326, 2002.
- 02.47** KEUNINGS R., “Finite Element Methods for Integral Viscoelastic Fluids”, *Invited review chapter to appear in Rheology Reviews 2003, British Society of Rheology*.
- 02. 62** SENELLART P., V. BLONDEL, “Automatic discovery of similar words”, *To appear in Survey of Text Mining, Springer Verlag Publisher*, 2002.
- 02.83** VANDENDORPE A., P. VAN DOOREN , “Projection of state space realizations”, *Submitted to Book on Open Problems in Systems Theory, Eds Brockett et al.*, 2002.
- 02.84** LENDASSE A., J. LEE, E. DE BODT, V. WERTZ, M. VERLEYSSEN, “Approximation by Radial-Basis Function networks - Application to option pricing”, *Accepted for publication in Connectonist Approaches in Economics and Management Sciences, C. Lesage ed., Kluwer Academic Publishers*, 2002.

Published journal papers

- 01.1** GENIN Y., R. STEFAN, P. VAN DOOREN, “Real and complex stability radii of polynomial matrices”, *Linear Algebra and its Applications.*, Vol. 351-352, pp. 381-410, 2002.
- 01.5** GEVERS M., “A decade of progress in iterative process control design : from theory to practice”, *Journal of Process Control*, vol 12, no 4, pp.519-531, 2002.
- 01.9** HIGHAM N.J., F. TISSEUR, P. VAN DOOREN, “Detecting a definite Hermitian pair and a hyperbolic or elliptic quadratic eigenvalue problem, and associated nearness problems”, *Linear Algebra and its Applications*, vol. 351-351, pp. 455-474, 2002.
- 01.17** GENIN Y., Y. HACHEZ, Y. NESTEROV, R. STEFAN, P. VAN DOOREN, S. XU, “Positivity and linear matrix inequalities”, *European Journal of Control*, Vol. 8, no 3, pp. 275-298, 2002.
- 01.21** ATALIK K., R. KEUNINGS, “Non linear temporal stability analysis of viscoelastic plane channel flows using a fully-spectral method”, *Journal of Non-Newtonian Fluid Mechanics*, Vol. 102, pp. 299-319, 2002.
- 01.22** XU S., P. VAN DOOREN, R. STEFAN, J. LAM, “Robust stability and stabilization for singular systems with state delay and parameter uncertainty”, *IEEE Transactions on Automatic Control*, vol. 47, no 10, pp. 1122-1128, 2002.
- 01.31** DE BROUWER S., D. YUKSEL, G. BLOHM, M. MISSAL, P. LEFÈVRE, “What triggers catch-up saccades during visual tracking ?”, *Journal of Neurophysiology*, vol 87, pp.1646-1650, 2002.
- 01.39** LENDASSE A., J. LEE, E. DE BODT, V. WERTZ, M. VERLEYSSEN, “Dimension Reduction of Technical Indicators for the Prediction of Financial Time Series - Application to the BEL 20 market Index”, *European Journal of Economic and Social Systems*, Vol 15, (2) pp. 31-48, 2002.
- 01.45** VAN RUYMBEKE E., R. KEUNINGS, V. STEPHENNE, A. HAGENAARS, C. BAILLY, “Evaluation of reptation models for predicting the linear viscoelastic properties of entangled linear polymers”, *Macromolecules*, vol. 35, pp 2689-2699, 2002.
- 01.47** ABSIL P.A., R. MAHONY, R. SEPULCHRE, P. VAN DOOREN, “A Grassmann-Rayleigh quotient iteration for computing invariant subspaces”, *SIAM Review*, Vol. 44, (1), pp. 57-73 , 2002.
- 01.48** MOREAU L., D. AEYELS, J. PEUTEMAN, R. SEPULCHRE, “A duality principle for homogeneous vector fields with applications”, *Systems and Control Letters*, vol. 47, no 1, pp. 36-46, 2002.

- 01.49** SEPULCHRE R., M. ARCAK, A. TEEL, “Trading the stability of finite zeros for global stabilization of nonlinear cascades”, *IEEE Transactions on Automatic Control*, Vol. 47, no 3, pp. 521-525, 2002.
- 01.66** WINCKELMANS G.S., H. JEANMART, D. CARATI, “On the comparison of turbulence intensities from large-eddy simulation with those from experiment or direct numerical simulation”, *Physics Fluids*, vol. 14 (5), pp. 1809-1811, 2002.
- 01.67** PLOUMHANS P., G.S. WINCKELMANS, J.K. SALMON, A. LEONARD, M.S. WARREN, “Vortex methods for direct numerical simulation of three-dimensional bluff body flows; Application to the sphere at RE=300, 500 and 1000”, *J. Comput. Phys.*, vol. 178,no 2, pp. 427-463, 2002.
- 01.78** DE BROUWER S., M. MISSAL, G. BARNES, P. LEFEVRE, “Quantitative analysis of catch-up saccades during sustained pursuit”, *Journal of Neurophysiology*, vol. 87, pp. 1772-1780, 2002.
- 01.81** MISSAL M., A. COIMBRA, P. LEFEVRE, E. OLIVIER, “A quantitative analysis of correlations between eye movements and neural activity in the pretectum”, *Experimental Brain Research*, Vol. 143, pp. 373-382 , 2002.
- 02.5** SMETS I., D. DOCHAIN, J.F. VAN IMPE, “Optimal Temperature Control of a Steady-State Exothermic Plug-Flow Reactor”, *AIChE Journal*, Vol. 48, no 2, pp. 279-286, February, 2002.
- 02.8** VAN RUYMBEKE E., R. KEUNINGS, C. BAILLY, “Determination of the Molecular Weight Distribution of Entangled Linear Polymers from Linear Viscoelasticity Data”, *J. Non-Newt. Fluid Mech.*, Vol. 105, pp. 153-175, 2002.
- 02.16** ORLOV Y., D. DOCHAIN, “Discontinuous feedback stabilization of minimum phase semilinear systems with application to chemical tubular reactors”, *IEEE Transactions on Automatic Control*, Vol. 47, no 8, pp. 1293-1304, 2002.
- 02.26** KLAN P., R. GOREZ, “Testovací modely pro automatické řízení”, *Automatizace*, Vol. 45, (4), 2002.
- 02.34** FIBRIANTO H., D. DOCHAIN, “Time Optimal Control of the Switched Continuous Hybrid Model of an Aerobic Biological Wastewater Treatment Process”, *International Journal of Hybrid Systems*, Vol. 2, no 3, pp. , 2002.
- 02.39** BEN-NAOUM A.K., “Linear fractional transformation of continued fractions with bounded partial quotients : arithmetical and geometrical point of view”, *International Journal of Pure and Applied Mathematics*, Vol. 2, no 3, pp. 273-279, 2002.
- 02.46** HADJILI M. V. WERTZ, “Takagi-Sugeno Fuzzy Modeling Incorporating Input Variables Selection”, *IEEE Transactions on Fuzzy Systems*, vol. 10, no 4, December, 2002.

- 02.48** MISSAL M., A. COIMBRA, P. LEFEVRE, E. OLIVIER, “Further evidence that separate circuits drive slow eye movements and saccades through a shared efferent collicular pathway”, *Experimental Brain Research*, Vol. 147, pp.344-352, 2002.
- 02.49** BLOHM G., M. MISSAL, P. LEFEVRE, “Interaction between smooth anticipation and saccades during ocular orientation in darkness”, *Journal of Neurophysiology*, in press (DOI, 10.1152/jn.00675.2002), 2002.
- 02.53** GROGNARD F., R. SEPULCHRE, G. BASTIN, “Improving the performance of low-gain designs for bounded control of linear systems”, *Automatica*, Vol. 38, no 11, pp. 1777-1782, 2002.
- 02.6** BLONDEL V., D. HINRICHSEN, J. ROSENTHAL, P. VAN DOOREN, “Foreword to the fourth special issue on linear systems and control”, *Linear Algebra and its Applications*, Vol. 351-352, pp. 1-9, 2002.
- 02.63** BLONDEL V., N. PORTIER, “The presence of a zero in an integer linear recurrent sequence is NP-hard to decide”, *Linear Algebra and its Applications*, vol. 351-352, pp. 91-98, 2002.
- 02.64** NIKOLOV S., I. DOGHRI, O. PIERARD, L. ZEALOUK, A. GOLDBERG, “Multi-scale constitutive modeling of the small deformations of semi-crystalline polymers”, *Journal of the Mechanics and Physics of Solids*, vol. 50, pp. 2275-2302, 2002.
- 02.65** BLONDEL V., J. CASSAIGNE, C. NICHITIU, “On the presence of periodic configurations in Turing machines and in counter machines”, *Theoretical Computer Science*, vol. 289, pp. 573-590, 2002.
- 02.66** LENDASSE A., J. LEE, V. WERTZ, M. VERLEYSSEN, “Forecasting electricity consumption using nonlinear projection and self-organizing maps”, *Neurocomputing*, Vol. 48, no 1-4, pp. 299-311, 2002.
- 02.7** CODRONS B., B.D.O. ANDERSON, M. GEVERS, “Closed-loop identification with an unstable or nonminimum phase controller”, *Automatica*, vol. 38, no 12, pp. 2127-2137, 2002.
- 02.75** DAENINCK G., P. PLOUMHANS, G.S. WINCKELMANS, “Simulation of three-dimensional bluff body Flows using vortex methods : from direct numerical simulation towards large-eddy simulation modelling”, *J. of Turbulence*, 3-043, 2002. (<http://www.iop.org/>)
- 02.76** THIRIFAY F., G.S. WINCKELMANS, “Development of a Lagrangian method for combustion and application to the planar methane-air jet diffusion flame”, *J. of Turbulence*, 3- 059, 2002. (<http://www.iop.org/>)

- 02.104** ASTOLFI A., R. ORTEGA, R. SEPULCHRE, “Stabilization and disturbance attenuation of nonlinear system using dissipativity theory”, *European Journal of Control*, vol. 8, no 5, pp. 432-434.
- 02.106** WINKIN J., “Spectral factorization of meromorphic functions of finite order for distributed parameter systems”, *21rst Benelux Meeting on Systems and Control*, Velhoven (NL), March 2002.
- 02.107** WINKIN J., “Equilibrium profiles of tabular reactor nonlinear models”, *International Symposium on the Mathematical Theory of Networks and Systems (MTNS)*, University of Notre-Dame (Indiana, USA), August 2002.

