



Centre for Systems Engineering and Applied Mechanics



ACTIVITY REPORT

2000 - 2001

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Contents

1. PERSONNEL	1
1 Academic staff	2
2 Academic and post-doctoral visitors	3
3 Scientific staff	5
4 Administrative and technical staff	6
5 Short-term visitors	6
2. RESEARCH	8
1 Research activities	9
1.1 Matrix theory and applications	9
1.2 Linear system theory	10
1.3 Linear control systems	13
1.4 Complexity of dynamical systems	15
1.5 Computational rheology	16
1.6 Numerical simulation of fluids and flows	19
1.7 System identification	21
1.8 Fuzzy systems for modelling and optimization	23
1.9 Nonlinear control design	25
1.10 Control of distributed parameter systems	26
1.11 Biomedical engineering	27
1.12 Biotechnological processes	29
2 Research programmes and contracts	34
2.1 European Programmes	34
2.2 Belgian Federal Programmes	36
2.3 Regional Programmes	37
2.4 Special Research Fund (UCL)	39
2.5 Industrial Contracts	40
2.6 Other international contracts	42
3. PUBLICATIONS	44
1 PhD Theses presented in 2000 and 2001	45

2	Publications 2000	45
3	Publications 2001	59
4	Editorial activities	70
4.	TEACHING	72
1	Undergraduate and Graduate Teaching	73
1.1	Applied Mathematics	73
1.2	Mechanics	73
1.3	Systems and Control	74
2	Post-Graduate Training	75
2.1	The Graduate School in Systems and Control	75
2.2	The Graduate School in Computational Mechanics (GRASMECH)	77
3	Mini courses	78
4	Other teaching activities	78
5.	SEMINARS AND WORKSHOPS	80
1	Cesame colloquium	81
2	Seminars	82
3	Workshops	86
3.1	Workshop on “The Dynamics of Neurons and Vision”	86
3.2	Workshop on “Dynamics and Verification”	88
3.3	Workshop on “Recent advances in oculomotor research”	89
3.4	Workshop on “Modelling and Monitoring of Batch Processes”	90
4	5th National Congress on Theoretical and Applied Mechanics	91
5	20th Benelux Meeting on Systems and Control	91
6	Fourth SIAM Conference on Linear Algebra in Signals, Systems and Control	92
7	Third NICONET Workshop on Numerical Software in Control Engineering	93
6.	SCIENTIFIC MISSIONS	94

1. PERSONNEL

1 Academic staff

BASTIN Georges
BEN NAOUM Kouider
BLONDEL Vincent
CAMPION Guy
CROCHET Marcel
DE LEERSNIJDER Eric
DOCHAIN Denis
DOGHRI Issam
DUPRET François
GENIN Yves
GEVERS Michel
INSTALLE Michel
KEUNINGS Roland, President of CESAME
LEFEVRE Philippe
LEGAT Vincent
MUND Ernest
NESTEROV Yurii
SEPULCHRE Rodolphe
VAN DEN BOGAERT Nathalie
VAN DOOREN Paul
WERTZ Vincent
WILLEMS Pierre Yves
WINCKELMANS Grégoire

AWARDS

On November 28, 2001, Prof. M. Gevers received the title of Doctor Honoris Causa from the Vrije Universiteit Brussel.

On July 14, 2001, Prof. V. Blondel received the Triennial SIAM prize on Systems and Control, San Diego, California.

On August 13, 2000, Prof. Y. Nesterov received the Dantzig Prize of Mathematical Programming Society and SIAM

2 Academic and post-doctoral visitors

ACHHAB M.Elarbi	14/08/00 - 13/09/00	Visiting professor, Univ. Chouaib Doukkali, El Jadida, Maroc
ANDERSON Brian	08/05/00 - 25/05/00 14/05/01 - 01/06/01	Visiting professor, Research school, of information & eng., Australia
ATALIK Kunt	01/04/00 - 31/12/01	Postdoctoral researcher, Bosphorus Univ., Istanbul, Turquie.
BERIS Antony	01/01/00 - 30/06/00	Visiting professor, Univ. of Delaware, Newark, USA
BOUMEHRAZ Mohamed	20/03/01 - 20/04/01	Visiting professor, Univ. of Biskra, AlgÈrie
CANTERINI Vincent	18/09/00 - 16/12/01	Postdoctoral researcher, Univ. de la MÈditÈrranÈe, Marseille, France
GAJARDO Anahi	01/10/01 - 31/12/01	Postdoctoral researcher, Univ. of Chile
GOMEZ Guillermo	01/01/00 - 25/09/00	Postdoctoral researcher, Univ. Tecnica, Federico Santa Maria, Valparaiso, Chili
GURVITS Leonid	14/03/00 - 28/03/00	Visiting professor, Institute for Advanced Studies, Princeton, USA
HILDEBRAND Roland	15/03/01 - 31/12/01	Postdoctoral researcher, Freie Univ. Berlin, Germany
HOCHEREAU Dominique	01/10/00 - 31/12/01	Researcher, First enterprise, Univ. Paris-Sud, France
JOHNSTON Leigh	03/07/00 - 31/12/00	Postdoctoral researcher, Univ. of Melbourne Australia
KULCZYCKI Piotr	01/02/00 - 28/02/00	Visiting professor, Cracow univ. of Tech., Poland
LECCHINI Andrea	01/04/01 - 31/12/01	Postdoctoral researcher, Univ. of Brescia, Italy
MOSSBERG Magnus	01/07/00 - 31/12/00	Postdoctoral researcher, Univ. of Uppsala, Sweden
NICHITIU Codrin	15/01/00 - 15/09/00	Postdoctoral researcher, ENS, Lyon, France
SOME Longin	28/09/00 - 31/12/00	Visiting professor, Fac. Sciences et Techniques, Ouagadougou
STEFAN Radu	01/01/00 - 31/07/01	Postdoctoral researcher, Univ. of Bucarest, Roumania
TISSEUR FranÁoise	27/03/00 - 08/04/00	Visiting assistant professor, Manchester Univ., UK
TITICA Mariana	03/11/01 - 31/12/01	Postdoctoral researcher, Lab. d' Automatique, INP, Grenoble, France
VLADIMIROV Alexander	20/08/01 - 20/11/01	Visiting professor, Academy of Sciences, Russia
WAPPEROM Peter	01/01/00 - 31/08/00	Postdoctoral researcher, Delft Univ., The Netherlands
XU Shengyuan	01/12/00 - 31/11/01	Postdoctoral researcher, Nanjing Univ., China
YURKOVICH Stephen	23/04/01 - 18/06/01	Visiting professor, Ohio State University, USA

3 Scientific staff

ABBAD Omar	01/02/00 - 31/12/01
AKSIKAS Ilyasse	07/09/01 - 31/12/01
ALSTEENS Bernard	01/08/01 - 31/12/01
AVOWLANOU Kokou	01/01/00 - 30/09/01
BENAYAD M. Abdou	21/02/00 - 22/05/00
BLOHM Gunnar	01/01/00 - 31/12/01
BOMBOIS Xavier	01/01/00 - 31/10/00
BOUAGADA Djillali	19/04/01 - 19/05/01
CHAHLAOUI Younes	01/01/00 - 31/12/01
CHEN Libei	01/01/00 - 01/04/00
CODRONS Benoit	01/01/00 - 30/06/00
DAENINCK Goeric	01/10/00 - 31/12/01
DAVID Benoît	01/01/00 - 31/12/01
de BROUWER Sophie	01/01/00 - 31/12/01
de HALLEUX Jonathan	01/10/00 - 31/12/01
DELATTRE Cédric	01/01/00 - 31/12/01
DELSAUTE Brieux	01/09/00 - 31/12/01
GALLEZ Xavier	01/01/00 - 31/08/01
GROGNARD Frédéric	01/01/00 - 30/10/01
GUFFENS Vincent	05/09/01 - 31/12/01
HADJILI Mohamed	01/01/00 - 31/12/01
HACHEZ Yvan	01/01/00 - 31/12/01
HAMED Zouaki	18/06/01 - 18/07/01
JACOT Pieter	01/08/00 - 31/12/01
JANKOVIC Dejan	01/02/00 - 31/12/01
JEANMART Hervé	01/01/00 - 31/12/01
JEGGY Cécile	01/01/00 - 31/12/01
LAABISSI Mohamed	01/03/00 - 31/05/00
LEGRAND Sébastien	01/01/00 - 31/12/01
LENDASSE Amaury	01/01/00 - 31/12/01
LEYGUE Adrien	01/01/00 - 31/12/01
LOIX Fabrice	01/01/00 - 31/12/01
MAGOTTE Olivier	01/01/00 - 31/12/01
MENVIELLE Sylvaine	01/02/01 - 31/12/01
MITICHE Amel	20/08/01 - 17/09/01
MOENS Luc	01/01/00 - 31/12/01
MOHYMONT Bernard	01/01/00 - 31/09/01
MOTTE Isabelle	01/01/00 - 31/12/01
NASUTION Uly	01/07/00 - 31/12/01
NDIAYE Mariama	01/10/01 - 31/12/01
OLSSON Henrik	19/02/01 - 15/06/01

ONDERBEKE David	01/09/00 - 31/12/01
OUAAR Amine	01/01/00 - 31/12/01
PLOUMHANS Paul	01/01/00 - 31/02/01
PROVOST AgnÈs	01/09/01 - 31/12/01
REDAELLI Silvia	01/10/01 - 31/12/01
REGNIER Vincent	01/01/00 - 31/12/01
ROLINSKY Roman	01/01/00 - 31/12/01
SCHREIBER CÈline	07/09/01 - 31/12/01
SOLARI Gabriel	01/09/01 - 31/12/01
STANCIULESCU Cristina	01/01/00 - 31/08/01
THEYS Jacques	01/06/01 - 31/12/01
THIRIFAY FranÁois	01/01/00 - 31/12/01
TUDOR Angela	01/07/01 - 31/12/01
VANDENDORPE Antoine	01/02/01 - 31/12/01
VAN GOETHEM Nicolas	01/09/00 - 31/12/01
VAN RUYMBEKE Evelyne	15/07/00 - 31/12/01
WU Liang	01/01/00 - 31/12/01
WU Xuekui	01/06/01 - 31/12/01

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

ABSIL P.A.	16/05/00, 03/11/00	Ulg, LiÈge, Belgium
ASARINN E.	30/10/00 - 03/11/00	Academy of Science, Moscow, Russia
BARNES G.R.,	14/05/01 - 15/05/01	Manchester University, U.K.
	16/10/01 - 17/10/01	

BERIS A.	01/02/01	University of Delaware, Newark, USA
BITMEAD R.R.,	11/05/01 - 16/05/01	Université of California at San Diego, U.S.A.
BERTRAND P.	12/01/01	Laboratoire des Signaux et systÈmes, Gif sur Yvette, France
CORON J.M. & PRIEUR	15/06/01	Université de Paris Sud, France
D'ANDREA NOVEL B.	03/05/00	Ecole des Mines, Paris, France
	15/06/01	
DUBACQ J.C.	27/06/00	Lyon, France
CIRRICIONE G.	23/06/00	ESAT, KULeuven, Belgium
ELSNER L.	10/10/01 - 13/10/01	University of Bielefeld, Deutschland
GOLDBERG M.	16/10/01 - 17/10/01	Columbia University, N.Y., U.S.A
GRODENT M.	28/08/01	Tech Space Aero
HADJ SADOK M.	15/05/00 - 15/06/00	Inst. d'Electronique de Blida, AlgÈrie
HIGHAM N.	27/03/00 - 08/04/00	Manchester Univ., UK
HJALMARSSON H.	15/05/00	University of Linköping, Sweden
HUEPER K.,	12/03/01 - 16/03/01	Universität de Wuerzburg, Deutschland
KLAN P.	25/09/00 - 06/10/00	Inst. of Computer Science, Prague, Czech Rep.
KOIRAN P.	12/01/01	Laboratoire d'informatique de l'ENS, Lyon,
	22/10/01 - 31/10/01	France
KRESSNER D.	28/02/00 - 11/03/00	Chemnitz University
LANDAU I.	22/02/00	INPG, Grenoble, France
LINGREN D.	14/11/01 - 16/11/01	Universität de Linköping, Sweden
LJUNG L.	14/11/00	University of Linköping, Sweden
MISSAL M.	01/03/00 - 18/03/00	Smith Kettlewell Eye Research Inst.,
	20/09/00 - 22/09/00	San Francisco, U.S.A.
MONTPETIT M.	25/09/00 - 27/09/00	Université de Sherbrooke, Canada
MOUNIER H.	18/04/01	Université de Paris Sud, France
M'SAAD M.	04/12/00 - 06/12/00	Université de Caen, France
NAJIB K.	12/09/01 - 13/09/01	Université Chouaib Doukkali, El Jadida, Maroc
PETIT N.	16/05/00	Ecole des Mines, Paris, France
PINTELON R.	24/04/01	V.U.B., Bruxelles, Belgium
PORTIER N.	12/01/01	Laboratoire d'informatique de l'ENS, Lyon,
		France
PRALY L.	13/07/01	Ecole des Mines de Paris, France
QUADRAT A.	26/03/01	University of Leeds, U.K.
SCORLETTI G.	05/10/00	Université de Caen, France
	14/11/00	
SEYNHAEVE F.	04/07/00	Lab. d'Inform. Fondamentale de Lille, France
SCHOUKENS J.	24/04/01	V.U.B., Bruxelles, Belgium
STRAMIGIOLI S.	01/09/01	University of Twente, Holland
VAN ROLLEGHEM P.	21/03/00	RUG, Gent, Belgium
WALDEN B.	11/09/01	Femlab, Sweden

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

ABSIL P.A., R. MAHONY, R. SEPULCHRE, P. VAN DOOREN, “A Grasmann-Rayleigh quotient iteration for computing invariant subspaces”, *to appear in SIAM Review*, 2001.

The classical Rayleigh Quotient Iteration (RQI) allows to compute a 1-dimensional invariant subspace of a symmetric matrix A . Here we propose a generalization of the RQI which computes a p -dimensional invariant subspace of A . The geometry of the algorithm on the Grassmann manifold $\text{Grass } pn$ is made explicit to show cubic convergence and to draw connections with recently proposed Newton algorithms on Riemannian manifolds. A continuous analogue with strong global convergence properties is also discussed.

BLONDEL V., J. THEYS, A. VLADIMIROV, “An elementary counterexample to the finiteness conjecture”, *Submitted to SIAM Journal of matrix analysis*, 2001.

The Lagarias-Wang finiteness conjecture was introduced in 1995, in connection with problems related to spectral radius computation of finite sets of matrices. The conjecture has recently been proved to be false by Bousch and Mairesse. In this paper we show that there exist infinitely many values of the real parameter b for which the pair of matrices

$$\begin{pmatrix} 1 & 1 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} b & 0 \\ b & b \end{pmatrix}$$

violates the conjecture. The proof is self-contained and fairly elementary; it uses only elementary facts from linear algebra.

CHAHLAOUI Y., K. GALLIVAN, P. VAN DOOREN, “Recursive calculation of dominant singular subspaces”, *Submitted SIAM Journal on Matrix Analysis and Applications*, 2001.

In this paper we show how to compute recursively an approximation of the left and right dominant singular subspaces of a given matrix. In order to perform as few as possible operations on each column of the matrix, we use a variant of the classical Gram-Schmidt algorithm to estimate this subspace. The method is shown to be particularly suited for

matrices with many more rows than columns. Bounds for the accuracy of the computed subspace are provided. Moreover, the analysis of error propagation in this algorithm provides new insights in the loss of orthogonality typically observed in the classical Gram-Schmidt method.

GENIN Y., Y. HACHEZ, Y. NESTEROV, R. STEFAN, P. VAN DOOREN, S. XU, “Positivity and linear matrix inequalities”, *Submitted to European Journal of Control*”, 2001.

In this paper we first recall the general theory of Popov realizations of parahermitian transfer functions in the context of generalized state space systems. We then use this general framework to derive linear matrix inequalities for various problem in systems and control. Finally, we indicate how these problems can be solved numerically and what specific numerical difficulties can be encountered.

GENIN Y., Y. HACHEZ, Y. NESTEROV, P. VAN DOOREN, “Optimization problems over positive pseudo-polynomial matrices”, *Submitted to SIAM Journal on Matrix Analysis and Applications*, 2001.

The Nesterov characterizations of positive pseudo-polynomials on the real line, the imaginary and the unit circle are extended to the matrix case. With the help of these characterizations, a class of optimization problems over the space of positive pseudo-polynomial matrices is considered. These problems can be solved in an efficient manner due to the inherent block Toeplitz or block Hankel structure induced by the characterization in question. The efficient implementation of the resulting algorithms is discussed in details. In particular, the real line setting of the problem leads naturally to ill-conditioned numerical systems. However, adopting a Chebyshev basis instead of the natural basis for describing the polynomial matrix space yields a restatement of the problem and of its solution approach with much better numerical properties.

1.2 Linear system theory

GENIN Y., R. STEFAN, P. VAN DOOREN, “Real and complex stability radii of polynomial matrices”, *To appear in Linear Algebra and Its Application*, 2001.

In this paper, analytic expressions are derived for the complex and real stability radii of non-monic polynomial matrices with respect to an arbitrary stability region of the complex plane. Numerical issues for computing these radii for different perturbation structures are also considered with application to robust stability of Hurwitz and Schur polynomial matrices.

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”, *To appear in Linear Algebra and its Applications.*, 2001.

An important class of generalized eigenvalue problems $Ax = \lambda Bx$ is those in which A and B are Hermitian and some real linear combination of them is definite. For the quadratic eigenvalue problem (QEP) $(\lambda^2 A + \lambda B + C)x = 0$ with Hermitian A , B and C and positive definite A , particular interest focuses on problems in which $(x^* Bx)^2 - 4(x^* Ax)(x^* Cx)$ is one-signed for all nonzero x . For the positive sign these problems are called hyperbolic and for the negative sign elliptic. The important class of overdamped problem arising in mechanics is a sub-class of the hyperbolic problems. For each of these classes of generalized and quadratic eigenvalue problems we show how to check that a putative member has the required properties and we derive the distance to the nearest problem outside the class. For definite pairs (A, B) the distance is the Crawford number, and we derive a bisection algorithm both for testing its positivity and for computing it. Testing hyperbolicity of a QEP is shown to reduce to testing a related pair for definiteness. The distance to the nearest non-hyperbolic or non-elliptic $n \times n$ QEP is shown to be the solution of a global minimization problem with $n - 1$ degrees of freedom. Numerical results are given to illustrate the theory and algorithms.

GALIVAN K., A. VANDENDORPE, P. VAN DOOREN, “Sylvester equations and projection-based model reduction”, *Submitted to JCAM Journal (Elsevier Science)*, 2001.

In this paper we establish a connection between Krylov subspace techniques for Multipoint Pade interpolation, and the use of Sylvester equations for constructing reduced order models. We also briefly point out that this connection partly extends to ADI-type techniques and to the Smith iteration for computing approximate solutions of Lyapunov equations.

IONESCU V., R. STEFAN, “Generalized time-varying Riccati theory : A Popov operator based approach”, *Accepted in Integral Equations and Operator Theory*, 2001. The main goal of this paper is to give necessary and sufficient conditions for the existence of the stabilizing solution to the differential Riccati equation, with indefinite sign quadratic term. The key object of the present approach is the Popov operator, associated with a controlled exponentially dichotomic evolution and a quadratic cost. Special attention is paid to the classical positivity theory and a time-varying version of the celebrated Kalman-Yakubovich-Popov Lemma is given under relaxed assumptions.