Papers accepted for publication

- 01.16** LEQUIN O., M. GEVERS, M. MOSSBERG, E. BOSMANS, L. TRIEST, “Iterative Feedback Tuning of PID parameters : comparison with classical tuning rules”, *Accepted to Control Engineering Practice*.
- 01.43** CHAHLAOUI Y., K. GALLIVAN, P. VAN DOOREN, “Recursive calculation of dominant singular subspaces”, *Accepted to SIAM Journal on Matrix Analysis and Applications*.
- 01.51** GALIVAN K., A. VANDENDORPE, P. VAN DOOREN, “Sylvester equations and projection-based model reduction”, *Accepted to J. Comp. Appl. Math. Special Issue*.
- 01.57** GENIN Y., Y. HACHEZ, Y. NESTEROV, P. VAN DOOREN, “Optimization problems over positive pseudo-polynomial matrices”, *SIAM Journal on Matrix Analysis and Applications*.
- 02.4** DOGHRI I., A. OUAAR, “Homogenization of two-phase elasto-plastic composite materials and structures. Study of tangent operators, cyclic plasticity and structures”, *International Journal of Solids and Structures*, vol. 40, no 7, pp 1681-1712,
- 02.12** WU X., G. CAMPION, “Fault detection and isolation of systems with slowly varying parameters. Simulation with a simplified aircraft turbo engine model”, *Accepted to Mechanical Systems and Signal Processing (MSSP)*.
- 02.13** HILDEBRAND R., M. GEVERS, “Identification for control : optimal input design with respect to a worst-case ν -Gap cost function”, *accepted to Siam Journal on Control and Optimization*.
- 02.18** WAPPEROM P., R. KEUNINGS, G. LANNIRUBERTO, “Prediction of Rheometrical and Complex Flows of Entangled Linear Polymers Using the DCR Model with Chain Stretch”, *J. of Rheology*, in press.

- 02.29** DOCHAIN D., S. GRÈGOIRE, A. PAUSS, M. SCHAEPPER, “Dynamical modelling of a waste stabilisation pond”, *Accepted to Bioprocess and Biosystems Engineering*.
- 02.3** DOCHAIN D., “State observers for processes with uncertain kinetics”, *Accepted to Journal of Process Control*.
- 02.36** GERNAEY K., B. PETERSEN, D. DOCHAIN, P. VANROLLEGHEM, “Modeling aerobic carbon source degradation processes using titrimetric data and combined respirometric titrimetric data : Structural and practical identifiability, *to appear in Biotechnology and Bioengineering*.
- 02.43** RENOU S., M. PERRIER, D. DOCHAIN, S. GENDRON, “Solution of the convection-dispersion-reaction equation by a sequencing method”, *to appear in Computers & Chemical Engineering*.
- 02.71** SJØBERG J., F. DE BRUYNE, M. AGARWAL, B.D.O. ANDERSON, M. GEVERS, F.J. KRAUS, N. LINARD, “Iterative controller optimization for nonlinear systems”, *accepted for publication in Control Engineering Practice*.
- 02.72** GEVERS M., X. BOMBOIS, B. CODRONS, G. SCORLETTI, B.D.O. ANDERSON, “Model validation for control and controller validation in a prediction error identification framework. Part I : Theory ”, *Accepted for publication in Automatica*.
- 02.73** GEVERS M., X. BOMBOIS, B. CODRONS, G. SCORLETTI, B.D.O. ANDERSON, “Model validation for control and controller validation in a prediction error identification framework. Part II : Illustrations”, *Accepted for publication in Automatica*.

Papers submitted for publication

- 01.33** ZHANG T., M. GUAY, D. DOCHAIN, “Adaptive extremum seeking control of continuous Stirred Tank Bioreactors”, Submitted to AICHE Journal, 2002.
- 02.1** GALLIVAN K., A. VANDENDORPE, P. VAN DOOREN, “ Model Reduction via truncation: an interpolation point to view”, *Submitted to Linear Algebra and its Applications*, 2002.
- 02.6** DE HALLEUX J., C. PRIEUR, J.M. CORON, B. D’ANDRÈA-NOVEL, G. BASTIN, “Boundary feedback control in networks of open channels”, *Submitted to Automatica*, 2002.
- 02.1** MOUNIER H., G. BASTIN, “Compartmental modelling for traffic control in communication networks”, *Submitted to IEEE Transactions on Automatic Control*, 2002.
- 02.11** PETERSEN B., K. GERNAEY, M. DEVISSCHER, D. DOCHAIN, P. VANROLLEGHEM, “A simplified method to access structural identifiable parameters in Monod activated sludge models”, *Submitted to Water Research*, 2002.

- 02.2** STEWART M., P. VAN DOOREN, “On the factorization of hyperbolic and unitary transformations into rotations”, *Submitted to SIAM Journal on Matrix Analysis and Applications*, 2002.
- 02.5** BLONDEL V., P. VAN DOOREN, “A measure of similarity between graph vertices”, *Submitted to SIAM Review*, 2002.
- 02.22** WU X., G. CAMPION, “An investigation on physical diagnosis for aircraft engines”, *submitted to Automatica*, 2002.
- 02.24** JEANMART H., D. CARATI, G.S. WINCKELMANS, “Non universality and symmetry breaking in three-dimensional turbulent Kolmogorov flow”, *Submitted to Phys. Fluids*, 2002.
- 02.25** LECCHINI A., M. GEVERS, “Explicit expression of the parameter bias in identification of Laguerre models from step responses”, *Submitted to Systems and Control Letters*, 2002.
- 02.27** CAMPI M.C., A. LECCHINI, S.M. SAVARESI, “An application of the Virtual Reference Feedback Tuning (VRFT) method to a benchmark active suspension system”, *submitted to European Journal of Control*, 2002.
- 02.28** LECCHINI A., B.D.O. ANDERSON, M. GEVERS, “Virtual reference feedback tuning with guaranteed stability”, *submitted to Automatica*, 2002.
- 02.31** MARCOS N., M. GUAY, D. DOCHAIN, T. ZHANG, “Adaptive Extremum-Seeking Control of a Continuous Bioreactor”, *Submitted to Journal of Process Control*, 2002.
- 02.33** LAABISSI M., M.E. ACHHAB, J.J. WINKIN, D. DOCHAIN, “Multiple Equilibrium Profiles for Nonisothermal Tubular Reactor Nonlinear Models”, *Submitted to IEEE Transactions on Automatic Control*, 2002.
- 02.35** TITICA M., D. DOCHAIN, M. GUAY, “Adaptive Extremum-Seeking Control of Fed-batch Bioreactors”, *European Journal of Control*, 2002.
- 02.37** VARGA A., P. VAN DOOREN, “Computing the zeros of periodic systems”, *Submitted to Systems and Control Letters*, 2002.
- 02.38** HILDEBRAND R., M. GEVERS, “Quantification of the variance of estimated transfer functions in the presence of undermodeling”, *submitted to IEEE Transactions on Automatic Control*, 2002.
- 02.4** SCHOEFS O., A. ELLERT, M. PERRIER, R. SAMSON, “Characterizing the Kinetics of Biodegradation of Hydrophobic Pollutants by Indigenous Soil Microorganisms”, *Submitted to Journal of Environmental Engineering*, 2002.

- 02.41** DELATTRE C., D. DOCHAIN, J. WINKIN, “Sturm-Liouville systems are Riesz-spectral systems”, *Submitted in Systems and Control letters*, 2002.
- 02.42** HACHEZ Y., P. VAN DOOREN, “Self-adjoint quadratic eigenvalue problems and associated distance problems”, *Submitted to Linear Algebra and its Applications*, 2002.
- 02.44** SCHOEFS O., M. PERRIER, R. SAMSON, “Development of a biocontact model for the biodegradation of hydrophobic pollutants in unsaturated soils”, *Submitted to Environmental Science and Technology*, 2002.
- 02.45** HILDEBRAND R., A. LECCHINI, G. SOLARI, M. GEVERS, “Convergence analysis and optimal prefiltering in Iterative Feedback Tuning”, *Submitted to IEEE on Automatic Control*, 2002.
- 02.61** DELATTRE C., D. DOCHAIN, J. WINKIN, “Observability analysis of Sturm-Liouville systems : application to a bioreactor model”, *submitted to Automatica*, 2002.
- 02.67** SCHOEFS O., M. PERRIER, D. DOCHAIN, R. SAMSON, “On-line estimation of biodegradation in an unsaturated soil”, *Submitted to Bioprocess and Biosystems Engineering*, 2002.
- 02.68** BITMEAD R.R., B.D.O. ANDERSON, M. GEVERS, L.C. KAMMER, “Cautious controller tuning”, *submitted to Automatica*, 2002.
- 02.69** BOMBOIS X., G. SCORLETTI, P. VAN DEN HOF, M. GEVERS, B.D.O. ANDERSON, “A new robust control design procedure based on a PE identification uncertainty set”, *submitted to Automatica*, 2002.
- 02.74** GUAY M., D. DOCHAIN, M. PERRIER, “Adaptive Extremum Seeking Control of Nonisothermal Continuous Stirred Tank Reactors”, *Submitted to Chemical Engineering Science*, 2002.
- 02.77** PLOUMHANS P., G. DAENINCK, G.S. WINCKELMANS, “Simulation of three-dimensional bluff body flows using the vortex particle and boundary element methods”, *J. Flow, Turbulence and Combustion*, 12 pages, 2002.
- 02.81** HUEPER K., P. VAN DOOREN, “New algorithms for the iterative refinement of estimates of invariant subspaces”, *submitted to the Journal Future Generation Computer Systems*, 2002.
- 02.82** LIN W.W., P. VAN DOOREN, Q.F. XU, “Equivalent characterizations of periodical deflating subspaces”, *submitted to Linear Algebra and its Applications*, 2002.
- 02.85** LEE J.A., A. LENDASSE, M. VERLEYSSEN, “Curvilinear Distance Analysis versus Isomap”, *Submitted to Neurocomputing*, 2002.

- 02.93** ABSIL P.A., R. MAHONY, R. SEPULCHRE, “Riemannian geometry of Grassmann manifolds with a view on algorithmic computation”, *submitted to Acta Applicandae Mathematicae*, 2002.
- 02.98** SCHOEFS O., D. DOCHAIN, M. PERRIER, R. SAMSON, “Estimation of the hydrodynamic and biokinetic models of soil bioremediation processes”, *Chemical Engineering Research and Design*, 2002.

Published conference papers

- 01.26** GALLIVAN K., A. VANDENDORPE, P. VAN DOOREN, “Model reduction via tangential interpolation, *MTNS 02*, Notre Dame, USA, CD Rom, paper WA4, 2002.
- 01.28** DOCHAIN D., M. PERRIER, “A state observer for (bio)processes with uncertain kinetics”, *Proceedings of the American Control Conference, ACC 2002*, Vol. 4, pp. 2873-2878, 2002.
- 01.3** MOURUE G., P. DESCAMPS, D. DOCHAIN, V. WERTZ, “Identification and control of an industrial polymerisation process”, *Proc. 15th IFAC World Congress*, Barcelona, Spain, CD-Rom, paper 164, July 21-26, 2002.
- 01.33** ZHANG T., M. GUAY, D. DOCHAIN, “Adaptive extremum seeking control of continuous Stirred Tank Bioreactors”, *Proc. 15th IFAC World Congress and also Submitted to AIChE Journal*, CD-Rom, paper 2393, July 21-26, 2002.
- 01.34** BROWN J., D. DOCHAIN, M. PERRIER, F. FORBES, Modal decomposition of a nonlinear tubular reactor model : a control perspective, *15th IFAC World Congress*, Barcelona, Spain, CD-Rom, paper 264, July 21-26, 2002.
- 01.35** BOMBOIS X., G. SCORLETTI, B.D.O. ANDERSON, M. GEVERS, P. VAN DEN HOF, “A new robust control design procedure based on a PE identification uncertainty set”, *15th IFAC World Congress 2002*, Barcelona, Spain, pp. 2842-2847, July 21-26, 2002.
- 01.37** HACHEZ Y., Y. NESTEROV, “Optimization problems over nonnegative polynomials with interpolation constraints”, *Proceedings 15th IFAC World Congress*, Barcelona, Spain, Cd Rom paper 1650, July 21-26, 2002.
- 01.38** LENDASSE A., M. COTTRELL, V. WERTZ, M. VERLEYSSEN, “Prediction of Electric Load using Kohonen Maps - Application to the polish electricity consumption”, *American Control Conference 2002*, Anchorage, Alaska, USA, pp. 3684-3689, June, 2002.
- 01.42** CHAHLAOUI Y., P. VAN DOOREN, “Estimating Gramians of Large-Scale Time-Varying Systems”, *15th IFAC World Congress*, Barcelona, Spain, CD Rom, paper 2440, July, 2002.