LAWRENCE C.T., A.L. TITS, P. VAN DOOREN , “A fast algorithm for the computation of an upper bound on the m-norm”, *Automatica*, vol. 36, pp. 449-456, 2000

A fast algorithm for the computation of the optimally frequency-dependent scaled H_∞ norm of a finite-dimensional LTI system is presented. It is well known that this quantity is an

upper bound to the " μ -norm"; furthermore, it was recently shown to play a special role in the context of slowly time-varying uncertainty. Numerical experimentation suggests that the algorithm generally converges quadratically.

MICHIELS, K. ENGELBORGH, D. ROOSE, D. DOCHAIN, "Sensitivity to infinitesimal delays in neutral equations", *SIAM J. Control & Optimization*, 2001.

The stability of a steady state solution of a neutral functional differential equation can be sensitive to infinitesimal changes in the delays. This phenomenon is caused by the behavior of the essential spectrum and is determined by the roots of an exponential polynomial. Avellar and Hale [J. Math. Anal. Appl., 73 (1980), pp. 434-452] have considered the case of multiple fixed and nonzero delays. In the first part of this paper their results are illustrated by means of spectral plots. In the second part we extend the theory of Avellar and Hale to the limit case where some of the delays are brought to zero, which may lead to characteristic roots with arbitrarily large real part. Necessary and sufficient conditions are provided. Using these results we show that the ratio of the delays plays a crucial role when several delays tend to zero simultaneously. As an illustration of the theory, we analyze the robustness of a boundary controlled PDE in the presence of a small feedback delay.

STEFAN R., "A note on state-space properties of discrete-time (J, J') -contractive systems", *Submitted to the European Journal of Control*, 2001.

Based on some extensions of Popov's positivity theory an appropriate version of the Bounded Real Lemma for both (J, J') -contractive and (J, J') -lossless discrete time system is obtained. The technical machinery is instrumented via the Kalman-Szego-Popov-Yakubovich system.

XU S., P. VAN DOOREN, R. STEFAN, J. LAM, "Robust stability and stabilization for singular systems with state delay and parameter uncertainty", *Accepted in IEEE Transactions on Automatic Control*, 2001.

This paper considers the problems of robust stability and stabilization for uncertain continuous singular systems with state delay. The parametric uncertainty is assumed to be norm-bounded. The purpose of the robust stability problem is to give conditions such that the uncertain singular system is regular, impulse free and stable for all admissible uncertainties, while the purpose of robust stabilization is to design a state feedback control law such that the resulting closed-loop is robustly stable. These problems are solved via the notions of generalized quadratic stability and generalized quadratic stabilization, respectively. Necessary and sufficient conditions for generalized quadratic stability and generalized quadratic stabilization are derived. A strict linear matrix inequality (LMI) design approach is developed. An explicit expression for the desired robust state feedback control law is also given. Finally, a numerical example is provided to demonstrate the

application of the proposed method.

1.3 Linear control systems

FILALI S., V. WERTZ, "Using genetic algorithms to optimize the design parameters of generalized predictive controllers", *International Journal of Systems Science*, vol. 32, no 4, pp. 503-512, 2001."

Generalized predictive control algorithms are a powerful control design method widely applied to industrial processes. However, there is no easy way to tune the design parameters, mainly prediction and control horizons, in order to achieve optimal performance. In this work, a genetic algorithm is proposed whose aim is to find on line the optimal values for the tuning parameters.

GEVERS M., "A Decade of Progress in Iterative Process Control Design : from Theory to Practice", *Accepted in Journal of Process Control* , 2001.

One of the most active areas of research in the nineties has been the study of the interplay between system identification and robust control design. It has led to the development of "control-oriented identification design", the paradigm being that, since the model is only a tool for the design of a controller, its accuracy (or its error distribution) must be tuned towards the control design objective. This observation has led to the concept of "iterative identification and control design" and, subsequently, to model-free iterative controller design, in which the controller parameters are iteratively tuned on the basis of successive experiments performed on the real plant, leading to better and better closed loop behaviour. These iterative methods have found immediate applications in industry; they have also been applied to the optimal tuning of PID controllers. This paper presents the progress that has been accomplished in iterative process control design over the last decade. It is illustrated with some application in the chemical industry.

GOREZ R., "Revisiting the Routh-Hurwitz stability criterion", *Submitted to European Journal of Control*

Since any polynomial with real coefficients may be associated to a L-C electrical network or to a mass-spring mechanical system, the Routh-Hurwitz stability criterion can be stated with a rigorous proof based on Lyapunov-Chetaev stability-instability theorems, as also with a plain physically intuitive argument.

GOREZ R., P. KLAN, "Nova metoda nastavovani PI regulatory "[A new approach to tuning of PI controllers], *AUTOMA*, Vol. 4, pp. 49-53, 2000

A new method for tuning of PI controllers is designed in this paper. The tuning method is based on a balance between proportional and integral actions. Such controllers are well

responded to both reference changes and disturbances.

GOREZ R., "A comparative analysis of design relations for PID controllers", *Submitted to Control Eng. Practice*, 2001.

This paper presents a comparative analysis of different design relations for PID or PI control of self-regulating processes. Well-known Ziegler-Nichols-, Chien-Hrones-Reswick-, and Cohen-Coon relations are considered, as also more recent relations derived by Astrom and Haggelund and new relations proposed by the author for 2-DOF controllers. The analysis is based on plots of the controller parameters and of the maximum sensitivity of the control loop as functions of the normalized dead time of the process to be controlled, and on closed-loop step responses to changes in the controller setpoint or to disturbances. It turns out that the new design relations proposed by the author guarantee that the maximum sensitivity of the control loop is closed to the desired value (used as tuning parameter), and that they provide a good rejection of disturbances and smooth step responses with almost constant controller output, hence preserving the main dynamics of the process.

KLAN P., R. GOREZ, "Balanced tuning of PI Controllers", *European Journal of Control (EJC)*, vol.6, no 6, pp. 541-550, 2001.

This paper proposes that PI controllers should be tuned with balanced proportional and integral actions. The tuning method involves the achievement of a critically damped control loop and/or the minimization of an extended Integral-Time-Absolute-Error (ITAE) criterion. As shown by simulation results on a batch of test processes, balanced tuning provides a robust control loop with good gain margin and smooth responses with almost no overshoot. The tuning method is model-free and can be used in an iterative closed-loop procedure; a simple tuning algorithm is proposed.

LEQUIN O., M. GEVERS, M. MOSSBERG, E. BOSMANS, L. TRIEST, "Iterative Feedback Tuning of PID parameters : comparison with classical tuning rules", *Submitted to Control Engineering Practice*, 2001.

We apply the Iterative Feedback Tuning (IFT) method to the tuning of PID parameters in applications where the objective is to achieve a fast response to set point changes. We compare the performance of these IFT-tuned PID controllers with the performance achieved by four classical PID tuning schemes that are widely used in industry. Our simulations show the dramatic improvements achieved with the IFT method over these four other methods : faster settling time and less overshoot. The IFT method used here is a variant of the initial IFT scheme, in which no weighting is applied to the control error during a time window that corresponds to the transient response, and where the length of this window is progressively reduced. This method was initially proposed in (Lequin, 1997), and elaborated on in (Lequin et al., 1999).

WILKIE J., P. KLAN, F. SMRCEK, L. KREJCI, R. GOREZ, “The development of a versatile low-cost controller”, *The Institute of Measurement and Control*, vol. 33 no 5, pp. 147-150, June, 2000.

This article has described the development of a compact digital controller. The move from analogue to digital permitted greater functionality within the one controller. A modular software design has permitted greater flexibility and functionality to be offered by the customer. The simple method of configuration using the programming tables has contributed to the ease of use and ready acceptance in industry. Today the controller is being used successfully in a variety of process control applications.

XU S., J. LAM, L. ZHANG, “Robust D-Stability Analysis for Uncertain Discrete Singular Systems with State Delay”, *Accepted to IEEE Transactions on Circuits and Systems I : Fundamental Theory and Applications.*, 2001.

This paper investigates the problem of robust D-stability analysis for uncertain discrete singular systems with state delay and structured uncertainties. Sufficient conditions are developed to ensure that, when the nominal discrete singular delay system is regular, causal and all its finite poles are located within a specified disk, the uncertain system still preserves all these properties when structured uncertainties are added into the nominal system. A computationally simple approach is proposed and a numerical example is given to demonstrate the application of the proposed method.

1.4 Complexity of dynamical systems

BLONDEL V., J. CASSAIGNE, C. NICHITIU, “On the presence of periodic configurations in Turing machines and in counter machines”, *To appear in Theoretical Computer Science*.

A configuration of a Turing machine is given by a tape content together with a particular state of the machine. Petr Kůrka has conjectured that every Turing machine – when seen as a dynamical system on the space of its configurations – has at least one periodic orbit. In this paper, we provide an explicit counter-example to this conjecture. We also consider counter machines and prove that, in this case, the problem of determining if a given machine has a periodic orbit in configuration space is undecidable.

BLONDEL V., V. CANTERINI, “Undecidable problems for probabilistic automata of fixed dimension”, *Submitted to J. of Theory of Computing Systems*, 2001.

We prove the several problems associated to probabilistic finite automata are undecidable for automata whose number of input letters and number of states are fixed. As a corollary of one of our results we prove that the problem of determining if the set of all products of

two 47×47 matrices with nonnegative rational entries is bounded is undecidable.

1.5 Computational rheology

ATALIK K., R. KEUNINGS, “Non linear temporal stability analysis of viscoelastic plane channel flows using a fully-spectral method”, *Accepted in J. Non-Newt. Fluid Mech*, 2001.

A non-linear analysis of the temporal evolution of finite, two-dimensional disturbances is conducted for plane Poiseuille and Couette flows of viscoelastic fluids. A fully-spectral method of solution is used with a stream-function formulation of the problem. The upper-convected Maxwell (UCM), Oldroyd-B and Giesekus models are considered. The bifurcation of solutions for increasing elasticity is investigated both in the high and low Reynolds number regimes. The transition mechanism is discussed in terms of both the transient linear growth of misfit disturbances due to non-normality, and their possible saturation into finite-amplitude periodic solutions due to non-linear effects.

GROSSO M. , P.L. MAFFETTONE, P. HALIN, R. KEUNINGS, V. LEGAT, “The Flow of Nematic Polymers in an Eccentric Cylinder Geometry: The Influence of Closure Approximations”, *J. Non-Newt. Fluid Mech.*, Vol. 94, pp. 119-134, 2000.

The start-up flow of a nematic rodlike polymer in an eccentric cylinder geometry is studied on the basis of the rigid rod model. The simulations neglect the polymer stress contribution in the momentum equation. The nematic configuration is obtained by integrating the diffusion equation for the orientational distribution function with a Galerkin approach. The predictions are compared with results obtained by introducing different closure approximations. Both a quadratic and a Bingham closure are considered. The comparison shows that the approximations have a qualitative impact on the results.

GROSSO M., R. KEUNINGS, S. CRESCITELLI, P.L. MAFFETTONE, “Prediction of Chaotic Dynamics in Sheared Liquid Crystalline Polymers”, *Physical Review letters* , Vol. 86, no 14, pp. 3184-3187, 2001.”

A rheological model for rodlike polymers in the nematic liquid crystalline phase is analyzed to characterize irregular dynamical response under pure shear flows. The model is studied with a continuation approach, and a period doubling scenario is detected. Time series generated via simulation are studied with nonlinear analysis tools that prove the existence of chaotic regime.

LEYGUE A., A.N. BERIS, R. KEUNINGS, “A constitutive equation for entangled linear polymer inspired by reptation theory and consistent with non-equilibrium thermodynamics”, *J. Non-Newt. Fluid Mech*, vol. 101, pp. 95-111, 2001. Using the single generator

bracket formalism of non-equilibrium thermodynamics, we build a thermodynamically consistent constitutive equation of the differential type for linear entangled polymers. The starting point of our developments is the MGI rheological model proposed recently by Marrucci et al. [*Rheol. Acta* 40 (2) (2001) 98], which can be viewed as a modification of the classical Doi-Edwards reptation theory that includes convective constraint release and a modified strain measure. The proposed constitutive equation has an additional parameter which governs the dissipative part of the model. The MGI model is recovered as a particular case, but with a stress-conformation relationship which contains an additional term suggested by non-equilibrium thermodynamics. Predictions of the proposed model in steady and transient shear flows are shown to be in qualitative agreement with experimental observations.

PARMENTIER P., G. LEBON, V. REGNIER, “Weakly nonlinear analysis of BÈnard-Marangoni instability in viscoelastic fluids”, *Journal of Non-Newtonian Fluid Mechanics*, Vol. 89, pp. 63-95, 2000.

The coupled thermogravitational and thermocapillary instability in a thin fluid layer of a viscoelastic medium heated from below is investigated. A linear and a weakly nonlinear analysis are successively presented. The viscoelastic medium is modelled by means of a general rheological model including the lower convected, the upper convected, and the co-rotational Jeffreys models as particular cases. In comparison with previous analyses, two new dimensionless numbers are introduced, namely the so-called gravitational and rate of heating numbers instead of the classical Rayleigh and Marangoni numbers. The critical values for the temperature gradient, wave number and oscillation frequencies corresponding to the onset of convection are determined from a linear approach. After motion has set in, particular patterns are predicted taking the form of either rolls, or hexagon, or squares. By means of a nonlinear technique, restricted to steady situations, it is determined under which specific conditions one pattern is preferred. The influence of the constitutive equation, the Prandtl and the Biot numbers is examined and discussed in details.

VAN RUYMEBEKE E., R. KEUNINGS, V. STEPHENNE, A. HAGENAARS, C. BAILLY, “Evaluation of Reptation Models for Predicting the Linear Viscoelastic Properties of Entangled Linear Polymers”, *Submitted for publication in Macromolecules*, 2001.

The ability of reptation theories to quantitatively predict the linear viscoelastic response of linear polymer melts is systematically tested for various combinations of almost monodisperse, bidisperse and polydisperse polystyrene (PS), high density polyethylene (PE) and polycarbonate (PC) samples. Broad industrial HDPE and PC samples have been fractionated according to molar weight by preparative methods. The experimental master-curves for dynamic moduli G' and G'' are compared with predictions obtained from the

experimentally determined molecular weight distribution (MWD) (by size exclusion chromatography) with the help of reptation models proposed in the literature. We focus on the Doi and Edwards relaxation function, with and without fluctuation effects, and the des Cloizeaux Time Dependent Diffusion relation function. These relaxation functions are combined with double reptation. We conclude that the des Cloizeaux relaxation function, associated with the double reptation model, gives the best results for well entangled polymers, which are in quantitative agreement with experimental data. Indeed, it is the only model which is able to correctly predict the intermediate region between reptation relaxation and Rouse relaxation. We study the influence of short chains (slightly longer than the critical molecular weight) on the relaxation moduli of blends with long chains. We conclude that the model predicts that the chains smaller than 4 Me relax too quickly in comparison with the experimental data. After a modification of the model, quantitative predictions are also obtained.

WAPPEROM P., R. KEUNINGS, "Simulation of linear polymer melts in transient complex flow", *J. Non-Newtonian Fluid Mechanics*, Vol. 95, pp. 67-83, 2000.

Recently, much progress has been made in improving the modelling of linear polymer melts with the aid of reptation theory. In simple shear flows, this has resulted in a much better prediction of the shear viscosity and normal stress ratio. Here, we evaluate in complex flows the transient and steady-state behaviour of a recently proposed model, the Marrucci-Greco-Ianniruberto model (*Rheol. Acta*, in press, 2000), that includes convective constraint release and a force balance on the entanglement nodes. To incorporate integral type models into the numerical framework of Lagrangian particle methods, which we have developed previously to simulate dilute polymer solutions, we have included the so-called deformation field method. For the contraction/expansion flow that we consider, we find that a correction of the convective constraint release contribution to the relaxation time is necessary to avoid the unphysical situation of negative relaxation times. With this correction, we could obtain mesh and time convergence for high Weissenberg numbers without adding any solvent viscosity. We find also that, in complex flow, both the steady-state and transient responses of the integral model can be very well approximated by a constitutive equation of differential type. Due to the dominance of the strong thinning in both shear and elongational flow for the model, however, the inelastic Carreau-Yasuda model reproduces the steady-state kinematics and pressure drop as well.

WAPPEROM P., R. KEUNINGS, "Numerical simulation of branched polymer melts in transient complex flow using pom-pom models", *Journal of Non-Newtonian Fluid Mechanics*, Vol. 97, 267-281, 2001." In recent years, a number of constitutive equations have

been derived from reptation theory to describe the rheology of both linear and branched polymer melts. While their predictions in rheometrical flows have been discussed in detail, not much is known of their behaviour in complex flows. In the present paper, we study by way of numerical simulation the transient, start-up flow of branched polymers through a planar contraction/expansion geometry. The constitutive equation is the so-

called pom-pom model introduced by McLeish and Larson (Molecular constitutive equations for a class of branched polymers : The pom-pom polymer, and later modified by Blackwell et al (Molecular drag-strain coupling in branched polymer melts. *J. Rheology*). By combining the Backward-tracking Lagrangian Particle and deformation Field methods, we obtain results for the original, integral pom-pom model which makes use of the Doi-Edwards orientation tensor. Two simplified versions of the pom-pom model are also considered, namely one based on the Curie approximation for the orientation tensor, and a differential constitutive equation. Finally, the simulation results are compared to those obtained with the so-called MGI model proposed recently by Marrucci et al. (Integral and differential constitutive equations for entangled polymers with simple version of CCR and force balance on entanglements. *Rheol. Acta* 2000) for describing linear polymer melts.

1.6 Numerical simulation of fluids and flows

H. JEANMART, WINCKELMANS G.S., “VLES of aircraft wake vortices in a turbulent atmosphere: a study of decay”, *Submitted to Int. J. Numerical Methods in Fluids*, 2001. Very Large-Eddy Simulations (VLES) of generic aircraft wake vortices in various atmo-

spheric turbulence conditions are carried out, using a dealiased pseudo-spectral method. The background atmospheric turbulence is here assumed isotropic; its level is characterized by the eddy dissipation rate, which ranges from very strong to weak. Two LES approaches are used. Most simulations were done using regular explicit filtering (here gaussian) added to the necessary LES truncation filtering, and a dynamic mixed model: the tensor-diffusivity model supplemented by a dynamic Smagorinsky term. As a point of comparison, some simulations were also done using the classical dynamic Smagorinsky model (thus LES without regular explicit filtering; truncation only). Initially, the wake vortices are assumed to follow the “universal” circulation profile shortly after rollout. The vortex global circulation is monitored as main diagnostic. Its decay is found to exhibit a similar behaviour in all cases, and for both LES models, leading to the exponential decay model with a time constant that scales on the background energy dissipation rate. The present model differs from others by the presence of a time delay before the exponential decay: this delay is related to the time required for the appearance of transverse vortex structures along the stretching regions of the vortex wake oval: the decay is due to the interaction of these structures with the primary vortices. The constant in the exponential decay model is also found to be quite different from that proposed in the literature. This lack of agreement is mostly explained by the differences in the definitions of vortex circulation.

LEGRAND S., V. LEGAT, E. DELEERSNIJDER, “Delaunay Mesh Generation for an Unstructured Grid Ocean General Circulation Model”, *Submitted to Ocean Modelling* An

incremental method is presented to generate automatically boundary-fitted Delaunay triangulations of the global ocean. The method takes into account Earth curvature and allows local mesh refinement in order to resolve topological or dynamical features like midocean ridges or western boundary currents. Crucial issues like the nodes insertion process, the boundary integrity problem or the creation of inner nodes are explained. Finally, the quality of generated triangulations is discussed.

PLOUMHANS P., G.S. WINCKELMANS, J.K. SALMON, A. LEONARD, M.S. WARREN, “Vortex methods for high-resolution simulation of three-dimensional bluff body flows; Application to the sphere at $Re = 300, 500$ and 1000 ”, *to appear in J. Comput. Phys.*, 2001.

Recent contributions to the 3-D vortex methods are presented. Following Cottet, the particles strength exchange (PSE) scheme for diffusion is modified in the vicinity of solid boundaries to avoid a spurious vorticity flux and to enforce a zero normal component of vorticity during the convection/PSE step. The vortex sheet algorithm used to enforce the no-slip boundary condition through a vorticity flux at the boundary, and the technique to perform accurate redistributions in the presence of bodies of general geometry, are extended from their 2-D counterpart. To perform simulations with non-uniform resolution, a mapping of the redistribution lattice is used. Computational efficiency is attained through the use of parallel tree codes based on multipole expansions of vortex particles and of vortex panels. The method is validated, by comparisons with other authors’ results, on the flow past a sphere at $Re = 300$. It is then applied to compute the flow at $Re = 500$ and $Re = 1000$.

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”, *Brief Comm. to appear in Phys.Fluids*, 2001.

The relation between the Reynolds stresses from experiment or direct numerical simulation (DNS) and large-eddy simulation (LES) is reviewed. As is well known, the Reynolds stresses can only be reconstructed from a LES when the average contribution from the subgrid-scale model is taken into account. However, in the case of LES using traceless models (e.g., effective viscosity models: Smagorinsky model, dynamic Smagorinsky model, etc.), or even partially traceless models (e.g., mixed models), only the deviatoric Reynolds stresses can be reconstructed. This obvious point is often overlooked in the literature. It has important consequences in all flows with at least one inhomogeneous direction (channels, boundary layers, wakes, shear layers, jets, etc): as far as the rms turbulence intensities are concerned, one can only properly reconstruct, and thus directly

compare with experimental or DNS data, their deviation from isotropy.

WINCKELMANS G.S., A. VRAY, O.V. VASILYEV, H. JEANMART, “Explicit-filtering large-eddy simulation using the tensor-diffusivity model supplemented by a dynamic Smagorinsky term”, *Phys. Fluids*, Vol. 13(5), pp. 1385-1403, 2001.

Large-Eddy Simulation (LES) with regular explicit filtering is investigated. The filtered-scale stress due to the explicit filtering is here partially reconstructed using the tensor-diffusivity model: it provides for backscatter along the stretching direction(s), and for global dissipation, both also attributes of the exact filtered-scale stress. The necessary LES truncations (grid and numerical method) are responsible for an additional subgrid-scale stress. A natural mixed model is then the tensor-diffusivity model supplemented by a dynamic Smagorinsky term. This model is reviewed, together with useful connections to other models, and is tested against Direct Numerical Simulation (DNS) of turbulent isotropic decay starting with $Re_\lambda = 90$ (thus moderate Reynolds number): LES started from a 256^3 DNS truncated to 64^3 and Gaussian filtered. The tensor-diffusivity part is first tested alone; the mixed model is tested next. Diagnostics include energy decay, entropy decay and energy spectra. After an initial transient of the dynamic procedure (observed with all models), the mixed model is found to produce good results. However, despite expectations based on favorable a priori tests, the results are similar to those obtained when using the dynamic Smagorinsky model alone in LES without explicit filtering. Nevertheless, the dynamic mixed model appears as a good compromise between partial reconstruction of the filtered-scale stress and modelling of the truncations effects (incomplete reconstruction and subgrid-scale effects). More challenging 48^3 LES are also done: again, the results of both approaches are found to be similar. The dynamic mixed model is also tested on the turbulent channel flow at $Re_\tau = 395$. The tensor-diffusivity part must be damped close to the wall in order to avoid instabilities. Diagnostics are mean profiles of velocity, stress, dissipation, and reconstructed Reynolds stresses. The velocity profile obtained using the damped dynamic mixed model is slightly better than that obtained using the dynamic Smagorinsky model without explicit filtering. The damping used so far is however crude, and this calls for further work.

1.7 System identification

BOMBOIS X, B.D.O. ANDERSON, M. GEVERS, “Insights on the relation between a set of linearly parametrized transfer functions and its images in the Nyquist plane”, *Submitted to SIAM J. Control and Optimization*, 2001.

This paper considers linearly parametrized plants whose parameters are normally distributed and addresses the problem of analyzing the image in the Nyquist plane of a set of these plants defined by a confidence ellipsoid in the parameter space. The image in the Nyquist plane of such a set of plants is made up of ellipses at each frequency. However,

these two types of representation do not contain the same information. We show indeed the probability level for the frequency domain set is generally larger than the probability for the parametric set. Moreover, in the classical case of systems parametrized with FIR or Laguerre basis functions, we show that it is impossible to recover the initial ellipsoid in parameter space from the ellipses in the Nyquist plane. The first phenomenon is due to the fact that the mapping between parametric and frequency domain spaces is not bijective and the second is due to the intrinsic properties of the considered basis functions.

DAVID B., G. BASTIN, "Parameter Estimation in Nonlinear Systems with Auto and Crosscorrelated Noise", *Submitted to Automatica*.

The Gohberg-Heinig explicit formula for the inversion of a block-Toeplitz matrix is used to build an estimator of the inverse of the covariance matrix of a multivariable autoregressive process. This estimator is then conveniently applied to maximum likelihood parameter estimation in nonlinear dynamical systems with output measurements corrupted by additive auto and crosscorrelated noise. An appealing computational simplification is obtained due to the particular form taken by the Gohberg-Heinig formula. The efficiency of the obtained estimation scheme is illustrated via Monte-Carlo simulations and compared with an alternative that is obtained by extending a classical technique of linear system identification to the framework of this paper. These simulations show that the proposed method improves significantly the statistical properties of the estimator in comparison with classical methods. Finally, the ability of the method to provide, in a straightforward way, an accurate confidence region around the estimated parameters is also illustrated.

LENDASSE A., J. LEE, E. DE BODT, V. WERTZ, M. VERLEYSSEN, "Forecasting electricity consumption using nonlinear projection and self-organizing maps", *Submitted to Neurocomputing*

A general-purpose useful parameter in time series forecasting is the regressor size, corresponding to the minimum number of variables necessary to forecast the future values of the time series. If the models are nonlinear, the choice of this regressor becomes very difficult. We present a quasi-automatic method using a nonlinear projection named Curvilinear Component Analysis to build this regressor. The size of this regressor will be determined by the estimation of the intrinsic dimension of an over-sized regressor. This method will be applied to electric consumption of Poland using systematic cross-validation. The nonlinear model used for the prediction is a Kohonen map (self-organizing map).

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", *Submitted to European Journal of Economic and Social Systems*, 2001.

Prediction of financial time series using artificial neural networks has been the subject of many publications, even if the predictability of financial series remains a subject of

scientific debate in the financial literature. Facing this difficulty, analysts often consider a large number of exogenous indicators, which makes the fitting of neural networks extremely difficult. In this paper, we analyze how to aggregate a large number of indicators in a smaller number using -possibly nonlinear- projection methods. Nonlinear projection methods are shown to be equivalent to the linear Principal Component Analysis when the prediction tool used on the new variables is linear. Furthermore, the computation of the nonlinear projection gives an objective way to evaluate the number of resulting indicators needed for the prediction. Finally, the advantages of nonlinear projection could be further exploited by using a subsequent nonlinear prediction model. The methodology developed in the paper is validated on data from the BEL20 market index, using systematic cross-validation results.

VAN GESTEL T., J. SUYKENS, P. VAN DOOREN, B. DE MOOR, "Identification of Stable Models in Subspace Identification by using Regularization", *IEEE on Automatic Control*, vol. 46, no 9, pp. 1416 - 1420, 2001.

In subspace methods for system identification, the system matrices are usually estimated by least squares, based on estimated Kalman filter state sequences and the observed inputs and outputs. It is well known that for an infinite amount of data and a correct choice of the system order, this least squares estimate of the system matrices is unbiased. However, for a finite amount of data, the estimated system matrix can become unstable, for a given deterministic system which is known to be stable. In this paper, stability is obtained by adding a regularization term to the least squares cost function. The regularization term used here is the trace of a matrix which involves the dynamical system matrix and a positive (semi-)definite weighting matrix. The amount of regularization needed can be determined by solving a generalized eigenvalue problem. It is shown that the so-called data augmentation method proposed by Chui and Maciejowski corresponds to adding regularization terms with specific choices for the weighting matrix.

1.8 Fuzzy systems for modelling and optimization

HADJILI M., V. WERTZ, G. SCORLETTI, "Local and global state-feedback control design for Takagi-Sugeno fuzzy systems", *Submitted to International Journal of Control*, 2001.

In this paper we consider the state-feedback control of Takagi-Sugeno (TS) fuzzy systems. TS fuzzy models are represented by a set of affine local models. Hence, model-based control techniques can be used based on the local models. To design stabilizing controllers using Lyapunov approach, four alternative approaches will be considered:

i) global controller based on global Lyapunov function, ii) local controllers based on global Lyapunov function, iii) global controller based on local Lyapunov functions, iv) local controllers based on local Lyapunov functions.

All these strategies will be presented and their performance will be compared.

HADJILI M., V. WERTZ, “Takagi-Sugeno fuzzy modeling incorporating input variables selection”, *Submitted to IEEE Transactions on Fuzzy systems* Fuzzy models especially

Takagi-Sugeno (TS) fuzzy models have received particular attention in the area of nonlinear modeling due to their capability to approximate any nonlinear behaviour. Based only on measured data without any prior knowledge, there is no systematic way to obtain a TS fuzzy model with a simple structure and sufficient accuracy. The main idea discussed in this paper is to reduce the complexity of TS fuzzy models by estimating an optimal number of fuzzy rules and selecting relevant inputs as antecedent variables independently of the selection of consequent regressors. A systematic procedure is proposed here and illustrated on static and dynamical nonlinear systems.

STANCIULESCU C., M. INSTALLÈ, V. WERTZ, “Robustness of solutions and risk assessment in multiobjective fuzzy linear programming problems”, *Submitted to “Fuzzy sets and Systems”*

Decision-making involving multiple objectives is one of the important daily human activities. Real decision problems often take place in an uncertain environment. A suitable way to consider this uncertainty is to use fuzzy logic concepts. This paper presents a methodology to propose robust solutions to a multiobjective decision-making process under risk, associating fuzzy logic concepts to optimization concepts within a mathematical programming approach. Thus a multiobjective fuzzy linear programming problem with fuzzy coefficients for the objectives and the constraints is considered. First, the robustness of the problem solutions with respect to the uncertainty of the objectives’ coefficients is taken into account. Then, two types of risk associated to a particular solution of the fuzzy problem are considered: the risk related to the fuzzy objectives’ values and the risk related to the violation of the fuzzy constraints. Numerical examples are presented as illustrations.

STANCIULESCU C., PH. FORTEMPS, M. INSTALLE, V. WERTZ, “Multiobjective fuzzy linear programming problems with fuzzy decision variables”, *Submitted to European Journal of Operational Research*

In this paper, a multiobjective decision-making process is modeled by a multiobjective fuzzy linear programming problem with fuzzy coefficients for the objectives and the constraints. Moreover, the decision variables are linked together because they have to sum up to a constant. Most of the time, the solutions of a multiobjective fuzzy linear programming problem are compelled to be crisp values. Thus the fuzzy aspect of the decision is partly lost and the decision-making process is constrained to crisp decisions. We propose a method that uses fuzzy decision variables with a joint membership function instead of crisp decision variables. First, we consider lower-bounded fuzzy decision variables that set up the lower bounds of the decision variables. Then, the method is generalized to

lower-upper-bounded fuzzy decision variables that set up also the upper bounds of the decision variables. The results are closely related to the special type of problem we are coping with, since we embed a sum constraint in the joint membership function of the fuzzy decision variables. Numerical examples are presented in order to illustrate our method.

1.9 Nonlinear control design

GROGNARD F., G. BASTIN, R. SEPULCHRE, L. PRALY, “Nested linear low gain design for semiglobal stabilization of feedforward systems”, *Journal A*, Vol. 41(2), pp. 35 - 40, 2000

We show the semiglobal stabilization of a large class of feedforward nonlinear system is achieved by low-gain linear feedback provided that the separation of the gains is sufficient. Particular situations are identified where the tuning of the gains only requires increasing powers of a single parameter

A recursive tuning of independent parameters is necessary in the general case to avoid vanishing regions of attractions.

MOREAU L., D. AEYELS , J. PEUTEMAN, R. SEPULCHRE, “A duality principle for homogeneous vector fields with applications”, *to appear in Systems and Control Letters*, 2001. We introduce a duality principle for homogeneous vector fields. As an application of this duality principle, stability and boundedness results for negative order homogeneous differential equations are obtained, starting from known results for positive order homogeneous differential equations.

MOTTE I., G. CAMPION, “A slow manifold approach for the control of mobile robots not satisfying the kinematic constraints”, *IEEE Trans. on Robotics and Automation* , vol. 16, no 6, pp. 875-879, December, 2000.

Realistic wheeled mobile robots do not satisfy the ideal kinematic constraints because of slipping effects at the wheel/ground contact zones. The slow manifold approach allows us to design feedback control laws taking into account these dynamics and ensuring the tracking error of the closed-loop system to converge towards zero.

SEPULCHRE R., M. ARCAK, A. TEEL, “Trading the stability of finite zeros for global stabilization of nonlinear cascades”, *to appear in IEEE Transaction on Automatic Control*, 2001.

This paper analyzes the stabilizability properties of nonlinear cascades in which a non-minimum phase linear system is interconnected through its output to a stable nonlinear system. It is shown that the instability of the zeros of the linear system can be traded with

the stability of the nonlinear system up to a limit fixed by the growth properties of the cascade interconnection term. Below this limit, global stabilization is achieved by smooth static state feedback. Beyond this limit, various examples illustrate that controllability of the cascade may be lost, making it impossible to achieve large regions of attractions.

XU S., “Robust H^∞ filtering for a class of discrete-time uncertain nonlinear systems with state delay”, *Accepted in IEEE Transactions on Circuits and Systems-I : Fundamental Theory and Applications*, 2001.

This paper investigates the problem of robust H_∞ filtering for a class of discrete-time non linear systems with state delay and norm-bounded parameter uncertainty. The nonlinearities are assumed to satisfy the global Lipschitz conditions and appear in both the state and measured output equations. The problem we address is the design of a nonlinear filter which guarantees the asymptotic stability of the error system and reduces the effect of the noise signals on the filtering error to a prescribed level. A sufficient condition for feasibility is derived in terms of a linear matrix inequality (LMI). An example is provided to demonstrate the applicability of the proposed approach.

1.10 Control of distributed parameter systems

LAABISSI M., M. ACHHAB, J. WINKIN, D. DOCHAIN, “Trajectory analysis of non-isothermal tubular reactor nonlinear models”, *Systems and Control Letters*, 42(3), pp. 169-184, 2001.”

The existence and uniqueness of the state trajectories (temperature and reactant concentration) are analyzed for nonisothermal plug flow and axial dispersion tubular reactor models. It is mainly shown that these trajectories exist on the whole (nonnegative real) time axis and the set of all physically feasible state values is invariant under the dynamics equations. The main nonlinearity in the model originates from the Arrhenius-type kinetics term in the model equations. The analysis essentially uses Lipschitz and dissipativity properties of the nonlinear operator involved in the dynamics and the concept of state trajectory positivity.

LEFEVRE L., D. DOCHAIN, S. FEYO DE AZEVEDO, A. MAGNUS, “Analysis of the Orthogonal Collocation method when applied to the numerical integration of chemical reactor models” , *Computer and Chemical Engineering*, 24(12),pp. 2571-2588, 2001.

In this paper, we analyse some properties of the orthogonal collocation in the context of its use for reducing PDE (Partial Differential Equations) chemical reactor models for numerical simulation and/or control design. The approximation of the first order derivatives are first considered and analyzed with respect to the transfer of the stability properties of the transport component from the PDE model to its approximated ODE (ordinary dif-

ferential equations) model. Then the choice of the collocation points as zero of Jacobi polynomial is analyzed and interpreted as an optimal choice with respect to a weighted norm. Finally some guidelines for the use of orthogonal collocation are proposed and the results are illustrated on a simulation example.

ORLOV Y, D. DOCHAIN, “Discontinuous Controller Design for Distributed parameter Systems with Distributed Sensors and Actuators”, *Submitted for publication to IEEE Transactions on Automatic Control*.

The paper develops discontinuous control methods for minimum phase semilinear infinite-dimensional systems driven in a Hilbert space. Control algorithms presented ensure asymptotic stability, global or local according as state feedback or output feedback is available, as well as robustness of the closed-loop system against external disturbances with the a priori known norm bounds. The theory is applied to stabilization of chemical processes around prespecified steady-state temperature and concentration profiles corresponding to a desired coolant temperature. Two specific cases, a plug flow reactor and an axial dispersion reactor, governed by hyperbolic and parabolic partial differential equations of first and second order, respectively, are under consideration. To achieve a regional temperature feedback stabilization around the desired profiles, with the region of attraction, containing a prescribed set of interest, a component concentration observer is constructed and included into the closed-loop system so that there is no need for measuring the process component concentration which is normally unavailable in practice. Performance issues of the discontinuous feedback design are illustrated in a simulation study of the plug flow reactor.

1.11 Biomedical engineering

DE BROUWER S., D. YUKSEL, G. BLOHM, M. MISSAL, P. LEFEVRE, “What triggers catch-up saccades during visual tracking ?”, *Journal of Neuro Physiology*, vol.87, pp. 1646-1650, 2002.

When tracking moving visual stimuli, primates orient their visual axis by combining two kinds of eye movements, smooth pursuit and saccades, that have very different dynamics. Yet, the mechanisms that govern the decision to switch from one type of eye movement to the other are still poorly understood, even though they could bring a significant contribution to the understanding of how the central nervous system combines different kinds of control strategies to achieve a common motor and sensory goal. In this study, we investigated the oculomotor responses to a large range of different combinations of position error and velocity error during visual tracking of moving stimuli in humans. We found that the oculomotor system uses a prediction of the time at which the eye trajectory will cross the target, defined as the eye crossing time. The eye crossing time, which depends on both position error and velocity error, is the criterion used to switch between smooth and

saccadic pursuit, i.e. to trigger catch-up saccades. On average, for TXE between 40 and 180 ms, no saccade is triggered and target tracking remains purely smooth. Conversely, when TXE becomes smaller than 40 ms or larger than 180 ms, a saccade is triggered after a short latency (around 125 ms).

DE BROUWER S., M. MISSAL, G. BARNES, P. LEFEVRE, "Quantitative analysis of catch-up saccades during sustained pursuit", *Accepted in Journal of Neurophysiology*, In press, 2002.

During visual tracking of a moving stimulus, primates orient their visual axis by combining two very different types of eye movements, smooth pursuit and saccades. The purpose of this paper was to investigate quantitatively the catch-up saccades occurring during sustained pursuit. We used a ramp-step-ramp paradigm to evoke catch-up saccades during sustained pursuit. In general, catch-up saccades followed the unexpected steps in position and velocity of the target. We observed catch-up saccades in the same direction as the smooth eye movement (forward saccades) as well as in the opposite direction (reverse saccades). We made a comparison of the main sequences of forward saccades, reverse saccades and control saccades made to stationary targets. They were all three significantly different from each other and were fully compatible with the hypothesis that the smooth pursuit component is added to the saccadic component during catch-up saccades. A multiple linear regression analysis was performed on the saccadic component to find the parameters determining the amplitude of catch-up saccades. We found that both position error and retinal slip are taken into account in catch-up saccade programming in order to predict the future trajectory of the moving target. We also demonstrated that the saccadic system needs a minimum period of 90 ms for taking into account changes in target trajectory. Finally, we reported a saturation (above 15 deg/s) in the contribution of retinal slip to the amplitude of catch-up saccades.