- 01.72** PLOUMHANS P., G. DAENINCK, G.S. WINCKELMANS, “Simulation of three-dimensional bluff body flows using the vortex particle and boundary element methods”, *IUTAM Symposium on Unsteady Separated Flows*, Toulouse, France, CD-Rom, 12 pages, April 8-12, 2002, 2002.
- 01.73** JEANMART H., G.S. WINCKELMANS, “Investigation of different approaches and models for subgrid-scale modelling”, *EUROMECH 9th European Turbulence Conference (ETC9)*, University of Southampton, U.K., CD-Rom, July 2-5, 2002, 2002.
- 01.77** BLONDEL V., J. THEYS, A. VLADIMIROV, “Switched systems that are periodically stable may be unstable”, *MTNS 2002*, Notre Dame, USA, CD-Rom, 2002.
- 01.8** DELATTRE C., D. DOCHAIN, J. WINKIN, “Observability analysis of a nonlinear tubular bioreactor”, *MTNS 2002*, Notre Dame, Usa, CD-Rom, paper TUP5, 2002.
- 01.83** LEE J.A., A. LENDASSE, M. VERLEYSSEN, “Curvilinear distance analysis versus isomap”, *ESANN’02*, Brugge, Belgium, pp. 185-192, April, 2002.
- 01.84** BENOUDJIT N., C. ARCHAMBEAU, A. LENDASSE, J. LEE, M. VERLEYSSEN, “Width optimization of the Gaussian kernels in Radial Basis Function Networks”, *ESANN’02*, Brugge, Belgium, pp. 425-432, April, 2002.
- 01.91** BASTIN G., A. PROVOST, “Feedback stabilisation with positive control of dissipative compartmental systems”, *MTNS 2002*, Notre Dame, USA, CD-Rom, paper MA5, 2002.
- 01.92** CHAHLAOUI Y., D. LEMONNIER, K. MEERBERGEN, A. VANDENDORPE, P. VAN DOOREN, “Model reduction of second order systems”, *Proceedings of MTNS 02*, Notre Dame, USA, CD Rom, paper 26984-4, 2002.
- 02.2** CHAHLAOUI Y, P. VAN DOOREN, “Recursive low rank Hankel approximation and model reduction”, *European Control Conference 2002*, Barcelona, Spain, August , 2002.
- 02.3** CORON J.M., J. DE HALLEUX, G. BASTIN, B. D’ANDRÉA-NOVEL, “ On boundary control design for quasilinear hyperbolic systems with entropies as Lyapunov functions”, *Conference on Decision and Control (CDC 2002)*, Las Vegas, USA, CD-Rom, paper ThM07-5, December, 2002.
- 02.7** VARGA A., P. VAN DOOREN, “On computing the zeros of periodic systems”, *Conference on Decision and Control (CDC 2002)*, La Vegas, USA, ThA06-2, December, 2002.
- 02.8** WINCKELMANS G.S., M. PAPALEXANDRIS, “Research activities relating to flow, turbulence and combustion at UCL/MECA and CESAME”, *Proc. One Day ERCOFTAC Seminar*, Organised by the ERCOFTAC Belgian Pilot Center, Gent, 21 pages, December 6, 2002.

- 02.9** PRIEUR C., J. DE HALLEUX, “Stabilization of a tank via output feedback”, *Conference on Decision and Control (CDC 2002)*, Las Vegas, USA, CD-Rom, paper WeA10-6, December, 2002.
- 02.14** THIRIFAY F., G.S. WINCKELMANS, “Development of a Lagrangian method for combustion and application the planar methane-air jet diffusion flame”, *Proc. 4th International Workshop on Vortex Flow and Related Numerical Method, IWVF4*, University of California, Santa Barbara, CA, USA, 2 pages, March 17-20, 2002.
- 02.15** DAENINCK, P. PLOUMHANS, G.S. WINCKELMANS, “Simulation of three dimensional bluff body Flows using vortex methods : from direct numerical simulation towards large-eddy simulation modelling”, *Fourth International Workshop on Vortex Flow and Related Numerical Methods*, Santa Barbara, USA, 2 pages, March 17-20, 2002.
- 02.17** LECCHINI A., M. GEVERS, “On Iterative Feedback Tuning for non-minimum phase plants”, *CD-ROM Proc. of IEEE Conference on Decision and Control (CDC 2002)*, Las Vegas, USA, December, 2002.
- 02.19** HOCHEREAU D., DESCAMPS P., LEEMPOEL P., DOCHAIN D., $CaCO_3$ dispersion in polymer flow : experimental study and simulation of rupture during twin screw extrusion, , *In : PPS-18*, Guinarcas, Portugal, , June , 2002.
- 02.21** GOREZ R., “La rÈgulation PID : pourquoi ? Comment ?”, *JournÈe de formation sur la rÈgulation PID*, IBRA Bruxelles, April 25, 2002.
- 02.23** LAABISSI M., M.E. ACHHAB, J.J. WINKIN, D. DOCHAIN, “Equilibrium profiles of tubular reactor nonlinear models”, *MTNS 2002*, CD-Rom, paper FM2, 2002.
- 02.52** INSTALLÈ M., “Introducing Sustainable Development Concepts in Engineering Curricula : Some Proposals and Implementations”, *Proc. of the International Conference on Engineering Education in Sustainable Development*, Delft, The Netherlands, pp. 167-173, October 23-25, 2002.
- 02.78** JEANMART H., G.S. WINCKELMANS, “Comparison of recent dynamic subgrid-scale models in the case of the turbulent channel flow”, *Proc. Summer Program 2002*, Center for Turbulence Research, Stanford University & NASA Ames, pp. 105-116, 2002.
- 02.79** DAENINCK G., P. CHATELAIN, M. RUBEL, G.S. WINCKELMANS, A. LEONARD, “Simulation of vehicle aerodynamics using a vortex element method”, *Proc. Conference on the Aerodynamics of Heavy Vehicles : Trucks, Buses and Trains, organized by United Engineering Foundation (UEF)*, Monterey, Canada, December 2-6, 2002.

- 02.94** ABSIL P.A., R. MAHONY, R. SEPULCHRE, “The continuous-time Rayleigh quotient flow on the Grassmann manifold”, *Proc. of the Fifteenth International Symposium on Mathematical Theory of Networks and Systems (MTNS 2002)*, Notre Dame, USA, CD-Rom paper WM-4, 2002.
- 02.97** JEANMART H., G. S. WINCKELMANS, “Comparison of recent dynamic subgrid-scale models in LES of the channel flow”, *55th Annual Meeting of the American Physical Society Division of Fluid Dynamics*, Dallas, USA, Vol. 47, no 10, November 24-26, 2002.
- 02.103** MICHIELS W., R. SEPULCHRE, D. ROOSE, L. MOREAU, “A perturbation approach to the stabilization of nonlinear cascade systems with time-delay”, *Proceedings of the 41th Conference on Decision and Control (CDC 2002)*, Las Vegas, USA, pp. 1898-1903, 2002.
- 02.108** MOSSBERG, M. GEVERS AND O. LEQUIN, “A comparison of Iterative Feedback Tuning and classical PID tuning schemes”, *Proc. 2002 WSEAS Int. Conference on Signal Processing, Robotics and Automation*, Cadiz, Spain, June 2002; also in ‘Advances in Systems Engineering, Signal Processing and Communications’, WSEAS Publ., N. Mastorakis Ed., pp. 165–170, 2002.

Submitted conference papers

- 02.45** HILDEBRAND R., A. LECCHINI, G. SOLARI, M. GEVERS, “Convergence analysis and optimal prefiltering in Iterative Feedback Tuning”, *Submitted to SYSID 2003*.
- 02.51** GROGNARD F., R. SEPULCHRE, “Computation of time-optimal switchings for linear systems with complex poles”, *Submitted to the European Control Conference 2003*, Cambridge.
- 02.54** BERNARD O., G. BASTIN, “Identification of reaction schemes for bioprocesses: determination of an incompletely known yield matrix”, *Submitted to European Control Conference 2003 (ECC 03)*.
- 02.55** LENDASSE A., V. WERTZ, M. VERLEYSSEN, “Nonlinear Time Series Prediction by Weighted Vector Quantization”, *Submitted to ICCS 2003*, St Petersburg, 2002.
- 02.56** HILDEBRAND R., M. GEVERS, “Minimizing the worst-case ν -gap by optimal input design”, *Submitted to SYSID 2003*.
- 02.57** GEVERS M., “A personal view on the development of system identification”, *Submitted to SYSID 2003*.
- 02.58** HILDEBRAND R., M. GEVERS, “Parameter variance of estimated transfer functions in the presence of undermodeling”, *Submitted to SYSID 2003*.

- 02.59** FIBRIANTO H., D. DOCHAIN, “Time optimal control of a biological wastewater treatment process by hybrid approach”, *submitted to the conf. of Analysis and Design of Hybrid Systems (ADHS 03)*, St Malo, France, June 2003.
- 02.86** GEORGES L., G. S. WINCKELMANS, “Investigation of numerics for LES using finite differences : case of Burger’s equation”, *Submitted to 6th National Congress on Theoretical and Applied Mechanics, organised by the National Committee for Theoretical and Applied Mechanics*, Ghent, Belgium, May 26-27, 2003.
- 02.87** DUFRESNE L., G. S. WINCKELMANS, “Numerical investigation of long wavelength instabilities in aircraft wake vortex systems”, *Submitted to 6th National Congress on Theoretical and Applied Mechanics, organised by the National Committee for Theoretical and Applied Mechanics*, Ghent, Belgium, May 26-27, 2003.
- 02.88** THIRIFAY F., G. S. WINCKELMANS, “A new lagrangian method for combustion; application to the planar methane-air jet diffusion flame”, *Submitted to 6th National Congress on Theoretical and Applied Mechanics, organised by the National Committee for Theoretical and Applied Mechanics*, Ghent, Belgium, May 26-27, 2003.
- 02.95** SIMON G., A. LENDASSE, V. WERTZ, M. VERLEYSSEN, “Fast approximation of the bootstrap for model selection”, *Submitted to ESANN 2003*, Brugges, Belgium, 2003.
- 02.96** DAENINCK G., G. S. WINCKELMANS, “A new hybrid eulerian-lagrangian vortex method for flows with massive separation”, *Submitted to 6th National Congress on Theoretical and Applied Mechanics, organised by the National Committee for Theoretical and Applied Mechanics*, Ghent, Belgium, May 26-27, 2003.