DE BROUWER S., M. MISSAL, P. LEFEVRE, "The role of retinal slip in the prediction of target motion during smooth and saccadic pursuit", *Journal of Neurophysiology*, Vol. 86, pp. 550-558, 2001.

Visual tracking of moving targets requires the combination of smooth pursuit eye movements with catch-up saccades. In primates, catch-up saccades usually take place only during pursuit initiation because pursuit gain is close to unity. This contrasts with the lower and more variable gain of smooth pursuit in cats, where smooth eye movements are intermingled with catch-up saccades during steady-state pursuit. In this paper, we studied in detail the role of retinal slip in the prediction of target motion during smooth and saccadic pursuit in the cat. We found that the typical pattern of pursuit in the cat was a combination of smooth eye movements with saccades. During smooth pursuit initiation, there was a correlation between peak eye acceleration and target velocity. During pursuit maintenance, eye velocity oscillated at approximately 3 Hz around a steady state value. The average gain of smooth pursuit was 0.5. Trained cats were able to continue pursuing in the absence of a visible target, suggesting a role of the prediction of future target motion

in this species. The analysis of catch-up saccades showed that the smooth pursuit motor command is added to the saccadic command during catch-up saccades and that both position error and retinal slip are taken into account in their programming. The influence of retinal slip on catch-up saccades showed that prediction about future target motion is used in the programming of catch-up saccades. Altogether, these results suggest that pursuit systems in primates and cats are qualitatively similar, with a lower average gain in the cat, and that prediction affects both saccades and smooth eye movements during pursuit.

MISSAL M., A. COIMBRA, P. LEFEVRE, E. OLIVIER, "A quantitative analysis of correlations between eye movements and neural activity in the pretectum", *Accepted in Experimental Brain Research*, in press, 2001.

The study of the saccadic system has focused mainly on neurons active before the beginning of saccades, in order to determine their contribution in movement planning and execution. However, most oculomotor structures contain also neurons whose activity starts only after the onset of saccades, the maximum of their activity sometimes occurring near saccade end. Their characteristics are still largely unknown. We investigated pretectal neurons with saccade-related activity in the alert cat during eye movements towards a moving target. They emitted a high frequency burst of action potentials after the onset of saccades, irrespective of their direction and will be referred to as pretectal saccade-related neurons. The delay between saccade onset and cell activity varied from 17 to 66 ms on average. We found that burst parameters were correlated with the parameters of saccades; the peak eye velocity was correlated with the peak of the spike density function, the saccade amplitude with the number of spikes in the burst and burst duration increased with saccade duration. The activity of six pretectal saccade-related neurons was studied during smooth pursuit at different velocities. A correlation was found between smooth pursuit velocity and average firing rate. A minority of these neurons (2/6) were also visually responsive. Their visual activity was proportional to the difference between eye and target velocity during smooth pursuit (retinal slip). These results indicate that the activity of pretectal saccade-related neurons is correlated with the characteristics of eye movements. This finding is in agreement with the known anatomical projections from premotor regions of the saccadic system to the pretectum.

1.12 Biotechnological processes

BERNARD O., Z. HADJ-SADOK, D. DOCHAIN, A. GENOVESI, J.P. STEYER, "Dynamical model development and parameter identification for an anaerobic wastewater treatment process", *Biotechnology & Bioengineering*, 2001.

This paper deals with the development and the parameter identification of an anaerobic digestion process model. A two-step (acidogenesis-methanization) mass balance model has been considered. The model incorporates electrochemical equilibria in order to include

the alkalinity, which has to play a central role in related monitoring and control strategy of the plant. The identification is based on a set of dynamical experiments designed to cover a wide spectrum of operating conditions that are likely to take place in the practical operation of the plant. A step by step identification procedure to estimate the model parameters is presented. The results of 70 days of experiments in a 1m³ fermenter are then used to validate the model.

BERNARD O., Z. HADJ-SADOK, M. PENGOV, D. DOCHAIN, “Modelling, Monitoring and Control of Anaerobic Digestion processes”, *Journal A*, 41 (3), pp. 82-88, 2001.

This paper presents research results that have performed in the framework of an EEC project whose objective was to design and implement a monitoring and control system for anaerobic digesters. This work includes the development, identification and validation of a dynamical model, and the design and application of monitoring and control strategies. The present paper is devoted to the activities of one research laboratory (CESAME) in the project.

BERNARD O., M. POLIT, Z. HADJ-SADOK, M. PENGOV, DOCHAIN D., M. ESTABEN, P. LABAT, “Advanced monitoring and control of anaerobic wastewater treatment plants : III-Software sensors and controllers for an anaerobic digester””, *Water Science & Technology*, Vol 43(7), pp. 175-182, 2001.

A mass balanced based model representing the dynamical behaviour of anaerobic digester has served as a basis for the design of software sensors for the concentration of inorganic carbon, alkalinity and volatile fatty acids. The predictions of the sensors are close to the actual off-line measurements. The model has also been used to design a model-based adaptive linearizing controller and a fuzzy controller whose objective is to regulate the ratio of the intermediate alkalinity over the total alkalinity below some desired value (0.3) under which the process is assumed to remain in stable conditions and avoid VFA accumulation. Both controllers were calibrated via extensive numerical simulations and implemented. The controllers proved successful in maintaining the ratio of TA over PA below 0.3, even in presence of large variations of the organic load.

KARAMA A., O. BERNARD, J.L. GOUZÈ, A. BENHAMMOU, D. DOCHAIN, “Hybrid Neural Modelling of an Anaerobic Digester with Respect to Biological Constraints”, *Water Science & Technology*, 43 (7), pp. 1-8, 2001.”

An hybrid model for an anaerobic digestion process is proposed. The fermentation is assumed to be performed in two steps, acidogenesis and methanogenesis, by two bacterial populations. The model is based on mass balance equations, and the bacterial growth rates are represented by neural networks. In order to guarantee the biological meaning of the hybrid model (positivity of the concentrations, boundedness, saturation or inhibition of the growth rates) outside the training data set, a method that imposes constraints in the neural network is proposed.

The method is applied to experimental data from a fixed bed reactor.

KARAMA A., O. BERNARD, A. GENOVESI, D. DOCHAIN, A. BENHAMMOU, J.P. STEYER, "Hybrid neural modelling of anaerobic wastewater treatment processes", *Wat. Sci. Technol*, Vol. 43 (1), pp. 43-50, 2001.

This paper presents a hybrid approach for the modelling of an anaerobic digestion process. The hybrid model combines a feedforward network, describing the bacterial kinetics, and the a priori knowledge based on the mass balances of the process components. We have considered an architecture which incorporates the neural network as a static model of unmeasured process parameters (kinetic growth rate) and an integrator for the dynamic representation of the process using a set of dynamic differential equations. The paper contains a description of the neural network component training procedure. The performance of this approach is illustrated with experimental data.

PATARINSKA T., D. DOCHAIN, S. AGATHOS, L. GANOVSKI, "Modelling of continuous microbial cultivation taking into account the memory effects", *Bioprocess Engineering*, Springer Verlag, Vol. 22 pp. 517-527, 2000.

The problem of chemostat dynamics modelling for the purpose of control is considered. The "memory" of the culture is explicitly taken into account. Two possibilities for improving the quality of the proposed modelling approaches are discussed. A general model that accounts for the culture 'memory' by means of different 'memory' functions in the expressions of the specific growth rate and of the specific consumption rate and of the substrate concentration for the yield factor is proposed. The case where the maintenance energy is taken into account is also discussed. Two modifications of the general model (μ -type and S-type) are presented. A zero-order 'memory' function and a δ -function with delay are applied in order to describe the 'memory' effects. Continuous growth of the strain *Saccharomyces cerevisiae* on a glucose limited medium is considered as a case study. Detailed investigations of the variety of models, derived from the general model by applying different 'memory' functions and different assumptions are carried out. The results are compared with those previously reported for the same process. It is shown that a significant improvement in predicting the substrate dynamics (not accompanied by any decrease in the quality of the model with respect to the biomass concentration) could be achieved, involving a first- or second-order polynomial function for the yield factor. It is also shown that the quality of the model mainly depends on the way that 'memory' function is incorporated. The detailed investigations give priority to the μ -type models. In this case past values of both biomass and substrate variables are considered. The time delay models with pure (constant) delay and those which account for the culture 'memory' by zero-order 'memory' function (adaptability parameter) are compared with respect to their utilization for the purpose of model-based control.

SMETS I., G. BASTIN, J. VAN IMPE, "On the stabilization of microbial growth processes with non-monotonic kinetics in fed-batch bioreactors", *Journal A*, Vol. 41(3), pp. 24-28, 2000.

This paper deals with the design of a feedback controller for fed-batch microbial growth processes which forces the substrate concentration C_s to a desired setpoint C_s^* , starting from an arbitrary (initial) substrate concentration and when non-monotonic growth kinetics apply.

This problem is representative for a lot of industrial fermentation processes, with the baker's yeast fermentation as well known example.

It is assumed that the specific growth rate μ is function of the substrate concentration only.

A first approach exploits the availability of on-line measurements of both the substrate and biomass concentrations.

A second approach is based on on-line measurements of the biomass concentration only.

STENELAIRE C., L. LESAGE-MEESSEN, J. ODDOU, O. BERNARD, G. BASTIN, B. COLONNA CECCALDI, M. ASTHER, "Design of a fungal bioprocess for vanillin production from vanillic acid at scalable level by *Pycnoporus cinnabarinus*", *Journal of Bio-science and Bioengineering*, Vol. 89 (3), pp. 223-230, 2000.

The biotechnological process of vanillin production from vanillic acid by *Pycnoporus cinnabarinus* was scaled-up at the laboratory level. Vanillin production was studied in two types of bioreactors, a mechanically agitated and an air-lift bioreactor. In the mechanically agitated bioreactor where vanillin was produced in greater quantities, oxygen availability was studied during the growth and production phases. A maximal aeration rate (90 l/h equivalent to 0.83 volume of air/volume of medium/min or vvm) during the growth phase and a minimal aeration rate (30 l/h equivalent to 0.28 vvm) during the production phase were necessary to increase vanillin production to 1260 mg/l. Vanillic acid bioconversion to vanillin occurred under the conditions of reduced dissolved oxygen concentration, gentle agitation, high carbon dioxide production and low specific growth rate. However, under these conditions, vanillin production was accompanied by a significant amount of methoxyhydroquinone. Vanillin over a concentration of 1000 mg/l was shown to be highly toxic to the growth of *P. cinnabarinus* on agar medium. The application of selective XAD-2 resin led to a reduction of vanillin concentration in the medium, thus limiting its toxicity towards the fungal biomass as well as the formation of unwanted by-products such as methoxyhydroquinone and allowed the concentration of vanillin produced to reach 1575 mg/l.

ZHANG T., M. GUAY, D. DOCHAIN, "Adaptive Extremum Seeking Control of Continuous Stirred Tank Bioreactors", *Submitted to AICHE Journal*, 2001.

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 issued 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.

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, Universite Joseph Fourier Grenoble, Technical University Denmark, University of Naples.

Training and Mobility of Researchers (March 2003)

- *Project title* : European Research Network on Systems Identification (ERNSI) (1998-2002)
- *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.

Training and Mobility of Researchers (1994-2001)

- *Project title* : The ALgebraic Approach to Performance Evaluation of Discrete Event Systems (ALAPEDES).
- *Promoter* : V. Blondel
- *Partners* : Technische Universiteit Delft (The Netherlands), Ecole des Mines (Paris, France), INRIA (Paris, France), Katholieke Universiteit Leuven (Louvain, Belgium), Hewlett-Packard Limited (Bracknell, UK), Université Pierre et Marie Curie (Paris, France), Rijksuniversiteit Groningen (Groningen, The Netherlands).

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 (July 98 - June 2001)

- *Project title* : The integration of computer modelling, mould design and the LIGA process for the micro-injection moulding of plastic parts
- *Promoter* : F. Dupret
- *Partners* : Oxley Developments Ltd (UK, coordinator) - Institut für Mikrotechnik Mainz GMBH (Germany) - Phillips Petroleum Chemicals NV/SA (Belgium).

BRITE-EURAM (January 1998 - June 2002)

- *Project title* : Numerics in Control Network(NICONET)
- *Promoter* : 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 München (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), Université Catholique de Louvain (BE), Ecole des Mines Paris - Armines (FR), Otigrade (SW), Technical University of Lodz (PL).

SOCRATES

- *Project title* : Environmental life-cycle engineering towards 2000
- *Promoter* : M. InstallÈ
- *Partners* : TU Delft, KULeuven, EMParis, NTNU Trondheim, RWTH Aachen, IC London.

RESEARCH & TRAINING NETWORKS (January 2000 - December 2003)

- *Project title* : Knowledge-driven Batch Production. driven batch production (BATCH-PRO).
- *Promoter* : D. Dochain

2.2 Belgian Federal Programmes

Interuniversity Attraction Pole IV/02

CESAME is the pilot team of IUAP IV/02.

- *Project title* : Modelling, Identification, Simulation and Control of Complex Systems.
- *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) -

Interuniversity Attraction Pole IV/06 (1997 - 2001)

- *Project title* : Fundamental Aspects of Hydrodynamic Instabilities in Multiphase and Multicomponent Systems.
- *Promoter* : F. Dupret
- *Partners* : ULB (pilot team), Service de Chimie-Physique E.P. (J.Cl. Legros) - ULG, DÈpartement de Physique, UnitÈ de Thermodynamique des PhÈnomÈnes IrrÈversibles (G. Lebon) - VUB, Dienst Stromingsmechanica (Ch. Hirsch) - UMH, UnitÈ de Chimie GÈnÈrale (J. Platten).

2.3 Regional Programmes

Action de Recherche Concertée ARC 97/02-210 (1997 - 2002)

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

Action de recherche concertée: ARC 95/00-189 (end 2000)

- *Project title* : Spatial localization and temporal distribution of cerebral activities in visual processes.
- *Promoter* : Ph. Lefèvre

CIUF/PIP Programme d'initiative propre

- *Project title*: Modélisation mathématique, optimisation et commande des systèmes (May 1999 - May 2005)
- *Promoter*: V. Wertz
- *Partner*: : Université Chouaib Doukkali d'El Jadida (Maroc), promoter : M. E. Achhab

FNRS, Fonds de la Recherche Fondamentale Collective (FRFC)- Initiative des Chercheurs, and Loterie Nationale (1998 - 2001)

- *Project title*: Modelling of the small scales and of the near-wall phenomena in turbulent flows; application to large-eddy simulations in complex geometries.
- *Promoters* : D. Carati (ULB), G. Winckelmans and V. Legat (UCL).

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

Fonds de la Recherche Fondamentale Collective (FRFC)

- *Project title* : Equipment for a precise measure of eye movements in humans.
- *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)(2001-2002)

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

FNRS (crÈdit aux chercheurs)

- *Project title* : Optimization, theoretical systems and numerical analysis
- *Promoter* : P. Van Dooren
- *Partners* : Y. Nesterov, Y. Genin

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.

2.4 Special Research Fund (UCL)

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

- *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* : Sustainable development indicators for firms : implementation and testing.
- *Promoter* : M. Installé

- *Project title* : Advanced control of nonlinear electromechanical systems.
- *Promoter* : D. Dochain

- *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
- *Promoter* : V. Blondel

- *Project title* : Integrated dynamic simulation of the critical stages in Czochralski growth (october 1998 - september 2000)
- *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

2.5 Industrial Contracts

- **WACKER-SILTRONIC** - Germany (2000 - 2001)
 - *Project title* : Numerical simulation of silicon growth
 - *Promoters* : F. Dupret

- **CAESAR INSTITUTE** - Germany (2000 - 2001)
 - *Project title* : Numerical simulation of silicon growth
 - *Promoter* : F. Dupret

- **SUPER SILICON CONSORTIUM** - Japan (2000)
 - *Project title* : Numerical simulation of 40 cm diameter silicon crystals
 - *Promoter* : F. Dupret

- **KOMATSU** - Japan (2000 - 2001)
 - *Project title* : Numerical simulation of silicon growth
 - *Promoter* : F. Dupret

- **SHIN ET'SU HANDOTAI** - Japan (2000 - 2001)
 - *Project title* : Numerical simulation of silicon growth
 - *Promoter* : F. Dupret

- **mitsubishi materials** - Japan (2000 - 2001)
 - *Project title* : Numerical simulation of silicon growth
 - *Promoter* : F. Dupret

- **NEC** - Japan (2000 - 2001)
 - *Project title* : Numerical simulation of silicon growth
 - *Promoter* : F. Dupret

- **HANYANG UNIVERSITY** - Korea (2000 - 2001)
 - *Project title* : Numerical simulation of silicon growth
 - *Promoter* : F. Dupret

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

- **THERMIBEL : with partial support of the Division GÉNÉrale Technologie, Recherche et Energie (DGTRE), RÉgion Wallonne**
 - *Project title* : Modelling of the mechanical and thermal behavior of thermometric probes. Phase II.
 - *Promoters* : G.Winckelmans and J.-M. Seynhaeve
 - *Collaborator* : H. Jeanmart

- **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. Phases III and IV.
 - *Promoters* : G. Winckelmans, J.-M. Seynhaeve.
 - *Collaborator* : H. Jeanmart

- **SEGAL Industry, Belgium**
 - *Project title* : Study of injector alimentation for galvanized products.
 - *Promoters* : G. Winckelmans and J.-M. Seynhaeve.

- **ELECTRICITE DE FRANCE, EDF**
 - *Project title* : Identification, model and controller reduction for a thermal power plant.
 - *Promoter* : M. Gevers

- **FONDATION ROI BAUDOIN**

- *Project title:* Implementation of decision-aid tools for the management of a small, socially-oriented enterprise.
- *Promoter :* M. Installé

- **SOVITEC** (mars 1999 - mars 2001)

- *Project title :* Modelling and control of glass grinding processes
- *Promoters :* G. Bastin, V. Wertz

- **USINOR-CARLAM**(February 2000 - January 2002)

- *Project title :* Modelling and control of cooling processes in hot rolling mills
- *Promoter :* G. Bastin

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 2000 and 2001

- 00.95 BOMBOIS X., “Connecting prediction error identification and robust control analysis : a new framework”, November 14, 2000.
- 00.96 CODRONS BENOÔT, “Experiment Design Issues in Modelling for Control”, July 6, 2000.
- 01.52 GROGNARD F., “Control of constrained systems : closed-loop, open-loop and hybrid solutions”, October 15, 2001.
- 01.53 DAVID B., “Parameter estimation in nonlinear systems with correlated noise”, November 20, 2001.
- 01.54 STANCIULESCU C., “Multiobjective decision support tools using concepts of fuzzy sets. Applications to sustainable management”, August 30, 2001.
- 01.82 DE BROUWER S., “Experimental study and modeling of the interaction between smooth and saccadic eye movements”, December 10, 2001.
- 01.100 SVETOSLAV N., “ModÈlisation multi-Èchelles de polymÈres semi-cristallins”, *ThÈse de doctorat*, June 22, 2001.
- 01.101 GALLEZ X., “Micro-Macro simulation of the flow of dilute polymer solutions”, December 17, 2001.
- 01.102 PLOUMHANS P., “Simulation of high reynolds number flows past bluff bodies using vortex and boundary element methods”, July 03, 2001.