Engineering theses (memoires)

1. BAES MICHEL
“Barrières augmentées pour le pôle de Lorentz”
Promoter : Y. Nesterov
2. BIQUET AMAURY
“Mise en œuvre de courbes à pôles : courbes de Bézier, B-splines et NURBS”
Promoter : V. Legat
3. BIOUL FRANÇOIS “Etude numérique de la convection induite par un champ magnétique alternatif à la surface d’un pont liquide métallique en microgravité.”
Promoter : F. Dupret
4. CARDON PIERRE
“ Classification des fonds communs d’investissement par cartes auto-organisées”
Promoters : M. Verleysen, V. Wertz

5. COPPENS D'EECKENBRUGGE ANNE-SOPHIE
 "Régulation du trafic sur les autoroutes automatisées"
Promoters : G. Bastin, G. Campion
6. DE PAUW SOFIE
 "Influence du mouvement de la tête sur l'orientation du regard vers une cible en mouvement"
Promoter : Ph. Lefèvre
7. DELFOSSE CHRISTOPHE
 "Méthodes de Galerkin discontinues"
Promoter : V. Legat
8. DELVENNE JEAN-CHARLES
 "Tilings, Automata and Dynamical Systems"
Promoter : V. Blondel
9. DEMANET LAURENT
 "Second generation curvelets"
Promoters : R. Von Sachs, P. Van Dooren
10. FABIAN BERNARD, JONCKHEERE MATHIEU
 "Etude des ondes de pression générées par un train à grande vitesse entrant dans un tunnel"
Promoters : G. Winckelmans, J. Anthoine (VKI)
11. FERRERA CHRISTEL
 Améliorations apportées à l'algorithme "Iterative Feedback Tuning" : application au bras flexible du CESAME
Promoter : M. Gevers
12. FRIEBEL CHRISTOPHE
 "Modélisation et simulation micro-macro de matériaux composites. Etude de l'influence des renforts (matériaux, forme et orientation)"
Promoter : I. Doghri
13. GOFFINET FRANÇOIS, GEORGES LAURENT
 "Simulation de rentrée martienne dans une installation Plasmatron, incluant l'évaluation des propriétés de transport par intégrales de collision"
Promoters : G. Winckelmans, O. Chazot (VKI)
14. LEDOUX ALEXANDRE
 "Etude expérimentale anisotherme de l'écoulement dans le bain en croissance des monocristaux par le procédé Czochralski"
Promoter : F. Dupret

15. LEMONNIER DAMIEN
 “Réduction de systèmes dynamiques du second ordre”
Promoter : P. Van Dooren

16. MARCHAND YOURI
 “Modélisation mathématique et numérique de mélange”
Promoter : V. Legat

17. MARECHAL XAVIER
 “Analyse des lois de commande pour robots mobiles non idéaux”
Promoter : G. Campion

18. MICHEL ROMAIN
 “Particle Image Velocimetry : study of hardware requirements and development of a software”
Promoters : G. Winckelmans, M. Dobre

19. MOREAU FRANÇOIS
 “Optimisation de la ventilation des tunnels à l’aide d’algorithmes génétiques”
Promoters : E. Jacques, V. Wertz

20. MUSEUR THOMAS
 “Contrôle prédictif de systèmes non linéaires modélisés par cartes auto-organisatives”
Promoter : V. Wertz

21. OLDENHOVE BRUNO, RIBESSE CHRISTOPHE
 “Etude statistique de l’évolution des structures tourbillonnaires en jet axisymétrique
 à l’aide de la technique de Vélocimétrie par Images de Particules (PIV)
Promoter : F. Dupret, J. Anthoine (von Karman Inst.)

22. ORBAN DE XIVRY JEAN-JACQUES
 “Modeling of anticipatory response build-up in repetitive oculomotor tasks”
Promoter : Ph. Lefèvre

23. QUAEGHEBEUR ERIK
 “Analyse et prédiction de débit de rivières par des méthodes non linéaires”
Promoter : V. Wertz

24. VAN RIJCKEVORSEL GUILLAUME , TREVE VINCENT
 “Investigation d’instabilités de sillage d’aide”
Promoters : G. Winckelmans

25. WHITE LAURENT
 “Modeling of the general circulation of the World Ocean using finite elements”
Promoter : V. Legat

4. TEACHING

1 Undergraduate and Graduate Teaching

1.1 Applied Mathematics

Mathematics

(K. Ben Naoum, M. Duhoux, R. Keunings, V. Legat, K. Peiffer, J.P. Vandeuren, E. Vitale, V. Wertz)

Applied Mathematics : Signals and systems

(A. Laloux, V. Wertz)

Stochastic processes and estimation theory

(M. Gevers, L. Vandendorpe)

Modelling and Analysis of Dynamical Systems

(G. Bastin, V. Wertz)

Scientific Computing on Parallel Computers

(R. Keunings)

Numerical algorithms

(P. Van Dooren)

Complexity of algorithms

(E. Huens, V. Blondel)

Numerical analysis Ia, Ib and II

(A. Magnus, P. Van Dooren)

Matrix theory

(P. Van Dooren)

Optimization

(V. Blondel)

Graph theory

(V. Blondel, L. Wolsey)

1.2 Mechanics

Physics I - Mechanics

(G. Champion, J. Govaerts, J.C. Samin, P. Willems)

Physics II - Mechanics

(G. Champion, J.C. Samin, P. Willems)

Mechanics of deformable solids

(I. Doghri)

Finite elements methods

(V. Legat)

Non-linear mechanics of deformable solids

(I. Doghri)

Continuum mechanics

(F. Dupret)

Simulation of transfer phenomena in industrial processes

(F. Dupret)

Mechanics of composite materials

(R. Keunings)

Properties, processing, analysis and design.

Computer aided design in mechanical engineering

(V. Legat)

Fluid mechanics and heat transfer I

(G. Winckelmans, V. Legat)

Fluid mechanics and heat transfer II

(G. Winckelmans, M. Giot)

Rheology

(R. Keunings)

Numerical methods in fluid mechanics

(G. Winckelmans)

External flow aerodynamics

(G. Winckelmans, F. Dupret)

Turbulence

(G. Winckelmans, G. Schayes)

1.3 Systems and Control

Automatic Control : Fundamentals

(G. Bastin, D. Dochain)

Systems analysis applied to agriculture and environment

(M. Installé)

Aerospace dynamics

(P.Y. Willems)

Modelling of Biological Systems

(Ph. Lefevre, P.Y. Willems)

Simulation of processes

(D. Dochain, F. Thyron)

Nonlinear control

(R. Sepulchre)

System identification

(M. Gevers)

Advanced control design : theory and implementation

(M. Gevers, V. Wertz)

Process Control

(D. Dochain, G. Bastin)

Modelling in neurosciences

(Ph. Lefevre)

Modelling and design of chemical reactors

(D. Dochain, F. Thyron)

Advanced design and modelling of bioreactors

(D. Dochain, S. Agathos)

Societies, population, environment and development : issues and interdisciplinary approaches

(M. Install )

Introduction to life science

(G. Bastin, P. Lef vre, V. Legat)

Seminars on “Environmental sciences and management”

(M. Install )

Seminars on “Ethics, technology, environment and society”

(M. Install )

System theory seminar

(G. Bastin, G. Campion, D. Dochain, M. Gevers, Ph. Lefevre, V. Wertz)

Projet de 2i me candidature (T.4)

(Ch. Bailly, P. Bertrand, J. Devaux, D. Dochain)

2 Post-Graduate Training

2.1 The Graduate School in Systems and Control

The Graduate School in Systems and Control was started in the Spring of 1992 at the initiative of the subnetwork Modelling and Control of IUAP 17, jointly with the groups PMA (KUL) and the Dienst Elektriciteit (VUB) of the IUAP 50. Within the framework of the new IUAP's the Graduate School in Systems and Control is organized jointly by the seven teams of IUAP V/22 and by three teams of IAP V/06 on “Advanced mechatronics Systems”.

The aim is to provide advanced courses in systems and control theory and to give an overview of recent research developments in this field. The school has been primarily intended for doctoral students, although a number of engineers from industry and academics have also taken the courses. They have been widely publicized in all centers that are active in systems and control in Belgium. The courses can now be taken as partial

fulfillment of the PhD programme in several universities in Belgium.

More information on <http://www.auto.ucl.ac.be/AUTO/graduate.html>

Spring 2002 session

- **Statistical Process Control : Theory and applications** (CESAME, Louvain-la-Neuve)

Lecturer : Prof. M. Perrier (Univ. de Montréal)

Participants : 14

Contents :

- Brief review of classical statistical process control concepts
- Connection between statistical and standard process control
- Stochastic process control
 - a) Disturbance models
 - b) Minimum variance controller structure for specific disturbances
- The notion of control loop performance assessment. (PA)
 - a) Traditional tools for PA : power spectrum and autocorrelation
- Univariate and multivariate PA
 - a) Feedback controller PA
 - b) Feedforward controller PA
- Control loop performance monitoring
- Practical considerations and industrial case studies

- **An introduction to distributed parameter systems theory** (CESAME, Louvain-la-Neuve)

Lecturer : Prof. E. Achhab (Université Chouaib Doukkali, Morocco)

Participants : 16

Contents :

- Introduction
- The Cauchy problem in a Hilbert space
- Controllability and Observability
- Stability, stabilisability and detectability
- Linear quadratic optimal control problems
- Extension to a class of semilinear systems

- Applications

Fall 2002 session

- **Mathematical models of systems** (KULeuven, Heverlee)

Lecturer : Prof. J.-C. Willems (KULeuven, Heverlee)

Participants : 38

Contents :

- Lecture 1 : Mathematical modeling concepts The behavior, behavioral equations, latent variables. Dynamical systems, linearity and time-invariance. Controllability and observability.
- Lecture 2 : Modeling by tearing and zooming Modularity. Interconnection laws. The elimination theorem. Control as interconnection. Controller implementability.
- Lecture 3 : State models State construction. The most powerful unfalsified model. Exact identification : model construction from data. The Hankel matrix.
- Lecture 4 : Dissipative dynamical system Construction of the storage function. Relations with LMI's, the Riccati equation, and polynomial matrix factorization
- Lecture 5 : Model reduction Representative of controllable systems. Matrix norms. The SVD and low rank approximations. Balanced realizations and order reduction.
- Lecture 6 : Distributed parameter systems Systems described by PDE's. Elimination. Controllability, image representations, and potentials. Dissipative distributed systems.

- **Modeling and regulations of biochemical processes**(KULeuven, Heverlee)

Lecturers: Prof. D. Dochain (CESAME, Louvain-la-Neuve) and Prof. J. Van Impe, K.U.Leuven

Participants : 31

The objective of this course is to give an introduction and cover recent aspects of dynamical modeling, monitoring and control of biochemical processes.

Part 1 - Dynamical modeling of biochemical processes : the notion of reaction networks and mass balance modeling will be introduced and used to build a general dynamical model for bioprocesses, both stirred tank reactors (described by ODE's)

and incompletely mixed reactors, such as fixed bed or fluidised bed reactors (described by PDE's). Mathematical concepts of the general dynamical model, including model reduction and stability, will be studied. The course will also cover the identification of bioprocess models (including the identifiability and the design of optimal experiments for parameter estimation).