2 Publications 2000

Book

- 00.116 DOGHRI, I., “Mechanics of deformable solids-linear, nonlinear, analytical and computational aspects”, Springer-Verlag, Berlin, 2000.

Chapters in books

- 98.46 GOREZ R., G. CALCEV, “Passivity and Stability of Fuzzy Control Systems”, *Analytical Issues in Fuzzy control : Synthesis and Analysis*, S. Farinwata, R. Langari and D. Filev, editors, J. Wiley of Sons, New York, Chap 6, pp. 113-144, 2000.

- 98.89 DOCHAIN D., M. PERRIER, “Bioprocess control”, *‘Bioreaction Engineering - Modelling and Control’*, K. Sch,gerl, K.H. Bellgardt (Eds) Springer Verlag, Vol. 5, pp. 145-165, 2000.
- 99.29 VAN DOOREN P., “Gramian Based Model Reduction of large-Scale Dynamical Systems”, *Numerical analysis 1999*, DF Griffiths and G A Watson (Editors), Chapman & Hall,(CRC Statistics and Mathematics (18th Biennial Conference on Numerical Analysis), pp. 231-247, 2000.
- 99.71 BLONDEL V., O. BOURNEZ, P. KOIRAN, J.N. TSITSIKLIS, “The stability of saturated linear dynamical systems is undecidable”, *Theoretical Aspects of Computer Science (STACS 2000)*, H. Reichel, S. Tison (Eds), *Lecture notes in Computer Science*, Heidelberg, Vol. 1770, pp. 479-490, 2000.
- 00.01 LAUB A.J., R.V. PATEL, P. VAN DOOREN, “Numerical and computational issues in linear control and system theory”, *Control System Fundamentals - William S. Levine Eds*, Chap. 21, pp. 403-418, 2000.
- 00.36 WERTZ V., L. MAGNI, G. BASTIN, “Multivariable Nonlinear Control of Cement Mills”, *Progress in Systems and Control Theory*, Vol. 26, pp. 434-447, 2000.
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- 01.34 BROWN J., D. DOCHAIN, M. PERRIER, F. FORBES, “Modal decomposition of a nonlinear tubular reactor model : A control perspective”, *Submitted to 15th IFAC World Congress 2002*, Barcelona, Spain.
- 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”, *Submitted to 15th IFAC World Congress 2002*, Barcelona, Spain.
- 01.36 DE HALLEUX J., G. BASTIN, “Stabilization of St Venant Equations using Riemann Invariants : Application to Waterways with Mobile Spillways”, *Submitted to 15th IFAC World Congress 2002*, Barcelona, Spain.
- 01.37 HACHEZ Y., Y. NESTEROV, “Optimization problems over nonnegative trigonometric polynomials with interpolation constraints”, *15th IFAC World Congress 2002*, Barcelona, Spain.

- 01.38 LENDASSE A., M. COTTRELL, V. WERTZ, M. VERLEYSSEN, “Prediction of Electric Load using Kohonen Maps - Application to the Polish Electricity Consumption”, *Submitted to 2002 American Control Conference (ACC 2002)*, Anchorage, Alaska, USA.
- 01.42 CHAHLAOUI Y., P. VAN DOOREN, “Estimating Gramians of Large-Scale Time-Varying Systems”, *Accepted for IFAC World Congress 2002*, Barcelona, Spain.
- 01.56 GALLIVAN K. , A. VANDENDORPE, P. VAN DOOREN, “On the generality of multi-point PadÈ approximations”, *Accepted for the IFAC World Congress, 2002*, Barcelona.
- 01.71 DAENINCK G., G.S. WINCKELMANS, H. JEANMART, “Efficient vortex methods for the simulation of three-dimensional unsteady vortex wakes”, *Submitted to EUROMECH Colloquium 433 : Dynamics of Trailing Vortices*, RWTH, Aachen, Germany, March 21-22, 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”, *Submitted to IUTAM Symposium on Unsteady Separated Flows* , Toulouse, France, April 8-12, 2002.
- 01.73 JEANMART H., G.S. WINCKELMANS, “Investigation of different approaches and models for subgrid-scale modelling”, *Submitted to EUROMECH 9th European Turbulence Conference (ETC9)*, University of Southampton, U.K., In Press, July 2-5, 2002.
- 01.80 DELATTRE C., D. DOCHAIN, J. WINKIN, “Observability analysis of a nonlinear tubular bioreactor”, *To be presented at MTNS 2002*, Notre Dame, USA.
- 01.83 LEE J.A., A. LENDASSE, M. VERLEYSSEN, “Curvilinear Distance Analysis versus Isomap”, *Submitted at ESANN’02*, Brugge, Belgium, 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”, *Submitted at ESANN’02*, Brugge, Belgium, April 2002.

4 Editorial activities

BASTIN Georges

- Associate Editor “IEEE Transactions on Automatic Control” (1998-2001)
- 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)
- Guest editor of Linear Algebra and its Applications (Elsevier).

DUPRET François

- Member of the Board editorial of the International Journal of Forming processes

GEVERS Michel

- Associate Editor of Mathematics of Control, Signals and Systems
- Editor at Large of the European Journal of Control

KEUNINGS Roland

- Associate Editor of the Journal of Non-Newtonian Fluid Mechanics (since 2001).

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

4. TEACHING

1 Undergraduate and Graduate Teaching

1.1 Applied Mathematics

Numerical Methods

(R. Keunings, A. Laloux)

Mathematics

(F. Dupret, M. Duhoux, K. Peiffer, J.P. Vandeuren, E. Vitale, V. Wertz)

Automatic Control : theory and implementation

(M. Gevers, V. Wertz)

Applied Mathematics

(R. Gorez, A. Laloux)

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

(P. Van Dooren, 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. Campion, J. Govaerts, J.C. Samin, P. Willems)

Physics II - Mechanics

(G. Campion, 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)

1.3 Systems and Control

Automatic Control : Fundamentals

(G. Bastin, D. Dochain)

Linear circuits and systems theory

(M. Installé)

Adaptive systems

(M. Installé)

Systems analysis applied to agriculture and environment

(M. Installé)

Control theory and optimization

(V. Wertz, M. Installé)

Aerospace dynamics

(P.Y. Willems)

Modelling of Biological Systems

(Ph. Lefevre, P.Y. Willems)

Simulation of processes

(D. Dochain, F. Thyriion)

Nonlinear control

(G. Bastin, G. Champion)

System identification

(M. Gevers)

Advanced control design : theory and implementation

(M. Gevers, V.Wertz)

Introduction to robotics

(R. Gorez, J.C. Samin)

Process Control

(D. Dochain, G. Bastin)

Modelling in neurosciences

(Ph. Lefevre)

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

(M. InstallÈ)

Seminars on “Environmental sciences and management”

(M. InstallÈ)

Seminars on “Ethics, technology, environment and society”

(M. InstallÈ)

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 five teams of IUAP IV/02 and by two teams of IUAP IV/24 on “Intelligent 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>

1. Spring 2000 session

- **System Identification** (CESAME, Louvain-la-Neuve)
Lecturers : Prof. J. Schoukens, R. Pintelon (VUB- Belgium)

Participants : 35

- **Model and Controller Reduction** (CESAME, Louvain-la-Neuve)
Lecturers : prof. B.D.O. Anderson (ANU, Australia), M. Steinbuch, P. Wortelboer (Philips Research, The Netherlands)
Participants : 18

2. Fall 2000 session

- **Introduction to Large-scale Continuous Optimization**(CESAME, Louvain-la-Neuve)
Lecturers : F. Oustry, (INRIA, Grenoble) and A. Sartenaer, (FUNDP, Namur)
Participants : 40
- **Case Studies in Biomedical Data Processing**(KULeuven, Heverlee)
Lecturer: S. Van Huffel, K.U.Leuven
Participants : 30

3. Spring 2001 session

- **Predictive Control** (CESAME, Louvain-la-Neuve)
Lecturer : J. Maciejowski, Cambridge Univ.
Participants : 42
- **Control in Automotive Applications** (CESAME, Louvain-la-Neuve)
Lecturer : S. Yurkovich, Ohio State Univ.
Participants : 13

4. Fall 2001 session

- **Computer vision** (KULeuven, Heverlee)
Lecturers : L. Van Gool and M. Pollefeys (KULeuven)
Participants : 19
- **Interval analysis for identification, state estimation and robust control**(KULeuven, Heverlee)
Lecturers : L. Jaulin (Université d'Angers) M. Kieffer (Université Paris Sud), E. Walter (CNRS)
Participants : 20

2.2 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, Université Catholique de Louvain, Université de Liège, Université Gent, Université 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 :

- solid mechanics and acoustics
- materials processing
- fluid mechanics
- rheologically complex materials
- 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 2000 and 2001:

- **Reynolds averaged navier stocks (RANS) and large-eddy simulations (LES)**
Lecturers : C. Benocci (VKI), D. Carati (ULB), E. Dick (UG), C. Lacor (VUB) and G. Winkelmans (UCL).
Date : March - April 2000
Participants : 10
- **Introduction to measurement techniques in fluid mechanics (VKI)**
Lecturers : T. Arts, M.L. Riethmuller, R.A. Van Den Braembussche, D. Olivari, G. Degrez.
Date : October 2000.
- **Numerical linear algebra**
Lecturer : R. Beauwens (ULB)
Date : November - December 2000.

- **High-performance computing**
Lecturer : D. Roose (KUL)
Participants : 17
Date : March 2000.
- **Advanced acoustics**
Lecturers : J. Anthoine (VKI), P. Bouillard (ULB), J.P. Coyette (UCL/FFT), W. Desmet (KUL), D. Vandepitte (KUL)
Participants : 5
Date : April - May 2000
- **Computational biomechanics**
Lecturers : J. Vander Sloten (KUL), P. Verdonck (UG) et al.
Participants : 10
Date : March 15 (Ulg), March 29 (KUL), April 19, 2000 (UG)
- **Advanced continuum mechanics**
Lecturers : F. Dupret (CESAME), J.P. Ponthot (Ulg)
Participants : 16
Date : October 15, 22, 29 and November 5, 2001.
- **Nonlinear finite elements**
Lecturer : S. Cescotto (Ulg)
Participants : 20
Date : November 30, December 7, December 14, 2001.

3 Mini courses

- Paul Van Dooren organized a mini course within the framework “Special topics in numerical linear algebra” on the theme “Polynomial matrix problems and related questions”, March 24 and 31, 2000, April 6 and 28, 2000 and May 12, 2000.

4 Other teaching activities

- **Analyse des Systèmes et Environnement**, Fondation Universitaire Luxembourgeoise, 20h. - G. Bastin
- **Systèmes Nonlinéaires Appliqués**, Ecole des Mines de Paris 15h. - G. Bastin
- **Materials Engineering** (EUPOCO, the European Postgraduate Program in Polymer and Composites Engineering), 60h. - R. Keunings and V. Legat

- **Modélisation mathématique et simulation numérique de l'injection** Ecole Supérieure de Plasturgie, (Oyonnax, France) 120h. - F. Dupret.
- **Computer Simulation of Viscoelastic Flows**, COSMASE - *Computation in Sciences : Methods and Algorithm in Super Computing for Engineering*, Ecole Polytechnique de Lausanne, 10 h - V. Legat
- **European School of Rheology**, (KULeuven), 2h - R. Keunings.

5. SEMINARS AND WORKSHOPS

1 Cesame colloquium

- Roland KEUNINGS (CESAME)
“Computational rheology : objective, approaches, and results”, 19/12/2000.
- Yurii NESTEROV (CESAME and CORE)
“Characteristic functions of directed graphs and their applications”, 13/02/2001.
- Philippe LEFEVRE (CESAME)
“Neural control of movement : theoretical and experimental approaches”, 20/03/2001.
- Issam DOGHRI (CESAME)
“Nonlinear mechanics of solid materials: some modeling and computational aspects”, 08/05/2001.
- Rodolphe SEPULCHRE (Ulg/CESAME)
“Analog computational algorithms in systems and control”, 19/06/2001.
- Vincent BLONDEL (CESAME)
“Dynamical systems that compute arbitrary computable functions”, 21/11/2001.

2 Seminars

- Michel GEVERS (CESAME), “Identification and validation for robust control : a prediction error approach”, February 01, 2000.
- Codrin NICHITIU (ENS Lyon/CESAME), “Election d’un chef sur graphes d’automates”, February 08, 2000.
- Piotr KULCZYCKI (Cracow University of Technology, Electrical and Computer Engineering - Institute of Automatic Control.), “A statistical system for detection, diagnosis and prognosis of faults”, February 15, 2000.
- I.D. LANDAU (Laboratoire d’Automatique de Grenoble, ENSIEG), “Direct controller order reduction by identification in closed loop. The Daphne algorithm”, February 22, 2000.
- Isabelle MOTTE (CESAME), “Godel’s incompleteness theorem on non demonstrability of mathematics”, March 07, 2000.
- Jan VAN IMPE (KUL), “Modelling of microbial conversion processes during food processing”, March 14, 2000.
- Peter VAN ROLLEGHEM (RUG), “Putting control into practice : an industrial case study in wastewater treatment”, March 21, 2000.
- Georges BASTIN (CESAME), “Issues in modelling and control of mass balance systems”, March 28, 2000.
- Philippe FORTEMPS (Institute of Technology, F.P.Ms, Mons), “Contraintes flexibles en recherche opérationnelle et en contrôle”, April 04, 2000.
- Radu STEFAN (CESAME), “The bounded real lemma in J-form”, April 11, 2000.
- Gilbert STRANG (CESAME), “Biorthogonal filters and wavelets”, April 28, 2000.
- Paul VAN DOOREN (CESAME), “Factorization problems of polynomial matrices”, April 28, 2000.
- Mohamed LAABISSI (CESAME/El Jadida), “Analysis of a nonlinear dynamical model of an axial dispersion nonisothermal reactor”, May 02, 2000.
- Frédéric GROGNARD (CESAME), “Control of linear systems with affine constraints : a gain-scheduling approach”, May 09, 2000.
- Pierre-Antoine ABSIL (Ulg), “Computing invariant subspaces : a new solution to an old problem”, May 16, 2000.

- Giansalvo CIRRINCIONE (ESAT, KULeuven), “Neural networks for inverse discontinuous problems”, May 23, 2000.
- Jose DE DONA (Ulg), “Input constrained linear control”, May 30, 2000.
- M. OUSSALAH (KULeuven), “Using possibilistic tools for identification purpose”, June 06, 2000.
- Kunt ATALIK (CESAME), “Spectral simulation of transition to turbulence in shear flows”, June 07, 2000.
- A. Illah YOUSOUF (ULB), “Analytical equivalent of a fuzzy incremental PI controller”, June 20, 2000.
- Lance M. OPTICAN (National Eye Institute, NIH Bethesda, USA), “A neuromimetic model of saccade generation”, September 21, 2000.
- Vincent CANTERINI (Université de la Méditerranée/CESAME), “Geometric representations of substitutions”, October 10, 2000.
- Leigh JOHNSTON (University of Melbourne/CESAME), “An introduction to the EM algorithm and its applications”, October 17, 2000.
- Raymond GOREZ, professeur ÈmÈrite, “Simple design relations for 2-Dof PID controllers”, October 24, 2000.
- Magnus MOSSBERG (Uppsala University/CESAME), “Parametric and non-parametric identification of viscoelastic materials”, October 31, 2000.
- Jonathan DE HALLEUX (CESAME), “Contrôle de niveaux et de vitesses dans des canaux d’irrigation par une approche de ”Lyapunov”, November 07, 2000.
- Philippe BOGAERTS (ULB), “Analytical equivalent of a fuzzy incremental PI controller”, November 21, 2000.
- Yvan HACHEZ (CESAME), “Convex optimization over nonnegative polynomials”, November 28, 2000.
- Patrick DEWILDE (DIMES, Delft University of Technology), “Inversion of linear time varying systems”, December 12, 2000.
- Roland KEUNINGS (CESAME), “Computational rheology: objectives, approaches, and results”, December 19, 2000.
- Jean-François REMACLE (Scientific Computation research Center Rensselaer Polytechnic Institute, USA), “A parallel adaptive framework for solving complex fluid problems”, January 5, 2001.

- Jean-Francois RASKIN (DÉpartement d'informatique, ULB), "Hybrid Systems : an Introduction", January 09, 2001.
- Younes CHAHLAOUI (CESAME), "Applications du calcul récursif des sous-espaces singuliers dominants", February 06, 2001.
- Yurii NESTEROV (CESAME and CORE), "Characteristic functions of directed graphs and their applications", February 13, 2001.
- Marie COTTRELL (Université Paris 1- PanthÉon-Sorbonne), "Algorithme de Kohonen et analyse exploratoire de données", February 23, 2001.
- Amaury LENDASSE (CESAME), "L'utilisation de cartes de Kohonen pour l'analyse et la prédiction de consommation Électrique", February 27, 2001.
- Radu STEFAN (CESAME), "Topics in stability radius theory", March 06, 2001.
- Knut HUEPER (University of Wuerzburg, Deutschland), "Local quadratic convergence of eigenvalue algorithms based on Riccati iterations", March 13, 2001.
- Alain VANDE WOUWER (Faculté Polytechnique de Mons), "Identification for state estimation: a new concept illustrated with bioengineering applications", March 13, 2001.
- Philippe LEFÈVRE (CESAME), "Neural control of movement : theoretical and experimental approaches", March 20, 2001.
- CÉdric DELATTRE (CESAME), "Introduction aux systèmes à paramètres répartis", April 17, 2001.
- Dominique HOCHEREAU (CESAME/Dow Corning), "ModÉles d'hysteresis et transitions de phase dans les matÉriaux", April 24, 2001.
- Isabelle MOTTE (CESAME), "New control laws for coordinated wheeled mobile robots", May 15, 2001.
- B.D.O. ANDERSON (Australian National University), "Multiple Model Adaptive Control with Safe Switching", May 22, 2001.
- Roland HILDEBRANDT (CESAME), "Recent advances in the theory of chattering", May 29, 2001.
- Andrea LECCHINI (CESAME), "Virtual reference feedback tuning : a new direct data-based method for the design of feedback controllers", June 05, 2001.
- Mohamed HADJILI (CESAME), "Fuzzy control of nonlinear systems using Takagi-Sugeno approach", June 12, 2001.

- Christian G'SELL (Ecole des Mines de Nancy), "DÉformation, endommagement et rupture des polymères", June 22, 2001.
- Hamid ZOUAKI (El Jadida - Maroc), "Problème de reconstruction de Minkowski, application à la représentation d'objets", June 25, 2001.
- Lieven VANDENBERGHE (Electrical Engineering Department, UCLA), "Fast interior-point methods for linear matrix inequalities derived from the KYP lemma", June 26, 2001.
- Corneliu BALAN (Politechnica University of Bucharest, Romania), "The concept of pure material instability in viscoelastic modelling, theory, numerical simulation and experiment", August 30, 2001.
- Alexander VLADIMIROV (Russian Academy of Sciences, Moscow), "Iterated Projections and Continuous Products of Matrices", September 25, 2001.
- Anahi GAJARDO (Université du Chili/ENS Lyon), "Research field : discrete dynamical systems", October 16, 2001.
- Pascal KOIRAN (Ecole Nationale Supérieure, Lyon), "Propriétés décidables et indécidables des systèmes linéaires saturés", October 23, 2001.
- Shengyan XU (CESAME), "Robust stabilization and H-infinity control for uncertain singular systems with state delay", October 30, 2001.
- Georges BASTIN (CESAME), "Compartmental modelling for traffic control in communication networks", November 13, 2001.
- Ilse SMETS (BioTec, KU Leuven), "Optimal temperature control of a steady-state exothermic plug flow reactor", November 27, 2001.
- Gunnar BLOHM (CESAME), "Anticipation in oculomotor control", December 4, 2001.
- Frank ALLGOWER (Institute for Systems Theory in Engineering, University of Stuttgart), "Theory and application of nonlinear model predictive control", December 11, 2001.
- Younes CHAHLAOUI (CESAME), "A new version for modified LR-Smith for model reduction of time-varying dynamical systems", December 18, 2001.