Part 2 - Monitoring : Design applications of state observers (Luenberger observers, Kalman filters, and asymptotic observers) and parameter estimation algorithms (in particular to estimate reaction rates and yield coefficients).

Part 3 - Control : Optimal control and (adaptive) linearizing control. The choice of these control approaches will be motivated in the context of bioprocess applications.

Several practical applications are used to illustrate the techniques and principles covered in this course. Examples will include problems from the food industry and the pharmaceutical industry to the environment and the waste water treatment. The last session of the course will be dedicated to two case studies : one from the food industry (baker's yeast), whose dynamics are described by ODE's and one from the environment (denitrifying biofilter for water treatment) whose dynamics are PDE's. The course will also contain one full session of practical exercises on computer dedicated to the application of analysis tools and methods introduced in the course.

2.2 The Graduate School in Neuroscience

- **Modelling in Neuroscience**(Cesame)

Date : May 2002

Lecturer: Prof. Lance M. Optican, Laboratory of Sensorimotor Research, National Eye Institute, NIH, Bethesda, MD 20892, U.S.A.

Participants : 21

2.3 The Graduate School in Computational Mechanics (GRASMECH)

Organized under the auspices of the National Committee on Theoretical and Applied Mechanics.

The participants came from the following institutions : Katholieke Universiteit Leuven, Universit  Catholique de Louvain, Universit  de Li ge, Universit  Gent, Universit  Libre de Bruxelles, Von Karman Institute, Vrije Universiteit Brussel.

The purpose of the Graduate School is to organise courses in the field of Computational Mechanics, on a third cycle level, to all Belgian graduate students, in compliance with the rules of the parent institution of the student. The field of science in "Computational Mechanics" is very wide.

Five subgroups are identified :

1. solid mechanics and acoustics
2. materials processing
3. fluid mechanics
4. rheologically complex materials
5. numerical aspects and programming

The school is primarily intended for doctoral students and researchers. Engineers from industry and professors from other educational institutions are also welcome.

The following courses took place in 2002:

- **Numerical Linear Algebra**

Lecturer : R. Beauwens (ULB)

Date : October 17, 31; November 14, 28; December 12

Address : Université Libre de Bruxelles (ULB), campus du Solbosch, Brussels

Course contents :

1. Iterative methods
 - Basic principles and examples
 - Convergence analysis and stopping criteria
 - Polynomial acceleration (steepest descent, Chebyshev, conjugate gradients)
2. Preconditioning
 - Preconditioners
 - Nonnegative and related matrices
 - Existence and convergence
 - Conditioning analysis
3. Projective methods
 - Galerkin projections
 - Schwarz method
 - Multilevel methods

4. Krylov subspace methods
 - Krylov I (minimization method)
 - Krylov II (short recurrence methods)
5. Eigenvalue problems
 - Introduction
 - Single vector iteration (basic methods)
 - Subspace iteration (Rayleigh-Ritz procedure, simultaneous iterations, Lanczos method)

- **Theory of quasi-static and dynamic fracture mechanics**

Lecturer : Ph. H. Geubelle, Associate Professor, Department of Aeroautical and Astronautical Engineering, University of Illinois at Urbana-Champaign visiting professor at UCL

Dates : November 21 and 28

Address : Université Catholique de Louvain (UCL), Cesame, Auditoire Euler, Louvain-la-Neuve.

Course contents :

1. Linear elastic quasi-static fracture mechanics
 - Stress concentration and stress singularity
 - Asymptotic K fields
 - Computation of stress intensity factors
 - Energy approach
 - Conservation integrals
2. Concepts of dynamic fracture mechanics
 - Review of elastodynamics
 - Steadily moving dynamic crack
 - Dynamic loading of a stationary crack
 - Energetics of a dynamically propagating crack

3 Mini courses

Seminar series on “**Rational approximations and systems theory**”

Graduate course on SPECIAL TOPICS IN NUMERICAL LINEAR ALGEBRA organized in the context of the UCL/DEA in Mathematics and sponsored by the Inter University Pole of Attraction V/22 ”Dynamical Systems and Control : Computation, Identifica-

tion and Modelling”

Friday 8/02/02

- 15h10 Positive Caratheodory interpolation on the polydisk (Hugo Woerdeman, Dept. Mathematics, William and Mary, USA)
- 15h30-16h30 Rational approximation theory solving a telecom problem (Annie Cuyt, Dept. Mathematics, USA)

Friday 22/02/02

- 14h00-15h00 Positive extensions and Riesz-Fejer factorization for two-variable trigonometric polynomials (Hugo Woerdeman, Dept. Mathematics, William and Mary, USA)
- 15h15-16h15 Optimization problems over nonnegative trigonometric polynomials with interpolation constraints (Yvan Hachez and Yurii Nesterov, CESAME, UCL)

Friday 1/03/02

- 14h00-15h00 Orthogonal rational functions and diagonal plus semiseparable matrices (Marc Van Barel, Dept. Comp. Sc., KUL)
- 15h15-16h15 Positive definite Hankel matrices, positive real functions and related questions (Yves Genin, CESAME, UCL)

Friday 15/03/02

- 14h00-15h00 Rational approximation and balanced truncation (Jan Willems, Dept. El. Engrg. ESAT, KUL)
- 15h15-16h15 Rational interpolation and model reduction (Antoine Vandendorpe and Paul Van Dooren, CESAME, UCL)

Friday 22/03/02

- 14h00-15h00 Spectral factorizations and sums of squares representations via semidefinite programming (Hugo Woerdeman, Dept. Mathematics, William and Mary, USA)
- 15h15-16h15 Commutant lifting and metric constrained interpolation (Rien Kaashoek, Dept. Mathematics, VU Amsterdam)

Friday 29/03/2

- 14h00-15h00 Identification with rational functions (Patrick Van Gucht and Adhemar Bultheel, Dept. Comp. Sc., KUL)
- 15h15-16h15 Asymptotic convergence rates of rational interpolation to exponential functions (Alphonse Magnus, CESAME, UCL)

4 Other teaching activities

- **Analyse des Systèmes et Environnement**, Fondation Universitaire Luxembourgeoise, 20h. - G. Bastin
- **Systèmes Non linéaires Appliqués**, Ecole des Mines de Paris 15h. - G. Bastin
- **Process control**, cours BEST, Louvain-la-Neuve, July-august 2002 - D. Dochain
- **Modelling and control of bioprocesses**, Graduate Course, Queen's University, Kingston, Ontario, Canada, may-june 2002 - D. Dochain
- **Commande des procédés chimiques et biochimiques**, Université Chouaib Doukkali, Faculté des Sciences, El Jadida, Maroc, march 2002 - D. Dochain
- **Micro-macro mechanics of materials**, cours de 3^{ème} cycle, ENIT (Tunisia), April 2002, 15 hours - I. Doghri
- **Modélisation mathématique et simulation numérique de l'injection** Ecole Supérieure de Plasturgie, (Oyonnax, France) 32h. - F. Dupret
- **Identification and Control : from Separate Design to Synergistic Design** - Cancun, Mexico, 3 h, may 2002 - M. Gevers
- **Materials Engineering** (EUPOCO, the European Postgraduate Program in Polymer and Composites Engineering), 60h. - R. Keunings and V. Legat

5. SEMINARS AND WORKSHOPS

1 CESAME colloquium

- Kouider Ben NAOUM (CESAME)
“RÙle des approximations diophantines dans la recherche des solutions pÈriodiques de l'Èquation des ondes non linÈaires”, 30/04/2002.

2 Seminars

- Petr KLAN (Institute of Computer Science, Prague), “PI controllers with predetermined aggressiveness”, January 29, 2002.
- Denis DOCHAIN (CESAME), “What can we learn from PDE models of tubular reactors ?” February 05, 2002.
- Mariana TITICA (CESAME), “Optimisation du profil aromatique de la biÈre lors de la fermentation alcoolique” February 12, 2002
- Roland HILDEBRAND (CESAME) “Identification for control: optimal input design with respect to the worst-case -gap” February 19, 2002
- Raymond GOREZ (Prof. EmÈrite, CESAME) “Internal model control with control-oriented modeling”. February 26, 2002
- Eric QUAEGHEBEUR “Game-theoretic learning with imprecise probabilities”. March 05, 2002
- Pieter JACOT (CESAME) “Modelling and control of a hot-rolling mill run-out table” March 12, 2002
- Dominique HOCHEREAU (CESAME) “ModÈlisation des mÈcanismes du mÈlange dispersif d'une charge dans un mÈlangeur ‡ double vis”. March 19, 2002
- Nicolas PETIT (Ecole des Mines de Paris) “Nonlinear trajectory generation : theory and applications” March 26, 2002
- Joseph WINKIN (FUNDP, membre associÈ du CESAME) “Equilibrium profiles of a nonisothermal tubular reactor nonlinear model”. April 9, 2002
- John A. LEE (UCL/DICE) “MÈthodes non-linÈaires de rÈduction de dimension” April 16, 2002
- Johan SCHOUKENS (VUB) “Application of linear models for control design in the presence of nonlinear distortions”. April 23, 2002

- Jan C. WILLEMS (KUL) “Modelling Interconnected Systems” May 07, 2002, Study Day IUAP-PAI ‡ Leuven
- Brian ANDERSON (ANU, Australia) “Nonlinear Systems and the Vinnicombe Metric” May 21, 2002
- Jonathan ROGGE (RUG) “Synchronization in Populations of Oscillators” May 28, 2002
- Michel PERRIER (Ecole Polytechnique de MontrÉal) “Boundary control of tubular reactors : application to pulp blechnum” June 11, 2002
- Jun WANG (The Chinese University of Hong Kong) “Recurrent Neural Networks for Real-Time Kinematic Control and Torque Optimization of Redundant Manipulators” June 25, 2002
- Denis DOCHAIN (CESAME) “Adaptive extremum seeking of bioreactors” October 1, 2002
- Amaury LENDASSE (CESAME) “SÉlection de structure de modÈle” October 8, 2002
- Roland KEUNINGS (CESAME) “Prediction of Rheometrical and Complex Flows of Entangled Linear Polymers Using the DCR Model with Chain Stretch” October 11, 2002
- Mariama NDIAYE (CESAME) “Etude des lois de contrÙle d’un canal horizontal avec prise latÈrale et simulation numÈrique” October 15, 2002
- Philippe GEUBELLE (CESAME) “Simulation of various scenarios of dynamic fracture” October 15, 2002
- Pierre DUPONT (INFO/UCL) “Inductive and statistical learning of formal grammars” October 22, 2002
- Damien ERNST (Ulg) “L’apprentissage par renforcement appliquÈ ‡ des systÈmes ayant un espace d’États continu” October 29, 2002
- Olivier SCHOEFS (CESAME) “Estimation en temps rÈel de la biodÈgration d’un polluant dans un sol non saturÈ en eau” November 11, 2002
- Mohamed HADJILI (CESAME) DÈfense publique de sa thÈse de doctorat sur le thÈme : “Fuzzy logic in nonlinear modeling and control” November 15, 2002
- Michel DEWAN (CESAME) “Programmation en temps rÈel et simulÈ en labVIEW” November 19, 2002

- Vincent GUFFENS (CESAME) “Using token leaky bucket with feedback control for guaranteed boundedness of buffer queue” December 3, 2002
- Hugo J. WOERDEMAN (KULeuven) “Multivariable polynomials and moments” December 10, 2002
- Issam DOGHRI (CESAME) “Micro-macro modeling and simulation of a class of elasto-plastic composites” December 10, 2002
- Abdou Khadry DRAMÈ (INRA-LASB, Montpellier) “Existence d’Équilibres multiples dans les cascades de réacteurs homogènes” December 17, 2002
- Kunt ATALIK (CESAME) “Spectral analysis of large amplitude oscillatory shear flow of viscoelastic fluids” December 17, 2002

3 Workshops

3.1 Workshop on “Dynamics and computation”

Organized by V. Blondel (CESAME), P. Rouchon (Ecole des Mines de Paris),
R. Sepulchre (ULg/CESAME).
Royal Academy of Sciences, Brussels, July 1-2, 2002.