3 Workshops

3.1 Workshop on “The Dynamics of Neurons and Vision”

Organized by V. Blondel (CESAME), Ph. Lefevre (CESAME), R. Sepulchre (Ulg/CESAME).
Brussels, September 4-5, 2000.

Programme

- September 4, 2000
Minicourse by H.R. Wilson, Centre for Vision Research, York University.
 - *Introduction to Nonlinear Neurodynamics*
 - *Excitatory & inhibitory networks*
 - *Neural oscillations & action potentials*
 - *Synapses & synchronization*
- September 5, 2000
 - 8h45 Introduction by G.A. Orban, Lab. Neuro-and Psychophysiology, KUL
 - 9h00 R. Vogels, Lab. Neuro- and Psychophysiology, KUL.
“Physiology of the primate visual system”
 - 10h00 H.R. Wilson, Centre for Vision Research, York University
“Dynamics and Vision: Cortical Networks, Perceptual Oscillations and Auras”
 - 11h00 Coffee + Posters
 - 11h30 B. Rossion, Cognitive Neuropsychology Unit, UCL
“Imaging the neural system for face processing in humans”
 - 14h00 P. Lefèvre, CESAME and Lab. Neurophysiology, UCL
“Tracking eye movements toward moving visual stimuli”
 - 15h00 Z. Li, Gatsby Computational Neuroscience Unit, Univ. Coll. London
“Nonlinear dynamics and computational advantages of asymmetric neural Networks”
 - 16h00 Coffee + Posters
 - 17h30 End of the workshop

List of posters

- Coding of 3D shape in inferior temporal cortex
Peter Janssen, Rufin Vogels, Guy Orban
- Spatial sensitivity of inferior temporal cortical neurons *Hans Opdebeeck, Rufin Vogels*
- Early Visual Extrastriate Activity in a Blindsight Patient *Gilles Pourtois, Beatrice de Gelder, Bruno Rossion, Lawrence Weiskrantz, Jean-Michel Guerit, Marc Crommelinck*

- ERP correlates of facial expressions discrimination *Salvatore Campanella, P. Quinet, R. Bruyer, J-M. GuÈrit, Marc Crommelinck*
- Time course of visual awareness : an ERP study *ValÈrie Goffaux, S. Desmet, Bruno Rossion, Marc Crommelinck*
- The neural basis of face categorical perception *Bruno Rossion, C. Schiltz, L. Robaye, D. Pirenne, Marc Crommelinck*
- Evidence for a visual feedback loop controlling smooth pursuit in the cat *Sophie de Brouwer, Marcus Missal, Philippe LefÈvre*
- Addition of saccadic and smooth pursuit motor commands during catch-up saccades *Sophie de Brouwer, Marcus Missal, G.R. Barnes, Philippe LefÈvre*

3.2 Workshop on “Dynamics and Verification”

Organized by V. Blondel (CESAME), Rodolphe Sepulchre (Ulg/CESAME) , B. Boigelot (Ulg) and J.-F. Raskin (ULB), AcadÈmie Royale des Sciences, Brussels, July 16-17, 2001.

The purpose of the workshop is to bring together students and researchers from the computer science, dynamical systems, and control communities on the general theme of verification and hybrid systems. The workshop will emphasize the dynamical aspect of verification methods.

The first day of the workshop will be an introductory minicourse by Professor R. Alur (University of Pennsylvania, USA). This minicourse will emphasize the dynamical aspects of hybrid systems and verification. The second day will consist of invited talks. All talks will be in tutorial format and informal discussions between the participants will be encouraged throughout the two days.

Programme

July 16 - One day introductory minicourse

“Hybrid Systems: Modeling and Verification”

Rajeev Alur, (Department of Computer and Information Science, University of Pennsylvania, USA)

- Part 1. Modeling and Semantics
- Part 2. Decidability, Verification, and Control
- Part 3. Symbolic Reachability Analysis
- Part 4. Application Domains

July 17 - Invited lectures

- | | |
|---------------|--|
| 9h00 - 9h15 | Introduction
Pierre Wolper, (University of LiÈge, Belgium) |
| 9h15 - 10h15 | About Some Canonical Structures Used in Model Checking
Laurent Fribourg, (Laboratoire SpÈcification et VÈrification, Ecole Normale SupÈrieure de Cachan, France). |
| 10h15 - 11h15 | Symbolic representation systems for infinite state spaces
Bernard Boigelot, (University of LiÈge, Belgium) |

- 11h45 - 12h45 Analysis of Safety and Liveness Properties of Parametric Counter/Clock Automata
Ahmed Bouajjani, (LIAFA, University of Paris 7, France)
- 14h30 - 15h30 Noise and Decidability
Eugene Asarin, (VERIMAG, Grenoble, France)
- 15h30 - 16h30 Efficient Verification Tools for Real-Time and Hybrid Systems. From Ideas to Usages
Kim Larsen, (BRICS, Aalborg University, Denmark)

3.3 Workshop on “Recent advances in oculomotor research”

Mini-symposium organized by Ph. Lefèvre, Louvain-la-Neuve, October 16, 2001

Programme

- 13h00 Marcus Missal (NEFY, UCL, Belgium)
“A common inhibitory gate for saccades and smooth pursuit eye movements”
- 13h40 Sophie de Brouwer (CESAME and NEFY, UCL, Belgium)
“Modelling smooth and saccadic pursuit”
- 14h20 Jan A. M. van Gisbergen (NICI, University of Nijmegen, The Netherlands)
“Interaction between visual and vestibular signals for the control of rapid eye movements”
- 15h30 Graham R. Barnes (Optometry & Neuroscience, UMIST, United Kingdom)
“Sequence learning could be the key to prediction in ocular pursuit”
- 16h10 Marcus Missal (NEFY, UCL, Belgium)
“Insights into the role of the Supplementary Eye Fields in expectation and anticipatory smooth pursuit”
- 16h50 Michael Goldberg (Columbia University College, USA)
“Tracking the spotlight of attention: physiological and psychophysical mechanisms in the monkey”
- 17h30 General discussion
- 18h30 End of the workshop

3.4 Workshop on “Modelling and Monitoring of Batch Processes”

Organized by D. Dochain, Louvain-la-Neuve, November 23-24, 2001.

Scientific presentations

Modelling

- 10h30 Mechanistic Modeling of Polymerization Processes
Costas Kiparissides
- 11h00 Computer Aided Stochastic Modeling of Batch Processes
Niels Rode Kristensen
- 11h30 Modelling and Optimization of a batch Methyl Methacrylate bulk polymerization reactor using the gPROMS/gOPT software tools
Christos Chatzidoukas
- 12h00 Lunch
- 14h00 Multimodeling of Batch Processes for ILC-MPC Control
Dennis BonnÉ
- 14h30 Knowledge-Based Hybrid Modelling of a Batch Evaporative Crystallisation Process
Petia Georgieva, Sebastiao Feyo de Azevedo
- 15h00 3 Design of Optimal Operating Procedures for Batch Processes
Irene Papaeconomou

Monitoring and Estimation

- 15h30 An Adaptive State Space Model for Batch Modelling and Performance Monitoring
Alex Simoglou
- 16h00 Coffee Break
- 16h30 High Gain Observers for Control
Rolf Findeisen, Eric Bullinger and Frank Allgower
- 17h00 State Observers for Processes with Uncertain Kinetics
Denis Dochain

Benchmark

- 17h30 Benchmark no 1 (polymerisation reactor)
Costas Kiparissides
- 18h00 Benchmark no 2 (sugar crystallisation)
Sebastiao Feyo de Azevedo
- 18h30 Benchmark no 3 (fedbatch bioreactor)
Frede Lei

4 5th National Congress on Theoretical and Applied Mechanics

Louvain-la-Neuve, Belgium, May 23-24, 2000.

This congress was organised by the National Committee for Theoretical and Applied Mechanics.

Organizers : G. Campion, R. Keunings

1. Plenary lectures by invited speakers

- “Modelling the climate system: a non-linear problem in fluid mechanics”, A. BERGER (UCL)
- “Non-equilibrium thermodynamics applications in polymer rheology”, A. BERIS (UCL)
- “Multidimensional upwind residual distribution schemes : an alternative to finite volume and finite element methods for solving convection dominated systems”, H. DECONINCK (VKI).
- “Are basins of attraction easy to enlarge by feedback ?” R. SEPULCHRE (Ulg)

2. 88 communications were given.

5 20th Benelux Meeting on Systems and Control

Houffalize, Belgium, March 26, 27 and 28, 2001.

The organizing Committee of the 20th Benelux Meeting consists of G. Bastin (CESAME), V. Blondel (CESAME), M. Gevers (CESAME), Ph. LefÈvre (CESAME), R. Sepulchre (Inst. Montefiore-ULg), V. Wertz (CESAME).

1. Plenary lectures by invited speakers

- Recent advances in adaptive filtering
Dr. Ali Sayed (University of California, Los Angeles, USA)
- Density and flow : a different view on nonlinear control
Dr. Anders Rantzer (Lund Institute of technology, Sweden)

2. Mini courses on Modeling and Control of Rigid Mechanical Systems by Dr. Stefano Stramigioli (Delft University of technology) and Dr. Herman Bruyninckx (KULeuven).
3. 121 communications were given

6 Fourth SIAM Conference on Linear Algebra in Signals, Systems and Control

Boston, U.S.A., August 13, 14 and 15, 2001.

Co-chairs were B. N. Datta (Northern Illinois University) and P. M. Van Dooren (UCL/CESAME).

There were 8 plenary lectures :

- Control and Signal Processing Issues in Quantum Spin Systems
Prof. Roger Brockett (Harvard University)
- Energy Conservation in Adaptive Filtering
Prof. Ali Sayed (University of California, Los Angeles, USA)
- Recent trends in optical image reconstruction.
Prof. Robert J. Plemmons (Wake Forest University)
- Square root algorithms for inverse problems
Prof. P. De Wilde (Delft University of Technology, The Netherland)
- Directions in the study of matrix inertia and stability.
Prof. Daniel Hershkowitz, Israel Institute of Technology, Israel.
- Partial realization theory : a basic paradigm in sigals, systems and control.
Prof. A. Lindquist (Royal Institute of Technology, Sweden)
- From data to linear and nonlinear dynamic models
Prof. Lennart Ljung, Linköpings Universitet, Sweden
- Linear algebra and the dynamics of large networked systems
Prof. G.C. Verghese, Massachusetts Institute of Technology

and 12 invited concurrent presentations.

7 Third NICONET Workshop on Numerical Software in Control Engineering

Organized at LLN on January 19, 2001.

Programme

08h30 - 09h00	Welcome
09h00 - 10h00	“Matching prediction error identification and robust control” by Prof. Michel Gevers (CESAME, Université catholique de Louvain).
10h00 - 10h20	“Niconet software for structured matrix decompositions” by Prof. P. Van Dooren (CESAME, Université catholique de Louvain)
10h20 - 10h50	Coffee break
10h50 - 11h50	“Model reduction within control systems design” by Dr. Pepijn Wortelboer (Philips Research Laboratory Eindhoven).
11h50 - 12h10	“Niconet software for subspace identification” by Dr. Vasile Sima (Res. Inst. for Informatics, Bucharest)
12h10 - 12h30	“Niconet software for nonlinear systems for robotics” by Prof. Vincente Hernandez (Universidad Politecnica de Valencia)
12h30 - 14h00	Lunch
14h00 - 14h45	“The Polynomial Toolbox for Matlab” by Dr. Michel Sebek (Czech Academy of Sciences) and by Prof. Didier Henrion (LAAS-CNRS, Toulouse)
14h45 - 15h30	“A Matlab Toolbox for Linear Matrix Inequalities” by Dr. Jos Sturm (Tilburg University)
15h30 - 16h00	Coffee break
16h00 - 17h30	Poster session
17h30	Closing remarks

6. SCIENTIFIC MISSIONS

Scientific missions

Abbad Omar

29/01/01 01/02/01 Participation on the annual colloquium of the French association MECAMAT in Aussois.

Atalik Kunt

06/06/00 Study day on “Problèmes mathématiques ouverts en mécanique des fluides non-Newtoniens” at the Institut Henri Poincaré in Paris. He made a presentation.

17/05/01 18/05/01 Meeting of the TMR Network “Dynamics of Polymeric Liquids” in Copenhagen. He presented a communication on “Non-linear temporal stability analysis of viscoelastic plane channel flows using a fully-spectral method”.

12/11/01 Joint Meeting of the Belgian Group of Rheology and Nederlandse Reologische Vereniging (Solvay Research Center, Brussels).

9/12/01 11/12/01 TMR meeting “Dynamics of Polymeric Liquids” in Cambridge, UK.

Bastin Georges

15/02/00 Meeting of the scientific evaluation committee at the “Laboratoire d’Automatique et d’Informatique Industrielle” in Lille (France).

24/02/00 Paris, in the framework of the collaboration that exists between the FSA (Faculté des Sciences Appliquées) and the IFP (Institut Français du Pétrole).

28/02/00 01/03/00 Ecole des Mines in Paris to give a course in the Automatic Department.

20/03/00 24/03/00 University of Abidjan (Ivory Coast) to give a course organized in the framework of a 3rd cycle seminar by the CIMPA (Centre International de Mathématiques Pures et Appliquées).

17/04/00 Habilitation committee of Salim Ibrir, Supelec, France.

30/05/00 Visit at the society “Les grands lacs de Seine”, Paris, France.

31/05/00 PhD thesis committee of Nicolas Petit, “Ecole des Mines”, Paris, France.

21/06/00 23/06/00 Participation in SYSID’2000, Santa Barbara, USA.

02/07/00 4/07/00 Participation in the colloquium “Contrôle fluides et fluide-structure” to present a paper entitled “Lyapunov control design for irrigation canals modeled by Saint Venant equations”, by JM Coron, B. d’Andréa, G. Bastin and J. de Halleux, Versailles (France).

29/08/00	30/08/00	Meeting of the european project BATCH PRO, Lyngby (Denmark).
04/09/00	09/09/00	Workshop on “The dynamics of neurons and vision”, Brussel (Belgium).
12/09/00	13/09/00	Habilitation committee of Pierre Rouchon, “Ecole des Mines”, Paris (France).
16/10/00	17/10/00	Evaluation committee of the INRIA, Nice, France.
24/10/00		Habilitation committee of Mazen Alamir, LAG, Grenoble, France.
13/11/00		PhD thesis committee of P. de Leenheer, Universiteit Gent, Belgium.
15/11/00		Presentation of a paper at the “SÈminaire d’Automatique de Paris”, France.
26/03/01	28/03/01	Benelux Meeting on Systems and Control in Houffalize.
25/06/01	27/06/01	IFAC Conference on Computer applications in biotechnology in Quebec, Canada. He presented a plenary conference.
02/07/01	07/07/01	NOLCOS2001 in Saint-Petersburg (Russia). He presented a communication on “ Comportmental modelling for congestion control in communication network” by H. Mounier and G. Bastin.
04/09/01	7/09/01	European Control Conference (ECC’2001) in Porto, Portugal.
24/09/01	28/09/01	Course in the framework of the Summer School on Mathematical Control Theory in Trieste (ICIP), Italy.
12/12/01		Visit of Carlam (Usinor) for a work meeting.

Ben Naoum Kouider

21/08/01	22/08/01	Meeting in the framework of “Candi 2000”, Matagne, Belgium.
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Blohm Gunnar

04/09/00	07/09/00	Participation at the workshop on the dynamics of neurons and vision, Brussel, Belgium.
26/03/01	28/03/01	Benelux Meeting on Systems and Control in Houffalize.
10/11/01	15/11/01	Annual meeting of the ”Society for Neuroscience” in San Diego. He presented a communication.
15/11/01	19/11/01	Visit of the Smith Kettlewell Eye Research Institute in San Francisco.

Blondel Vincent

25/01/00	26/01/00	Invited by Professor Jan C. Willems at the University of Groningen (The Netherlands) to present a "Stafcolloquia".
26/03/00	16/04/00	Université Denis Diderot and the Université Paris Sud as invited professor.
13/04/00		Presentation of a seminar "Complexité algorithmique de problèmes en théorie des systèmes", Université de Paris (Orsay), France.
14/05/00	20/05/00	Collaboration with Prof. C. Moore, Santa Fe Institute for Non-linear Studies, Nouveau Mexique, USA, and collaboration with Prof. J. Tsitsiklis at the MIT, Cambridge, USA.
22/05/00	27/05/00	Scientific visit to Prof. J. Tsitsiklis
13/06/00		Participant in a IUAP Study day.
18/06/00	23/06/00	Participation at the 14th Symposium on the Mathematical Theory of Networks and Systems (MTNS'2000), Perpignan, France.
07/07/00	09/07/00	Meeting of a European Network ALAPEDES, Hamburg, Germany.
04/09/00	09/09/00	Workshop on "The dynamics of neurons and vision", Brussel, Belgium.
27/10/00	29/10/00	Visit at the "Institut d'informatique", University of Dresden, Germany.
15/02/01		STACS Conference (International Symposium on Theoretical Aspects of Computer Science), Dresden, Germany, He was one of the organizers.
26/03/01	28/03/01	Benelux Meeting on Systems and Control in Houffalize.
28/03/01	31/03/01	Conference on "Hybrid Systems: Computation and Control" in Roma, Italy
15/05/01		Meeting at the FWO.
17/05/01	18/05/01	University of Groningen (The Netherlands) for the thesis of a student of Jan Willems.
27/05/01	04/06/01	University of Harvard, U.K., invited by Prof. R. Brockett
30/05/01		Harvard University, Cambridge, USA. Title of the presentation "Computing dynamical systems"
11/07/01	15/07/01	SIAM Conference in San Diego (California) to be awarded with the SIAM Prize on Systems Theory.
16/07/01	17/07/01	Fifth Dynamics workshop on "Dynamics and Verification" in Brussels.
24/08/01	26/08/01	Mini conference of the ALAPEDES network in Prague. He presented a communication.

25/08/01	29/08/01	IFAC workshop on “Discrete event systems”. Title of the presentation “Automatic search of synonyms and Maxplus linear systems : computing minimal realizations” Praha, Czech Republic
18/09/01	21/09/01	Meeting of European Union experts in Brussels.
24/09/01		Ecole Normale SupÈrieure in Paris for the defense of Pierre Senelart’s thesis.

Bombois Xavier

20/01/00	30/01/00	LAP-ISMRA (Caen, France) to work with GÈrard Scorletti.
01/03/00	03/03/00	Benelux Meeting on Systems and Control in Mierlo, Netherlands.
26/04/00	03/05/00	Visit at the University of Cambridge, USA. Collaboration with Glenn Vinnicombe.
21/06/00	23/06/00	IFAC Symposium on System Identification, SYSID’2000, Santa Barbara, USA.
10/12/00	19/12/00	Participation at the 39th IEEE Conference on Decision and Control (CDC), Sydney , Australia.

Campion Guy

16/02/00	17/02/00	Mid-term meeting in the framework of the European contract Brite Euram “OBIDICOT”, Athens, Greece.
25/01/01	26/01/01	University of El Jadida, Maroc for Abdou Benayad’s thesis.
15/02/01	16/02/01	Progress meeting at the University of Stuttgart in the framework of the European contract Brite Euram “OBIDICOTE”.
26/03/01	28/03/01	Benelux Meeting on Systems and Control in Houffalize.
10/12/01	11/12/01	Ecole des Mines de Paris. Member of a Ph.D. Committee of Mahmoud Ellouze.

Canterini Vincent

26/03/01	28/03/01	Benelux Meeting on Systems and Control in Houffalize, Belgium.
02/07/01	05/07/01	International Conference ”Discrete models, combinatorics, computation and geometry” in Paris.
16/07/01	17/07/01	Fifth Dynamics workshop on ”Dynamics and Verification” in Brussels.
24/08/01	26/08/01	Mini conference of the ALAPEDES network in Prague. He presented a communication.
27/08/01	29/08/01	IFAC workshop on “Discrete event systems”.

Chahlaoui Younes

- 19/01/01 NICONET meeting.
26/03/01 28/03/01 Benelux Meeting on Systems and Control in Houffalize.
26/06/01 Presentation of a seminar on “ Grammians based model reduction of large-scale dynamical systems ” at Linma (Laboratoire d’IngÈnierie MathÈmatique), DÈpartement de MathÈmatiques, FacultÈ des Sciences, UCD in El Jadida.
14/06/01 20/07/01 Working at Linma (Laboratoire d’IngÈnierie MathÈmatique) with E. Achhab.

Codrons BenoÓt

- 01/03/00 03/03/00 Benelux Meeting on Systems and Control in Mierlo, Netherlands.
21/06/00 23/06/00 IFAC Symposium on System Identification, SYSID’2000, Santa Barbara, USA.

Daeninck Goeric

- 01/03/00 03/03/00 Benelux Meeting on Systems and Control in Mierlo, Netherlands.

David BenoÓt

- 01/03/00 03/03/00 Benelux Meeting on Systems and Control in Mierlo, Netherlands.
12/12/01 Visit of Carlam (Usinor) for a work meeting.
21/06/00 23/06/00 Participation at the SYSID’2000, Santa Barbara, USA.
10/12/00 19/12/00 Participation at the 39th IEEE Conference on Decision and Control (CDC), Sydney, Australia.
12/12/01 Visit of Carlam (Usinor) for a work meeting.

de Brouwer Sophie

- 04/09/00 07/09/00 Participation at the workshop on the dynamics of neurons and vision, Brussels, Belgium.
04/11/00 09/11/00 Annual meeting of the “Society for Neuroscience”, New Orleans, USA.
25/03/01 31/03/01 attended the “Neural control of movements” NCM in Sevilla. She presented a poster on “What triggers catch-up saccades during smooth pursuit?”

de Halleux Jonathan

26/03/01	28/03/01	Benelux Meeting on Systems and Control in Houffalize, Belgium.
03/07/01	07/07/01	Participation at the conference NOLCOS'2001, St-Petersburg, Russia.
08/09/01	14/09/01	Participation at the "Third NCN Pedagogical School on Optimal Control", Coimbra (Portugal).
22/10/01	24/10/01	Visit to "Université de Paris Sud" and collaboration with Professors C. Prieur and J-M. Coron.

Delattre Cédric

01/03/00	03/03/00	Benelux Meeting on Systems and Control in Mierlo, Netherlands.
07/08/00	11/08/00	Visit at the "Laboratoire de Biotechnologie de l'environnement", INRA, France; collaboration with Prof. J. Harmand.
18/09/00	20/09/00	WATERMATEX 2000 "Systems Analysis and Computing in Water Quality Management", Gent, Belgium.
26/03/01	28/03/01	Benelux Meeting on Systems and Control in Houffalize, Belgium.
04/05/01	13/05/01	Montréal to work with his Promoter Denis Dochain.
02/07/01	06/07/01	Workshop on "Pluralism in distributed parameter systems" at the University of Twente, Enschede, Netherland.

Dochain Denis

02/02/00	06/02/00	Participation at MATHMOD'2000, Vienna
17/02/00	24/02/00	Visit at the UCD, El Jadida, Morocco, to give a course on "Modelling, estimation and control of chemical and biochemical processes", and visit at the University Cadi Ayyad, Marrakech, to work with Prof. A. Benhammou.
08/05/00	15/05/00	Visit at "Ecole Polytechnique de Montreal", Canada.
29/05/00	04/06/00	LAAS de Toulouse in the framework of the cooperation between FNRS/CNRS.
12/06/00	18/06/00	Participation at the "International Symposium on Advanced Control of Chemical Processes" (ADCHEM), Pisa, Italy.
20/06/00		PhD thesis committee of Stefan Weijers, Eindhoven, The Netherlands.
18/09/00	20/09/00	WATERMATEX 2000 "Systems Analysis and Computing in Water Quality Management", Gent, Belgium.
26/03/01	28/03/01	Benelux Meeting on Systems and Control in Houffalize, Belgium.
22/03/01	23/03/01	COST meeting, San Sebastian, Spain.
18/08/01	25/08/01	Working with Martin Guay, Tao Zhang, Juliana and Bruce Ramsay at the Chemical Engineering Department of the Queen's University of Kingston, Montreal, Canada.
31/08/01	02/09/01	Batch Pro Summer Course, Porto, Portugal.

04/09/01	7/09/01	European Control Conference (ECC'2001), Porto, Portugal.
29/10/01	31/10/01	PhD thesis committee in Narbonne, France.
12/11/01	14/11/01	PhD thesis committee at the LAG, Grenoble, France.
08/12/01	15/12/01	Visit at Queens University of Kingston, Montreal, Canada.
18/12/01		PhD thesis committee at INPL, Nancy, France.

Doghri Issam

20/08/00	02/09/00	ICES'2K in Los Angeles (August 20-25) and ICTAM 2000 in Chicago (August 27 - September 02). He there presented two communications whose co-authors are S. Nikolov and O. Pierard.
22/10/00	25/10/00	Ecole Normale Supérieure de Cachan to attend the International Symposium on Continuous Damage and Fracture where he made an invited presentation.
15/01/01		T.U. Eindhoven as member of the jury of Olaf van der Sluis' thesis.
22/03/01		ENSAM, Paris to make presentation in the framework of the MECAMAT Study Day on "Mécanique des Polymères".
19/07/01		Goodyear technical centre in Luxembourg. He presented a seminar.
01/08/01	03/08/01	6th US National Congress on Computational Mechanics, in Dearborn (Michigan). He made a presentation and chaired the session entitled "Symposium on multiscale methods in field theories of mechanics".

Dupret François

17/01/00	18/01/00	BRITE Consortium meeting (Oxley Dev., EOS Dev., TMM)
10/04/00	13/04/00	Participation in ESAFORM3, "Numerical modelling of bulk crystal growth : state of the art (F. Dupret, V. Regnier, N. Van den Bogaert)
23/05/00		Participation in "5e congrès national belge de mécanique théorique et appliquée". Two communications : - A three-dimensional approach for flow front tracking (O. Magotte, F. Loix, C. Jeggy, F. Dupret) - Numerical simulation of bulk crystal growth : development of a global dynamic model with melt convection prediction (R. Rolinsky, L. Wu, V. Regnier, N. Van den Bogaert, F. Dupret)
02/07/00	03/07/00	Brite Meeting (Leeds, UK)

26/08/00	02/09/00	Participation in 2nd International School on Crystal Growth Technology (ISCGT-2), Zao (invited communication) : Industrial Applications of Bulk Crystal Growth Dynamic Integrated Simulation (F. Dupret, N. Van den Bogaert, V. Regnier, R. Rolinsky, L. Wu)
31/08/00		Visit to Shin Etsu Handotai in Shirakawa
01/09/00		Visit to Komatsu (Hiratsuka)
11/09/00	13/09/00	Communication at “26 ^È mes JournÈes de l’Hydraulique, CongrÈs de la SociÈtÈ Hydrotechnique de France : Les logiciels de MÈcanique des Fluides au Service de l’Industrie et de l’Environnement”, Paris, Marne la VallÈe, “PrÈdiction dynamique inverse de la croissance des monocristaux avec prise en compte de la convection”, F. Dupret, Coauthors : V. Regnier, N. Van den Bogaert.
18/10/00	20/10/00	Communication at 3d International Workshop on Modeling in Crystal Growth, Hauppauge, New York, USA, (keynote speaker) “Principal issues of bulk crystal growth numerical modeling”, Co-author with N. Van den Bogaert, V. Regnier, R. Rolinsky, W. Liang, N. Van Goethem, B. Delsaute.
21/12/00	22/12/00	Thesis of D. DABOUSSY, Ecole des Mines, Sophia Antipolis, France.
16/01/01		BRITE Meeting
22/04/01	24/04/01	Participation in ESAFORM IV conference, Ulg, Belgium
30/07/01	04/08/01	Participation in 13th Int. Conf. on Crystal Growth (ICCG-13), Kyoto, Japan. Two communications on “Global Dynamic Modeling of Czochralski Growth : Simulation of the Entire Growth Process Taking the Complex Geometrical Evolution of the System into Account”, F. Dupret, N. Van den Bogaert, R. Rolinsky, W. Liang, B. Delsaute, N. Van Goethem, V. Regnier, and “Numerical Modeling of Melt Convection in Czochralski Growth : From 2D to 3D Models; From Experiments to Simulations”, F. Dupret, V. Regnier, W. Liang, R. Houtermans, B. Delsaute, N. Van Goethem, R. Rolinsky, N. Van den Bogaert.
11//07/01	12/07/01	Final BRITE Meeting
20/09/01		Thesis committee of Ch. El Amrani, Ulg, Belgium
28/09/01		Esaform Board of directors, Paris, France

Gevers Michel

16/02/00	17/02/00	Mid-term meeting of the Brite Euram project called "OBIDI-COTE".
01/03/00	03/03/00	Benelux Meeting on Systems and Control in Mierlo, Netherlands.
13/03/00	15/03/00	Visit to Professor Lennart Ljung at the Linköping University. He presented three seminars.
27/03/00		Visit to Profs K. Glover and J. Maciejowski in Cambridge. He presented a seminar.
28/03/00		Workshop on "Model Validation For Plant Control and Condition Monitoring", London, organized by the Institution of Electrical Engineers (IEE). He presented a plenary lecture entitled "Identification and validation for robust control: design issues".
18/05/00	20/05/00	Executive Committee of the IEEE Control Systems Society at the University of Illinois, Urbana-Champaign, USA.
16/06/00		Participation at the International Symposium on Advanced Control of Chemical Processes (ADCHEM 2000), Pisa, Italy.
21/06/00	23/06/00	Participation at the IFAC Symposium on System Identification, SYSID'2000, Santa Barbara, USA.
26/06/00	27/06/00	Participation at the Automatic Control Conference (ACC'2000) and meetings with the Executive Committee and the Board of Governors of IEEE Control Systems Society.
08/09/00		Visit to LABORELEC to give a seminar.
10/09/00	15/09/00	Visit in Sweden to the evaluation of the Sweden Networks Programmes in 'Signal and Systems', and visit at the Linköping University, Lund, Chalmers, KTH, Stockholm, Uppsala. Collaboration with some representants of the University of Lulea.
21/09/00	25/09/00	Visit at the Linköping University, Sweden for an evaluation of "Competence Center ISIS" (Information Systems for Industrial Control and Supervision)
20/10/00	28/10/00	Visit at the "Argentinian Chapter" of the IEEE and at the society "SIDERAR", Argentine.
03/11/00	05/11/00	Meeting of the Executive Committee of the IEEE Control Systems Society, Chicago, USA.
23/11/00		Visit at the VUB, Brussels, collaboration with R. Pintelon and J. Schoukens in the framework of the subgroup "Identification" of the PAI IV/02.
19/01/01		NICONET meeting. As invited guest, he presented a communication on "Matching prediction error identification and robust control".

26/03/01	28/03/01	Benelux Meeting on Systems and Control in Houffalize.
05/05/01	07/05/01	Executive Committee meeting of the IEEE/CSS in Baltimore. He presented a seminar on “Model Validation for Robust Control and Controller Validation in a Prediction Error Framework” at the Polytechnic University of Brooklyn.
24/06/01		Meetings of the IEEE Control Systems Society, in Arlington, Virginia: Executive Committee meeting, Member Activities Board meeting and Board of Governors meeting.
25/06/01		International Affairs Committee meeting of the IEEE Control Systems.
10/09/01		Meeting of the Swedish Research Council in Stockholm.
23/09/01	26/09/01	ERNSI workshop in Cambridge. He presented a communication on “Model reduction versus direct low order identification: a variance analysis” by L. Johnston and M. Gevers.
02/11/01	06/11/01	Executive Committee meeting of the IEEE Control Systems Society in Seattle.
21/11/01		Defense of the thesis of Tony Van Gestel at K.U.Leuven.
29/11/01		VUB for technical discussions with L. Ljung, P. Van den Hof, J. Schoukens and R. Pintelon.
02/12/01	08/12/01	CDC 2001 in Orlando, during which he also attended a serie of meetings of the IEEE Control Systems Society, namely the Executive Committee meeting, and the Board of Governors meeting.

Gallez Xavier

20/08/00	25/08/00	13th International Congress on Rheology in Cambridge (United Kingdom). He presented a communication.
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Gomez Guillermo

16/02/00	17/02/00	Mid-term meeting of the Brite Euram project “OBIDICOTE”.
01/03/00	03/03/00	Benelux Meeting on Systems and Control, Mierlo, Netherlands.
13/06/00	18/06/00	Symposium on Fault Detection, Supervision and Safety for Technical Processes : SAFEPROCESS 2000,Budapest, Hongrie.
26/06/00	02/07/00	Participation at the American Control Conference (ACC), Chicago, USA.

Grognard FrÈdÈric

01/03/00	03/03/00	Benelux Meeting on Systems and Control in Mierlo, Netherlands.
19/06/00	23/06/00	International Symposium of mathematical Theory of Networks and Systems MTNS'2000, Perpignan, France.
30/08/00	01/09/00	Participation at the workshop "On systems with time domain constraints", TUE Eindhoven, The Netherlands.
04/09/00	05/09/00	Participation at the workshop on "The dynamics of neurons and vision", Brussels.
10/12/00	19/12/00	Participation at the 39th IEEE Conference on Decision and Control, Sydney, Australia.
16/07/01	17/07/01	Fifth Dynamics workshop on "Dynamics and Verification" in Brussels.
23/07/01		TUEindhoven to work with Prof. Stoorvogel.
25/07/01		Ecole des Mines de Paris in Fontainebleau to meet Laurent Praly.
03/12/01	07/12/01	40th IEEE Conference on Decision and Control in Orlando. He presented a communication on "Dynamical systems that compute time-optimal switchings" by F. Grognard and R. Sepulchre.

Guffens Vincent

23/11/01		Visit at the "Université de Paris Sud", Paris, to work with H. Mounier.
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Hachez Yvan

01/03/00	03/03/00	Benelux Meeting on Systems and Control in Mierlo, Netherlands.
04/09/00	07/09/00	UKACC International Conference on Control, University of Cambridge, U.K.
19/01/01		NICONET meeting, Louvain-la-Neuve, Belgium.

Hadjili Mohamed

29/03/00	30/03/00	"BELGIUM/FUZZY 2", Workshop on Fuzzy Logic and Applications.
18/05/00		Participation at the ICCOS Workshop, RUG Gent, Belgium.
11/09/00	15/09/00	ICSE'2000 International Conference on Systems Engineering, Coventry.
19/01/01		NICONET meeting, Bremen, Germany.
07/05/01	09/05/01	Visit at the ISMRA, Caen, France. Collaboration with Prof. GÈrard Scorletti.

Hannert Emmanuel

- 25/03/01 30/03/01 attended the “ European Geophysical Society ”, XXVI General Assembly Nice (France), and presented the following two posters : HANERT E., LEGAT V., DELEERSNIJDER E. “ A preliminary comparison between finite element and finite difference for a shallow-water model” and LEGRAND S., LEGAT V., DELEERSNIJDER E, “ A variational inverse model on the world ocean”.
- 07/05/01 09/05/01 Université de Caen (ISMRA) for a working visit with GÈrard Scorletti.

Hildebrand Roland

- 23/09/01 26/09/01 ERNSI Workshop in Cambridge. He presented a poster on “Identification for control: optimal input design with respect to a worst-case nu-gap cost function” by R Hildebrand and M Gevers.

InstallÈ Michel

- 08/03/00 10/03/00 Meeting of the department of environmental engineering of the university consortium CLUSTER, Barcelona (Spain)
- 30/03/00 2/04/00 51th Days of the European Working Group “Aide MulticritÈre ‡ la DÈcision”, Madrid (SPAIN)
- 12/04/00 17/04/00 Visit at the University of Sherbrooke, QuÈbec, Canada.
- 07/03/01 11/03/01 at EPFL in Lausanne from where he participated in a meeting of the persons in charge of environmental engineering training within the Cluster university consortium.
- 10/10/01 12/10/01 EPFL in Lausanne to attend, as member of the international jury, the thesis presentations of the Postgrade Cycle in Science and Environmental Engineering
- 24/10/01 26/10/01 Ecole Polytechnique in Turin to attend, as member of the international jury, the thesis presentations of the Postgrade Cycle in Science and Environmental Engineering of this school.
- 17/05/01 18/05/01 Meeting of the working group on Environmental Engineering of the CLUSTER university consortium in Turin, Italy.
- 13/11/01 20/11/01 International conference on “Environmental Training in Engineering Education: ENTREE 2001” organized by the SEFI Working Group on Environmental Engineering. He presented a communication on “From Green Policies to Integrated Policies”.

Jacot Pieter

02/09/00	06/09/00	Wacker for a work session visit, Munich, Germany.
04/11/00	10/11/00	Wacker for a work session visit, Munich, Germany.
21/11/00	23/11/00	Wacker for a work session visit, Munich, Germany.
26/03/01	28/03/01	Benelux Meeting on Systems and Control, Houffalize, Belgium.
22/06/01		Working session at CRM (Centre de Recherches Metallurgiques) in Liège.
09/07/01	10/07/01	Wacker for a work session visit.
12/12/01		Visit of Carlam (Usinor) for a work meeting.

Jankovic Dejan

20/08/00	25/08/00	13th International Congress on Rheology in Cambridge (United Kingdom). He made a plenary lecture at the opening session of the congress.
12/11/01		Joint Meeting of the Belgian Group of Rheology and Nederlandse Reologische Vereniging (Solvay Research Center, Brussels).

Jeanmart Herve

04/09/01	07/09/01	European Congress on Computational Methods in Applied Sciences and Engineering ECCOMAS Computational Fluid Dynamics Conference 2001 in Swansea, Wales, UK. He presented an invited contribution on “VLES of aircraft wake vortices in a turbulent atmosphere: a study of decay” for the session entitled “Very Large Eddy Simulation for Engineering and Geophysical Flows”.
18/07/01	20/07/01	Participation in the workshop on direct and large-eddy simulation IV (DLES-4) at U. Twente, The Netherlands.
07/12/01		ERCOFTAC One-Day Seminar on Advanced Heat Transfer Modelling for Industrial Flows, Leuven. He presented an invited contribution on “H. Jeanmart, R. Englebert, N. van Hille, L. Bolle: Local temperature distribution in staggered finned-tube heat exchangers”.