Programme

- July 1, 2002

Minicourse by R. Brockett, Harvard University (USA)
“Dynamical Systems and Computational Mechanisms”.

Part 1. Examples and Mathematical Background

Part 2. Principal components, Neural Nets and Automata

Part 3. Precise and Approximate Representation of Numbers

Part 4. Quantum Computation

- July 2, 2002

Invited speakers

- Introduction by Jan C. Willems, K.U.L. (Belgium)
- Control issues in Underactuated Robotic Manipulation by
J. Lynch, Northwestern University (U.S.A.)
- Flatness based motion planning of quantum oscillators by
P. Rouchon, Ecole des Mines de Paris (France)
- Quantum control : from controllability to algorithms by
G. Turicini, Inria Rocquencourt (France)
- Optimization on Lie Groups : Applications in NMR Spectroscopy by
U. Helmke, Wuerzburg University (Germany)

3.2 Workshop on “Initiatives locales du dÈveloppement durable en Wallonie : Identification, rencontre et analyse”

In collaboration with “Fondation pour les GÈnÈrations Futures” et “WWF-Belgium”,
October 14, 2002.

Participants : 45 from Belgian universities, NGO’s and public administrations.

3.3 Meeting of the Belgian Group of Rheology “Rheology as a Characterization tool”

Chaired by Roland Keunings, Monnet Centre - International Laboratory, Louvain-la-Neuve, October 9, 2002.

- 9h00-9h15 : Welcome by Monnet Center - International Laboratory and Roland Keunings, president of the BGR
- 9h15-10h00 : Prof. Christian Friedrich (University Freiburg, Germany)
Keynote lecture
Rheology as a tool for the characterization of polymeric materials
- 10h00- 10h30 : Posters - demonstrations by manufacturers of rheological equipment
- 10h30-10h55 : Linda Pellens, (K.U. Leuven, Belgium)
Using rheology to probe the associations in associating polymers
- 10h55-11h25 : Henri Burhin (Alpha Technologies, Belgium)
Large amplitude oscillatory shear and fourier transform rheology as a characterization tool for polymer long chain branching
- 11h25-11h50 : Dr. Kunt Atalik (UCL, Belgium)
Theoretical analysis of large amplitude oscillatory shear (LAOS) experiments in polymer melts
- 11h50-12h15 : Dr. Jörg Lauser (Paar Physica, Germany)
Rheological testing for coating applications
- 13h45-14h10 : Prof. Christian Bailly (UCL, Belgium)
A new method to detect very low levels of long chain branching in high density polyethylene from molar mass distribution and linear viscoelastic response
- 14h10-14h35 : Vincent. Gaullaird (Univ. P and M Curie, France)
An indirect measurement of the swelling of vulcanized rubber particles via a torque rheometer
- 14h35-15h00 : Jan De Munck, (Benelux Scientific)
New Trends in Rheology
- 15h00-15h45 : Posters - demonstrations by manufacturers of rheological equipment
- 15h45-16h10 : Dr. Galina Ourieva (Exxonmobil Chemical)
Mixing laws for the prediction of linear and non-linear viscoelastic properties of linear/LCB-PO blends.
- 16h10-16h35: Bernard Alsteens (UCL, Belgium)
Modeling of the break-up of agglomerates in complex flow fields

6. SCIENTIFIC AWARDS AND RESPONSIBILITIES

1 Scientific Award

BLONDEL Vincent

On December 14, 2002, Prof. Vincent Blondel received the “2002 Prize in Mathematics of the Belgian Royal Academy of Sciences”.

2 Responsibilities

BASTIN Georges

- Associate Editor Journal of Forecasting (Wiley)
- Associate Editor Electronic Journal of Control, Optimization and Calculus of variations (European series in Applied and Industrial Mathematics)
- Associate Editor European Journal of Automation (Hermes)
- Associate Editor Bioprocess and Biosystems Engineering (Springer verlag)

BLONDEL Vincent

- Associate editor of Systems and Control Letters (Elsevier Science)
- Associate editor of the Bulletin of the Belgian Mathematical Society
- Associate editor of Mathematics of Control, Signals, and Systems (Springer Verlag)

DOCHAIN Denis

- Member of the Editorial Board “Journal A”
- Associate editor of the “Journal of Process Control”
- Member of the “International Advisory Board” of the “Canadian Journal of Chemical Engineering”

GEVERS Michel

- Associate Editor of Mathematics of Control, Signals and Systems
- Member of the IFAC Technical Committee on Robust Control

- Member of the IFAC Technical Committee on Modelling, Identification and Signal Processing
- Member of the Research Council at UCL
- Member of the Scientific Ethics Committee of UCL
- Chairman of the Department of Mathematical Engineering
- Member of the Swedish Research Council Committee on Signals and Systems

KEUNINGS Roland

- Co-Editor, with Prof. G.H. McKinley (M.I.T.), of the Journal of Non-Newtonian Fluid Mechanics.
- President of the Belgian Group of Rheology (1992-95, and second term since 1999).
- Representative of Belgium at the European Society of Rheology.
- Member (and Past-President, 1996-2000) of the National Committee of Theoretical and Applied Mechanics, Royal Academy of Belgium.
- Representative of Belgium at the International Union of Theoretical and Applied Mechanics (IUTAM).
- Member of the IUTAM Working Party on Non-Newtonian Fluid Mechanics and Rheology.
- Member of the Committee "Electricité-Mécanique" of the Belgian Fonds National de la Recherche Scientifique (FNRS).
- President of the Committee for Post-graduate Education (Commission du Troisième Cycle) of the School of Engineering, UCL.
- Invited Professor (Gasthoogleraar), School of Engineering, Katholieke Universiteit Leuven, Belgium.

INSTALLE Michel

- Member of the Editorial Board of the International Journal of Environment and Sustainable Development
- Member of the Walloon Council of Sustainable Development as the representative of the french-speaking Belgian universities
- Director of the Master Program of Environmental Science and Management

- President of the Interfaculty Commission of the Management of Environmental Science Master Program

SEPULCHRE Rodolphe

- Associate Editor of Automatica (Elsevier)
- Associate Editor of Mathematics of Control, Signals and System (Springer)

VAN DOOREN Paul

- Editor-in-chief, SIAM Journal on Matrix Analysis and Applications, SIAM Publ.
- Associate Editor, Numerische Mathematik, Springer-Verlag, Berlin.
- Associate Editor, Linear Algebra and its Applications, Elsevier, North Holland.
- Associate Editor, Journal Comp. & Appl. Mathematics, Elsevier, North Holland.
- Associate Editor, Numerical Algorithms, Baltzer.
- Associate Editor, Applied Mathematics Letters, Pergamon, Oxford.
- Associate Editor, Electronic Transactions on Numerical Analysis
- Associate Editor, Applied and Computational Control, Signals and Systems, Birkhauser
- Associate Editor, Mathematics of Control, Signals and Systems, Springer.

WERTZ Vincent

- Member of the Conference Editorial Board of IEEE-CSS

WINKIN Joseph

- Associate Editor of the International Journal of Applied Mathematics and Computer Science.

7. SCIENTIFIC MISSIONS

Scientific missions

Alsteens Bernard

17/06/02 19/06/02 “User Group Meeting of Fluent” (USA). Poster presentation on Modeling the break-up of agglomerates.

Atalik Kunt

26/05/02 29/05/02 “3rd International Conference on the Dynamics of Polymeric Liquids” in Capri (Italy). Presentation of a communication.

Bastin Georges

24/04/02 PROLOG, Paris (France).
01/07/02 07/07/02 Colloquium of the African network in applied mathematics for the development (RAMAD) in Bamako.
20/07/02 26/07/02 IFAC’2002 (Barcelone), Spain.
12/08/02 16/08/02 MTNS (Chicago, USA).
22/09/02 25/09/02 11th Seminar on Systems Identification (ERNSI Workshop) at Le Croisic (France), communication : “S.I. for chemical and biochemical systems”.
10/12/02 16/12/02 CDC, Las Vegas, (USA). Communication: “On boundary control design for quasilinear hyperbolic systems with entropies as Lyapunov functions” by Coron J-M, de Halleux Jonathan, Bastin Georges and d’Andrea-Novel Brigitte.

Ben Naoum Kouider

11/03/02 12/03/02 Colloquium, Institut Henri PoincarÈ (Paris, France).
29/05/02 31/05/02 Colloquium at AIPU (Association Internationale de PÈdagogie Universitaire), Louvain-la-Neuve. Communication with Vincent Wertz, on “Problem-based Learning in Mathematics: an experiment in first year engineering”.
14/06/02 20/06/02 “International Conference on Problem-based Learning in Higher Education; PBL 2002: A pathway to better Learning” in Baltimore (USA). Presentation of a communication.
01/07/02 06/07/02 “2nd International Conference on the Teaching of Mathematics at the Undergraduate Level”, Hersonissos in CrÈte.

Blohm Gunnar

02/11/02 08/11/02 Annual meeting of the “Society for Neuroscience”, Orlando (USA), presentation of two posters.

Blondel Vincent

12/05/02 17/05/02 Stay at Cambridge in Massachusetts (USA) to work with Professors J. Tsitsiklis (from MIT) and R. Brockett (from Harvard University).

18/05/02 21/05/02 STOCS Conference in Montreal (Canada).

22/05/02 Algotel Conference, Montpellier (France) : a plenary conference on the graph of the web.

03/06/02 07/06/02 Université de Paris as invited professor to work with Jean Mairesse.

04/07/02 05/07/02 INPG, Grenoble (France) to attend, as member of the jury, the thesis defense of G. Schneider on “polygonal hybrid systems”. He also worked with Eugène Asarin.

01/07/02 02/07/02 “6th Workshop on Dynamics and Computing” at the Academy of Sciences in Brussels (Belgium).

12/08/02 16/08/02 MTNS’2002 in South Bend, Chicago (USA), organization of two sessions on open problems in mathematics of systems.

15/11/02 16/11/02 Participation in a symposium “New directions in Mathematical Systems Theory and Optimization” organized in Stockholm (at KTH), in commemoration of the 60th birthday of Professor Anders Lindquist.

Campion Guy

14/02/02 15/02/02 Closing meeting of the Brite-Euram project called OBIDICOTE, Paris (France).

12/03/02 Meeting at Techspace Aero, Liège (Belgium).

Chahlaoui Younes

20/07/02 26/07/02 IFAC’2002, Barcelone (Spain). Communication on “Estimating Gramians of large-scale time-varying systems” by Y. Chahlaoui and P. Van Dooren.

12/08/02 16/08/02 MTNS, Chicago, USA where he presented a communication on “Model reduction of second order systems”.

de Halleux Jonathan

- 23/01/02 Stay in Paris in order to attend a work meeting with G. Bastin, J.M. Coron, B. d'Andr ea-Novel and Ch. Prieur regarding the writing of a scientific article on canal network regulation.
- 17/06/02 19/06/02 Stay at CAS in Fontainebleau (France) where he gave a seminar on "Stabilisation d'un bac de fluide" in collaboration with Christophe Prieur (Universit  Paris-Sud).
- 20/07/02 26/07/02 IFAC'2002, Barcelona (Spain). Presentation of the following two communications: "Stabilization of St Venant Equations Using Riemann Invariants: Application To Waterways With Mobile Spillways" by J. de Halleux, G. Bastin, and "Complete Stabilization of a Tank" by C. Prieur and J. de Halleux.
- 02/09/02 06/09/02 Ecole Internationale d'Automatique in Lille (France) which topic was: "Contr le des syst mes   param tres r partis: th orie et applications".
- 07/12/02 14/12/02 CDC, Las Vegas (USA), where the following communications were presented: "Stabilization of a tank via output feedback" by Prieur Christophe and de Halleux Jonathan), and "On boundary control design for quasilinear hyperbolic systems with entropies as Lyapunov functions" by Coron J-M, de Halleux Jonathan, Bastin Georges and d'Andrea-Novel Brigitte.

Delattre C dric

- 12/08/02 16/08/02 MTNS'2002 in Chicago where he presented a communication on "Observability analysis of a nonlinear tubular bioreactor".
- 02/09/02 06/09/02 Ecole Internationale d'Automatique in Lille (France) which topic was: "Contr le des syst mes   param tres r partis : th orie et application".

Dochain Denis

- 31/01/02 01/02/02 LAGEP, Lyon (France) to give a seminar.
- 04/02/02 Symposium on Supervision, Control and Optimization of Biotechnological Processes, in Ghent where he presented a communication on "Adaptive extremum seeking control of continuous stirred tank bioreactors".

06/02/02	08/02/02	Novozymes in Copenhagen to attend a work meeting in the framework of the European Network BatchPro.
06/04/02	10/04/02	Université d'El Jadida to give a course on "Commande des procédés" organized in the framework of the existing cooperation agreement linking the two universities.
16/04/02		Meeting at Paris (France) of the scientific council that is to prepare the 9th Congress of the French Engineering Society on process scheduled on September 2003.
18/04/02		Beldem, Andenne, for a work meeting.
22/04/02	29/04/02	INRA in Narbonne in the framework of a project called "Tournesol" (C.F.) in order to meet and work with J-Ph. Steyer and the members of his team.
05/05/02	08/05/02	Casablanca (Ecole de printemps francophone en modélisation et commande des procédés).
09/05/02	12/05/02	Faculté des Sciences Semlalia in Marrakech in the framework of the AUPELF-UREF co-operation agreement.
22/05/02	14/0/02	Queen's University in Kingston, Ontario (Canada) as invited professor.
20/07/02	26/07/02	IFAC'2002, Barcelona (Spain).
08/10/02	13/10/02	"Mid-term review" meeting of the European Network BatchPro in Thessaloniki (Greece).

Dupret François

31/02/02	01/02/02	Visit to Freiburger Compounds in Freiberg (Germany)
11/03/02	12/03/02	Teaching at the "Ecole Supérieure de Plastugie" (France)
13/04/02	18/04/02	ESAFORM 2002 (Poland)
23/06/02		Cluster Meeting in London (UK)
16/09/02	21/09/02	Courses given at the "Ecole thématique CNRS : Injection des Polymères", Agay (France)
30/09/02		ESAFORM Meeting, Paris (France)

Doghri Issam

20/02/02		Two meetings in Liège: first at CRIF (Research Project), then at Ulg (Scientific Committee meeting of the EMMC6 Congress to take place in Liège in September 2002).
01/04/02	06/04/02	Ecole Nationale d'Ingénieurs de Tunis (ENIT) in Tunisia. He give a third cycle course.
09/09/02	12/09/02	Scientific committee in the 6th European Mechanics of Materials Conference (EMMC6) in Liège. He presented a communication whose co-author is A. Ouaar.

- 23/10/02 25/10/02 4th International Conference on Applied Mathematics and Engineering Sciences (CIMASI 2002) in Casablanca (Maroc). He presented a communication whose co-authors are C. Friebel and A. Ouaar.
- 20/11/02 ABAQUS Benelux User's meeting in Eindhoven (Holland). He presented a communication whose co-authors are C. Friebel and A. Ouaar.

Gevers Michel

- 28/03/02 Visit to Paul Van Den Hof and Xavier Bombois at TU Delft for a working day.
- 03/05/02 Participation in public defense of the Ph.D. thesis of Tony Van Gestel (KUL/ESAT) as member of the jury.
- 20/05/02 22/05/02 5th IASTED International Conference on Control and Applications in Cancun, Mexico, Plenary tutorial presentation on "Identification and Control: from separate design to synergistic design" (3h30).
- 01/07/02 02/07/02 6th workshop on "Dynamics and Computing" at the Academy of Sciences in Brussels (Belgium).
- 22/09/02 25/09/02 11th Workshop on Systems Identification (ERNSI Workshop) in Le Croisic, France. Presentation on "System Identification and Control".
- 25/09/02 27/09/02 Swedish Research Council Evaluation Meeting as member of the evaluation panel of the Swedish research projects in signals and systems
- 22/11/02 Meeting organized by the European Commission regarding the projects of networks of excellence in the field of "embedded systems" and "control systems".
- 15/11/02 16/11/02 Symposium on "New directions in Mathematical Systems Theory and Optimization" organized in commemoration of the 60th birthday of Professor Anders Lindquist at KTH in Stockholm.
- 21/11/02 22/11/02 Two days "brainstorming meeting" on systems identification at VUB with Lennart LJUNG, Paul van den HOF, Bart DE MOOR, Johan SCHOUKENS and Rik PINTELON.
- 07/12/02 14/12/02 IEEE Conference on Decision and Control in Las Vegas (USA). He chaired a meeting of 25 European researchers on December 10, aiming at the creation of a network of European Centres of Excellence in "Systems and Control".
- 18/12/02 19/12/02 Visit to Professor Lennart Ljung (Linköping University, Sweden)

Guffens Vincent

- 22/01/02 23/01/02 Université de Jussieu. He attends the ASO1 Study Day: an interuniversity meeting on Automatics applications to the problematic of communication networks.
- 20/03/02 Visit to Hugues Mounier in Paris (France)
- 18/06/02 19/06/02 Stay in Paris to attend the ASO1 Study Day on networks.
- 01/06/02 02 July 6th workshop on “Dynamics and Computing” at the Academy of Sciences in Brussels.
- 15/10/02 15/02/03 Ecole des Mines de Paris (France) in order to pursue his research and meet specialists in the fields of communications networks and automatic control.

Hachez Yvan

- 01/03/02 30/06/02 LOGILAB in Geneva to work with J-Ph. Vial.
- 03/03/02 07/03/02 Swiss spring seminar ”3^Ème cycle romand de recherche opérationnelle” in Zinal (Switzerland). Communication on “Optimization problems over nonnegative trigonometric polynomials with interpolation constraints”.
- 20/07/02 26/07/02 IFAC’2002, Barcelona (Spain). Communication on “Optimization problems over nonnegative trigonometric polynomials with interpolation constraints” by Yvan Hachez and Yurii Nesterov.

Hildebrand Roland

- 28/03/02 TU Delft to take part in a whole day work session with Paul van den Hof and Xavier Bombois.
- 01/07/02 02/07/02 “6th Workshop on Dynamics and Computing” at the Academy of Sciences in Brussels.
- 22/09/02 25/09/02 11th Seminar on Systems Identification (ERNSI Workshop) at Le Croisic (France). Communication on “Convergence analysis and optimal filtering in iterative feedback tuning”.

Hochereau Dominique

- 16/06/02 20/06/02 Conference of the “Polymer Processing Society” (PPS18) in Guimarães (Portugal), communication on “CaCO₃ Dispersion in Polymer Flow: Experimental Study and Simulation of Rupture During Twin Screw Extrusion”.

InstallÈ Michel

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| 21/06/02 | 29/06/02 | Mission in St Petersburg and Moscow in the framework of a convention between the RÈgion Wallonne and the Federation of Russia regarding the development of exchanges with respect to environmental training matters. |
| 08/10/02 | 12/10/02 | EPFL, Lausanne to participate in a European thesis jury in environmental sciences. |
| 23/10/02 | 26/10/02 | “International Conference on Engineering Education in Sustainable Development” in Delft where he presented a communication on “Introducing Sustainable Development Concepts into Engineering Curricula: Some Proposals and Implementations”. |
| 27/10/02 | 30/10/02 | Participation as member of the European jury in thesis defenses in environmental science and management at the Ecole Polytechnique de Turin, in Turino (Italy). |

Keunings Roland

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| 25/03/02 | 27/03/02 | “INNFM Conference on Process Modelling” in Lake Vrnwy (United Kingdom), keynote lecture. |
| 21/05/02 | 22/05/02 | Participation in a project research meeting funded by BASF in Ludwigshafen (Germany). |
| 26/05/02 | 29/05/02 | “3rd International Conference on the Dynamics of Polymeric Liquids” in Capri (Italy). Presentation of a communication. |
| 01/09/02 | 04/09/02 | European Congress of Rheology in Erlangen (Germany). |
| 11/09/02 | 13/09/02 | Member of a 4 external professors evaluation panel in the evaluation of the Danish Polymer Center in Copenhagen (Denmark). |
| 13/10/02 | 16/10/02 | Mission in Minneapolis (USA) to present an invited conference at the “Symposium on Molecular Rheology of Concentrated Polymeric Systems” organized by the American Society of Rheology. |
| 11/12/02 | | T.U. Eindhoven (Holland) to participate in a thesis defense (F. Baaijens). |

Lecchini Andrea

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| 28/03/02 | | TU Delft to take part to a whole day work session with Paul van den Hof and Xavier Bombois. |
| 01/07/02 | 02/07/02 | “6th Workshop on Dynamics and Computing” at the Academy of Sciences in Brussels. |
| 22/09/02 | 25/09/02 | 11th Seminar on Systems Identification (ERNSI Workshop) at Le Croisic (France). |
| 30/11/02 | 20/12/02 | Australian National University in Canberra (Australia) to work with Professor Brian D. Anderson on “Identification and Control” in view of finalizing his research. |

07/12/02 14/12/02 IEEE Conference on Decision and Control in Las Vegas (USA) where he presented a communication on “On Iterative Feedback Tuning for non-minimum phase plants” by A. Lecchini and M. Gevers.

Lefèvre Philippe

14/03/02 University of Antwerp to present a communication at a working session meeting with Belgian laboratories active in “computational neuroscience”.

01/07/02 02/07/02 “6th Workshop on Dynamics and Computing” at the Academy of Sciences in Brussels.

02/11/02 08/11/02 Annual meeting of the “Society for Neuroscience” in Orlando where he presented two posters.

Legat Vincent

17/06/02 19/06/02 “User Group Meeting of Fluent” in the United States with a poster presentation on “Modeling the break-up of agglomerates”.

Lendasse Amaury

24/04/02 “European Symposium on Artificial Neural Networks” (ESANN’2002). Presentation of two communications. The first one on “Curvilinear Distance Analysis versus Isomap” by J. Lee, A. Lendasse and M. Verleysen ; and the second on “Width optimization of the Gaussian kernels in Radial Basis Function Networks” by N. Benoudjit1, C. Archambeau, J. Lee, A. Lendasse and M. Verleysen.

08/05/02 10/05/02 ACC’2002 in Anchorage, with a paper presentation on “Prediction of Electric load using Kohonen maps - Application to the polish Electricity Consumption” by A. Lendasse, M. Cottrell, V. Wertz and M. Verleysen.

11/05/02 16/05/02 Visit to Professor Steve Yurkovich at Ohio State University where he gave two seminars on “Model Structure Selection” and “Prediction of time series using Radial Basis Functions Networks”, respectively.

Leygue Adrien

21/05/02 Research projects meeting funded by BASF in Ludwigshafen (Germany).

26/05/02 29/05/02 “3rd International Conference on the Dynamics of Polymeric Liquids” in Capri (Italy). Presentation of a communication.

Moens Luc

24/04/02 PROLOG IngÈnierie, Paris (France) in order to define a prevision flood tool for the Oise and Aisne rivers.

Ndaye Mariama

21/05/02 31/05/02 Mathematics Institute of the Neufchâtel University to work with Professor O. Besson.

01/07/02 07/07/02 Colloquium of the African network in applied mathematics for the development (RAMAD) in Bamako.

Provost AgnÈs

04/02/02 Symposium on Supervision, Control and Optimization of Biotechnological Processes, in Ghent (Belgium).

12/08/02 16/08/02 MTNS, Chicago (USA). Presentation of a communication on “Feedback stabilisation with positive control of dissipative compartmental systems”.

Schoefs Olivier

04/02/02 Symposium on Supervision, Control and Optimization of Biotechnological Processes, in Ghent.

04/04/02 09/04/02 INRA, Narbonne (France) to work with Jean-Philippe Steyer in the framework of the European project TELEMAC.

22/04/02 European project TELEMAC, a working session meeting in Ghent with Peter Vanrolleghem.

16/05/02 17/06/02 Ecole Polytechnique de MontrÈal (Canada) to work with Professors R. Sanson and M. Aubertin.

19/06/02 23/06/02 Meetings with partners of the European project TELEMAC in Bologna (Italy).

Schreiber CÈline

02/11/02 08/11/02 Annual meeting of the “Society for Neuroscience” in Orlando (USA). Presentation of two posters.

Sepulchre Rodolphe

28/01/02	02/02/02	Université d'El Jadida (Maroc) to give a course on Nonlinear Systems
24/02/02	01/03/02	Mathematisches Forschungsinstitut Oberwolfach. Participation in the 2002 Oberwolfach meeting in Systems and Control.
19/03/02	21/03/02	Participation in the 21st Benelux meeting, Veldhoven, The Netherlands.
22/05/02		Thesis defence of Wim Michiels, Computer Science, KUL.
19/06/02	21/06/02	Invited speaker at Workshop on Stabilization of Nonlinear Systems, INRIA, Metz.
01/07/02	02/07/02	6th Workshop on Dynamics and Computation, Academy of Science, Brussels.
03/07/02	04/07/02	Invited lecturer at DISC/EM Summerschool on Modelling and Control of Mechanical Systems, Woudschoten, The Netherlands.
12/08/02	16/08/02	Mathematical Theory of Networks and Systems Symposium 2002, South Bend, Illinois.
15/08/02	31/12/02	Sabbatical leave at Princeton University, Department of Aerospace and Mechanical Engineering.
25/11/02	26/11/02	Visit at Yale University and presentation of a seminar.
10/12/02	13/12/02	41st IEEE Conference on Decision and Control, Las Vegas, USA.

Solari Gabriel

28/03/02		TU Delft (Holland) to take part to a whole day work session with Paul van den Hof and Xavier Bombois.
01/07/02	02/07/02	“6th Workshop on Dynamics and Computing” at the Academy of Sciences in Brussels.
22/09/02	25/09/02	11th Seminar on Systems Identification (ERNSI Workshop) at Le Croisic (France).

Theys Jacques

01/07/02	02/07/02	participated in the “6th Workshop on Dynamics and Computing” at the Academy of Sciences in Brussels.
12/08/02	16/08/02	participated in MTNS in Chicago where he presented a communication on “Switched systems that are periodically stable may be unstable”.

Titica Mariana

- 04/02/02 Symposium on Supervision, Control and Optimization of Biotechnological Processes, in Ghent.
- 06/02/02 08/02/02 Novozymes, Copenhagen to attend working session meetings in the framework of the European Network BatchPro.
- 18/03/02 22/03/02 Novozymes in Copenhagen (Denmark) (the industrial partner of the European project BatchPro) in order to attend testing sessions and recuperate the experimental data.
- 18/04/02 Work meeting at Beldem in Andenne.
- 30/05/02 31/05/02 Laboratoire d'Automatique of the Ecole Polytechnique Fédérale in Lausanne (Suisse) to meet Prof. Dominique Bonvin and Dr. Bala Srinivasan in view of a future collaboration in the framework of the European project BatchPro.

Vandendorpe Antoine

- 20/07/02 26/07/02 participated in IFAC'2002 in Barcelona where he presented a communication on "On the generality of multipoint PadÈ approximations" by K. Gallivan, A. Vandendorpe and P. Van Dooren.
- 12/08/02 16/08/02 participated in MTNS in Chicagon where he presented a communication on "Model reduction via tangential interpolation" by K. Gallivan, A. Vandendorpe and P. Van Dooren.

Van Dooren Paul

- 28/02/02 03/03/02 Purdue University (West Lafayette) to attend a meeting of the National Science Fundation.
- 08/03/02 Meeting of the mathematics committee at the FNRS.
- 06/04/02 08/04/02 Meeting of the NICONET project in Oxford (United Kingdom).
- 11/06/02 14/06/02 Thesis defense of Alain-JÈrÙme Riquet at the UniversitÈ du Littoral de la CÙte d'Opale in Calais (France). He also presented a seminar on "Riccati stabilizes large scale systems".
- 16/06/02 23/06/02 "Householder Symposium" in Edinburgh (Scotland) as member of the organizing committee. Seminar on "Hubs, authorities and graph similarity".
- 28/06/02 Meeting of the European Committee on Control Training Site at the Institut PoincarÈ, Paris (France).
- 07/07/02 14/07/02 SIAM Annual Meeting in Philadelphia (USA).
- 22/07/02 26/07/02 Tenth International Congress on Computational and Applied Mathematics at KULEuven where he gave the opening plenary lecture.

28/07/02	23/08/02	University of Florida in Thallahasse (Florida) to work with Gallivan.
12/08/02	16/08/02	MTNS'2002 at the University of Notre Dame in Chicago (USA).
25/09/02	27/09/02	UniversitÈ du Littoral de la CÙte d'Opale in Calais (France) where he gave a seminar.
19/10/02	01/11/02	National Tsing Hua University in Hsinchu (TaÔwan) for a research visit.
29/11/02		Meeting of the Control Training Site (CTS) at the UniversitÈ Marie Curie, Paris (France).
05/12/02		Seminar at Department of Computer Sciences of the University of Stanford.
06/12/02	07/12/02	SIAM Board Meeting in Philadelphia (USA)
08/12/02	09/12/02	Work session at Purdue University with Ahmed Sameh.

Van Ruymbeke Evelyne

26/05/02	29/05/02	"3rd International Conference on the Dynamics of Polymeric Liquids" in Capri (Italy) Presentation of a communication.
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Wertz Vincent

04/03/02		Meeting of the "comitÈ d'encadrement" of Jeroen Buijs thesis at KULeuven (ESAT).
09/03/02	18/03/02	UniversitÈ d'El Jadida (Maroc) where, in the framework of the CIUF convention, he gave a course on "Fuzzy control".
20/03/02		SupÈlec (France) to attend as member of the jury and as rapporteur, the "thÈse d'habilitation" of Didier Dumur.
29/05/02	31/05/02	AIPU Colloquium (Association Internationale de PÈdagogie Universitaire) in Louvain-la-Neuve. Presentation, in collaboration with K. Ben Naoum, of a communication on "Problem-based learning in mathematics: an experiment in first year engineering".
14/06/02	20/06/02	"International conference on problem-based learning in higher education, PBL 2002: A pathway to better Learning" in Baltimore (USA). Presentation of a communication.

Winckelmans GrÈgoire

08/04/02	12/04/02	"IUTAM Symposium on Unsteady Separated Flows", organized by IMFT in Toulouse. Presentation of a communication on "Simulation of three-dimensional bluff body flows using the vortex particle and boundary element method".
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17/06/02	18/06/02	6th WakeNet Workshop/Final Review Meeting “Challenges in Wake Vortex Research”, organised by the Thematic Network “WakeNet” of the EC in Toulouse.
19/06/02		attended the Wake Vortex Team, Specialist Meeting for CFD work on AWIATOR (Aircraft WIng with Advanced Technology Operation).
01/07/02		Kick-off meeting of the AWIATOR project (Aircraft WIng with Advanced Technology Operation).
10/07/02	12/07/02	Kick-off meeting of the ATC-WAKE project (Integrated Air Traffic Control wake vortex safety and capacity system).
28/07/02	23/08/02	Summer Program 2002 of the Center for Turbulence Research (CTR) at Stanford University and at NASA Ames Research Center.
30/09/02	01/10/02	Quarterly Progress Meeting of the European ATC-WAKE project at Euro Control in BrÈtigny.
02/10/02		CFD Fast line Meeting of the European project AWIATOR at Paris CDG in Paris.
28/10/02	29/10/02	Preliminary Design Meeting of the European project AWIATOR at ONERA in Toulouse.
07/11/02	08/11/02	Second Project Steering Committee Meeting of the European project I-WAKE at the DLR Centre in Oberpfaffenhofen.
24/11/02	26/11/02	55th Annual Meeting of the Division of Fluid Dynamics of the American Physical Society (APS-DFD02) in Dallas, Texas. Presentation of a communication on “Comparison of recent dynamic subgrid-scale models in LES of the channel flow” by H. Jeanmart and G. Winckelmans.

Winkin Joseph

01/01/02	31/01/02	UniversitÈ Chouaib Doukkali, Department of Mathematics, El Jaidida (Maroc). Presentation of a seminar on “Fonctions de transfert de systÈmes † paramÈtres rÈpartis”
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Wu Xuekui

14/02/02	15/02/02	Closing meeting of the European project Brite-Euram: OBIDI-COTE in Paris (France).
12/03/02		Meeting at Techspace AÈro in LiÈge (Belgium).