Jeggy CÈcile

12/11/01		Joint Meeting of the Belgian Group of Rheology and Nederlandse Reologische Vereniging (Solvay Research Center, Brussels).
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Johnston Leigh

- 04/09/00 05/09/00 Participation au workshop on the dynamics of neurons and vision, Brussel, Belgium.
- 23/11/00 Visit at the VUB, Brussels, collaboration with R. Pintelon and J. Schoukens in the framework of the subgroup "Identification" of the PAI IV/02.
- 25/06/01 29/06/01 Participation at the International Symposium on Information Theory, Washington, USA.

Keunings Roland

- 29/05/00 01/06/00 Gave with Prof. H.C. Ottinger (ETH Zurich) the "MathEngine Lectures on Computational Rheology"
- 06/06/00 Study day on "Problèmes mathématiques ouverts en mécanique des fluides non-Newtoniens" at the Institut Henri Poincaré in Paris. He made a presentation.
- 20/08/00 25/08/00 13th International Congress on Rheology in Cambridge, United Kingdom. He made a plenary lecture at the opening session of the congress.
- 10/11/00 EUPOCO courses at KUL.
- 13/11/00 16/11/00 INRIA (Paris) to give a course.
- 21/11/00 22/11/00 4th European Fluid Mechanics Conference in Eindhoven, The Netherlands.
- 12/01/01 14/01/01 Presentation at the meeting of the Modeling Technical Advisory Board of the Dow Chemical Company, Houston, Texas.
- 02/05/01 04/05/01 Invited conference at the colloquium on "Ecoulements de Fluides Non-Newtoniens" organized by the Department of Mathematics of the University of Metz, France.
- 11/05/01 19/05/01 Participation in the "2nd Workshop on Inverse Problems in Rheology and Related Experimental Techniques" in Badenweiler (Germany).
- 17/05/01 18/05/01 Meeting of the TMR Network "Dynamics of Polymeric Liquids" in Copenhagen.
- 27/06/01 29/06/01 Courses in the framework of the Summer School on "Analytical and Numerical Methods in non-Newtonian Fluid Mechanics" at the University of Minho, Guimarães, Portugal.
- 11/09/01 Meeting of the Steering Committee of the GraSMech doctoral school at ULg.
- 14/09/01 Course at KUL, in the framework of the 7th European School of Rheology.
- 05/11/01 Thesis defense at T.U.Eindhoven.

12/11/01		Joint Meeting of the Belgian Group of Rheology and Nederlandse Reologische Vereniging (Solvay Research Center, Brussels).
20/11/01	21/11/01	Invited conference at the symposium on "New developments in rheology" organized by Atofina, Paris, France.
03/12/01	04/12/01	Thesis defense at the Technical University of Lyngby, Denmark.
9/12/01	11/12/01	TMR meeting "Dynamics of Polymeric Liquids" in Cambridge, UK.
14/12/01	15/12/01	Meeting of the editors of the Journal of Non-Newtonian Fluid Mechanics, Elsevier in Amsterdam.

Lecchini Andrea

21/06/01		Department of Applied Physics of the Delft University of Technology (The Netherlands) He present a seminar on " Virtual Reference Feedback Tuning: a data-based method for the design of feedback controllers".
23/09/01	26/09/01	ERNSI workshop in Cambridge. He presented a poster on " On Iterative Feedback Tuning for non-minimum phase plants".

LefÈvre Philippe

19/06/00	22/06/00	Visit at the Institute of Neurology, London, U.K. Collaboration with Dr Graham Barnes.
04/09/00	05/09/00	Participation in workshop on the dynamics of neurons and vision, Brussel, Belgium.
14/10/00	16/10/00	Work meeting in Brussels in the framework of an ESA Topical Team.
04/11/00	09/11/00	Annual meeting of the "Society for Neuroscience", New Orleans, USA.
25/03/01	31/03/01	Workshop on "Neural control of movements" NCM in Sevilla, Spain. He presented a communication on " Evidence for prediction in catch-up saccade programming ".
27/04/01		Visit of the BioTeC labo at KULeuven. He presented a seminar.
30/06/01	01/07/01	Work session in Birmingham (UK), in the framework of an ESA Topical Team.
10/11/01	15/11/01	Annual meeting of the "Society for Neuroscience" in San Diego. He presented a communication.
15/11/01	19/11/01	Visit of the Smith Kettlewell Eye Research Institute in San Francisco . He was invited to give a colloquium.

Legat Vincent

29/05/00	30/05/00	Annual OPA meeting (Ocena Model) at the Université de Jussieu. He presented a communication on “Application of Finite Element Methods with unstructured Grids for Ocean Modeling ”.
08/06/00		“JournÈe de l’IngÈnierie NumÈrique” in Charleville-MÈziÈres (France). He presented a communication on “ModÈlisation et simulation des fluides complexes dans les gÈomÈtries complexes”.
August 14/08/00	18/08/00	Workshop on Nonequilibrium Thermodynamics and Complex Fluids in Oxford (United Kindgom).
20/08/00	25/08/00	13th International Congress on Rheology in Cambridge (United Kingdom).
09/03/01		Ecole SupÈrieure de Chimie et de Physique industrielle to attend a meeting of the BRITE network.
02/05/01		Université de LiÈge to present a siminar on “Micro-macro modeling of viscoelastic fluids”.
12/11/01		Joint Meeting of the Belgian Group of Rheology and Nederlandse Reologische Vereniging (Solvay Research Center, Brussels).

Legrand SÈbastien

29/05/00	30/05/00	Annual OPA meeting (Ocena Model) at the Université de Jussieu. He presented a communication on “ Application of Finite Element Methods with unstructured Grids for Ocean Modeling ”.
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Lendasse Amaury

30/03/00		KUL (ESAT-SISTA) to present a seminar on “ Time Series Forecasting using CCA (Nonlinear Projection) and Kohonen Maps - Application to Electricity Consumption”.
26/04/00	28/04/00	Participation at ESANN’2000, Bruges, Belgium.
14/12/00	15/12/00	ACSEG’2000, Paris, ”Connectionist Approaches in Economics and Management Sciences” Seventh International Meeting. He presented a communication on ”Dimension Reduction of Technical Indicators for the Prediction of Financial Time Series - Application to the BEL20 Market Index” by Lendasse Amaury, Lee John, de Bodt Eric, Wertz Vincent, Verleysen Michel.
30/03/00		KUL (ESAT-SISTA) to present a seminar on “ Time Series Forecasting using CCA (Nonlinear Projection) and Kohonen Maps - Application to Electricity Consumption”.

26/03/01	28/03/01	Benelux Meeting on Systems and Control in Houffalize.
25/04/01	27/04/01	"ESANN'2001", European Symposium on Artificial Neural Networks, in Bruges. He presented a communication on "Input Data Reduction for the Prediction of Financial Time Series " by A. Lendasse, J. Lee, E. de Bodt, V. Wertz, M. Verleysen.
11/05/01		Université de Paris I Sorbonne where he attended the seminar given by Prof. Erki Oja and organized by Marie Cottrell.
16/05/01	18/05/01	Université de Paris I Sorbonne to work with Prof. Erki Oja and Marie Cottrell.
20/11/01	23/11/01	ACSEG, Rennes, France, to present a paper on " Approximation by Radial Basis Functions networks for Pricing and Hedging Securities".
27/11/01	30/11/01	Université Paris 1 to work with Marie Cottrelle.
14/12/01	15/12/01	Participation to ACSEG'2000, Paris, "Connectionist Approaches in Economics and Management Sciences" Seventh International Meeting. He presented a communication on "Dimension Reduction of Technical Indicators for the Prediction of Financial Time Series - Application to the BEL20 Market Index" by Lendasse Amaury, Lee John, de Bodt Eric, Wertz Vincent, Verleysen Michel.

Leygue Adrien

14/08/00	18/08/00	Workshop on Nonequilibrium Thermodynamics and Complex Fluids in Oxford (United Kindgom). He presented a communication.
20/08/00	25/08/00	13th International Congress on Rheology in Cambridge (United Kingdom). He presented a communication.
21/11/00	22/11/00	4th European Fluid Mechanics Conference in Eindhoven (The Netherlands). He presented a communication.
12/11/01		Joint Meeting of the Belgian Group of Rheology and Nederlandse Reologische Vereniging (Solvay Research Center, Brussels).

Moens Luc

12/12/01		Visit of Carlam (Usinor) for a work meeting.
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Mohymont Bernard

26/03/01	28/03/01	Benelux Meeting on Systems and Control in Houffalize.
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Motte Isabelle

- 01/03/00 03/03/00 Benelux Meeting on Systems and Control in Mierlo, Netherlands.
19/06/00 23/06/00 Participation at the International Symposium of mathematical Theory of Networks and Systems MTNS'2000, Perpignan, France.
26/03/01 28/03/01 Benelux Meeting on Systems and Control in Houffalize.

Mund Ernest

- 01/01/00 31/03/00 "Laboratoire de MÈcanique des Fluides" (LMF) de l'Ecole Polytechnique Federale de Lausanne

Nichitiu Codrin

- 28/02/00 Seminar at LORIA, Nancy (France)
27/03/00 31/03/00 Visit at the ISMRA, Caen (France).

Ouaar Amine

- 29/01/01 01/02/01 Annual colloquium of the French association MECAMAT in Aussois. He presented a poster.

Ploumhans Paul

- 19/11/00 20/11/00 "53rd Annual Meeting of the American Physical Society's Division of Fluid Dynamics (APS/DFD 2000)" in Washington. Communication by Ploumhans, Winckelmans et al. "A non-uniform vortex method for 3-D bluff body flows using parallelized multiple tree codes
11/02/00 Participation in ERCOFTAC one-day seminar on "Unsteady flows: Experiments and simulations". Seminar by P. Ploumhans, G.S. Winckelmans, O. Karatekin and J.M. Charbonnier : "Unsteady incompressible flows past bluff bodies : experiments and simulations using vortex methods".

Rolinsky Roman

- 01/02/01 02/02/01 Wacker Siltronic, Germany.

Redaelli Silvia

- 12/11/01 Joint Meeting of the Belgian Group of Rheology and Nederlandse Reologische Vereniging (Solvay Research Center, Brussels).

Sepulchre Rodolphe

01/03/00	03/03/00	Participation at 19th Benelux Meeting on Systems and Control, Mierlo, The Netherlands.
05/04/00	07/04/00	Visit at Gatsby Computational Neuroscience Unit, Univ. Coll. London) and at Imperial College, London. Hosted by Alessandro Astolfi.
23/05/00	24/05/00	Participation at the 5th National Congress on Theoretical and Applied Mechanics, Louvain-La-Neuve, Belgium, and presentation of a plenary lecture.
05/06/00	09/06/00	Participation at the second EC-TMR Nonlinear Control Network Workshop, Paris, France, and presentation of a communication.
19/06/00	23/06/00	Participation at 14th International Symposium on Mathematical Theory of Networks and Systems, Perpignan, France, and presentation of a communication.
26/06/00	28/06/00	Participation at the 7th European Particle Accelerator Conference, Vienna, Austria, and presentation of a poster.
05/07/00	06/07/00	Visit at Schneider Electric S.A., Paris. Hosted by Fabrice Jadot.
08/11/00	10/11/00	Participation at the IEEE Symposium on Bioinformatics and Biomedical engineering, Arlington, USA. Organization of an invited session and presentation of a communication.
11/11/00	18/11/00	Visit at the Center for Control Engineering and Computation, University of California Santa Barbara. Presentation of a seminar. Hosted by P. Kokotovic.
26/03/01	28/03/01	Participation at the 20th Benelux Meeting on Systems and Control, Houffalize, Belgium.
31/03/01	03/04/01	Participation at the 3rd Nonlinear Control Workshop on Dynamics, Bifurcations, and control, Kloster Irsee, Germany. Presentation of a communication.
22/04/01	23/04/01	Visit at the Centre d'Automatique et SystÈmes, Ecole des Mines de Paris. Member of thesis committee of B. Kiss. Hosted by J. Levine.
24/04/01	27/04/01	Visit at the department of mathematics, Würzburg, Germany and presentation of a seminar. Hosted by U. Helmke.
02/07/01	06/07/01	Participation at the 5th IFAC Symposium on Nonlinear Control Systems, St Petersburg, Russia, and presentation of a communication.
04/09/01	07/09/01	Participation at the 5th European Control Conference, Porto, Portugal, and presentation of a communication.

- 17/09/01 21/09/01 Participation at the 22nd Summerschool on “Geometric modelling and control of physical systems”, Grenoble, France; presentation of two invited lectures.
- 03/12/01 07/12/01 Participation at the 40th IEEE Conference on Control and Decision, Orlando, Florida, and presentation of a communication.

Stanciulescu Cristina

- 01/03/00 03/03/00 Benelux Meeting on Systems and Control in Mierlo, Netherlands.
- 15/03/00 18/03/00 Cristina Stanciulescu was in Frankfurt to attend the 10th workshop of the GOR-workshop group ”Decision theory and practice”. She presented a communication on “ Robustness of solutions and risk assessment in multiobjective fuzzy linear programming problems”.
- 24/03/00 ULB at the “Institut de statistiques et de recherche opérationnelle” to present a seminar on “Optimisation multicritère floue de la répartition de terres agricoles pour différentes cultures” (by Ph. Fortemps FPMs and C. Stanciulescu) in the framework of the 3rd Cycle FNRS programme called “ Aide à la décision et modélisation des préférences”.
- 29/03/00 30/03/00 “BELGIUM/FUZZY 2”, a workshop on Fuzzy Logic and Applications. She presented a communication respectively on “ Solving multiobjective fuzzy linear programming problems with fuzzy decision variables” and “Identification of Takagi-Sugeno fuzzy models”.
- 28/03/01 01/04/01 53rd Meeting of the European Working Group ”Multicriteria Aid for Decisions”, in Athens. She presented a communication on “Energy sustainable planning using a multiobjective fuzzy mathematical programming approach”.

Stefan Radu

- 10/01/00 14/01/00 INRIA (Grenoble, France) to work with Professor Fr. OUSTRY.
- 01/03/00 03/03/00 Benelux Meeting on Systems and Control in Mierlo, Netherlands.
- 12/04/00 13/04/00 Visit at the “Université de Technologies de Compiègne”, collaboration with V. Rasvan.
- 09/05/00 12/05/00 Mission at the LAG, Grenoble, France.

19/06/00	23/06/00	Participation at the International Symposium of Mathematical Theory of Networks and Systems MTNS'2000, Perpignan (France).
04/09/00	07/09/00	Participation at the workshop on the dynamics of neurons and vision, Brussels (Belgium).
20/11/00	24/11/00	Visit at the RWTH, Aix-la-Chapelle, collaboration with Prof. Dirk Kremer.
19/01/01		NICONET meeting, Bremen (Deutschland) .
26/03/01	28/03/01	Benelux Meeting on Systems and Control in Houffalize, Belgium.
24/06/01	01/07/01	ACC'2001, American Control Conference in Arlington (Virginia). He presented 2 communications: "Chain-scattering solution to the H-infinity control problem: A Popov-Yakubovich based approach" by Ionescu V. and R. Stefan ; and "Maximizing the stability radius: An LMI approach" by Oara C., R. Stefan and P. Van Dooren.
04/09/01	7/09/01	European Control Conference (ECC'2001) in Porto (Portugal).

Solari Gabriel

23/09/01	26/09/01	ERNSI workshop in Cambridge.
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Theys Jacques

25/06/01	26/06/01	Mini-course on "Convex Optimization with Engineering Applications" given by Lieven Vandenberghe (UCLA) at K.U.Leuven.
16/07/01	17/07/01	Fifth Dynamics workshop on "Dynamics and Verification" in Brussels.

Thirifay FranÁois

07/12/00		ERCOFTAC One-Day Seminar on Advanced Heat Transfer Modelling for Industrial Flows, Leuven.
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Van Den Bogaert Nathalie

01/02/01	02/02/01	Wacker Siltronic, Germany.
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Vandendorpe Antoine

- 26/03/01 28/03/01 Benelux Meeting on Systems and Control in Houffalize, Belgium.
18/07/01 29/07/01 Working at the Florida State University with Kyle Gallivan and Paul Van Dooren.
26/09/01 29/09/01 Advanced computational tools for "Computer-Aided Control Systems Design" at the Universität Bremen. He presented a poster on "Model reduction of large scale dynamical systems via Multipoint Pade".

Van Dooren Paul

- 02/005/00 30/05/00 NICONET meeting at DLR Munich, Germany.
19/06/00 23/06/00 Participation at the International Symposium of mathematical Theory of Networks and Systems MTNS'2000, Perpignan, France.
07/07/00 15/07/00 2000' SIAM Annual Meeting, Rio Grande, Puerto Rico.
20/10/00 22/10/00 "Computational Information Retrieval Workshop", Raleigh, USA.
16/11/00 17/11/00 Participation au symposium on "New Trends in Mathematical Modeling and Numerical Methods", Leuven, Belgium.
08/12/00 PhD thesis committee of J.C. Jeannerod, IMAG, Grenoble, France.
08/01/01 10/01/01 Paul Van Dooren was at the University of Wurzburg, Department of Applied Mathematics to work with Uwe Helmke. He presented a seminar on "Grassman-Rayleigh quotient iteration for computing invariant subspaces".
19/01/01 NICONET meeting. He made a presentation on "Niconet software for structured matrix decompositions".
26/03/01 28/03/01 Benelux Meeting on Systems and Control in Houffalize.
02/05/01 Presentation of a seminar on "Model reduction of large scale dynamical systems" at the Department of Computer Engineering & Informatics, in Patras, Greece.
04/05/01 University of Bremen (Deutschland) where he attended Peter Benner's thesis.
28/05/01 31/05/01 Colloquium organized by the Université Mohamed V - Agdal de Rabat on "AlgÈbre LinÈaire et ArithmÈtique: calcul numÈrique, symbolique et parallÈle". He presented a mini course on "Model reduction of large scale systems". He then went to the Université d'El Jadida where he presented a seminar on "Rayon de stabilitÈ".
09/07/01 13/07/01 "2001 SIAM Annual Meeting" in San Diego. He presented a communication on "Grammian-based model reduction".

- 14/07/01 03/08/01 Working session with Gallivan at the Florida State University. He attended the AMS-IMS-SIAM Conference, Fast algorithms in Mathematics, Computer Science & Engineering in Boston where he presented a communication on “Convex optimisation over positive polynomials matrices”. During the SIAM Conference on “Linear algebra in signal systems and control”, he gave a mini-cours on “Numerical methods and software for control systems design”.
- 04/09/01 7/09/01 European Control Conference (ECC’2001) in Porto (Portugal)
- 24/08/01 29/08/01 IFAC Workshop on Periodic Control Systems in Como, Italy. He presented two communications: “Periodic invariant subspaces in control” by Wen-Wen Lin, Paul Van Dooren and Quan-Fu Xu, as well as “Stability radius and optimal scaling of discrete-time periodic sytems” by Y. Genin, I. Ipsen, R. Stefan, P. Van Dooren.
- 26/09/01 29/09/01 Advanced computational tools for ”Computer-Aided Control Systems Design” at the Universität Bremen. He gave a mini-course on “Basic control software” organized by NICONET”.
- 29/11/01 02/12/01 SIAM, Philadelphia to attend the SIAM Board meetings.

Van Ruymbeke Evelyne

- 11/05/01 19/05/01 Participation on the “2nd Workshop on Inverse Problems in Rheology and Related Experimental Techniques” in Badenweiler (Germany). She presented a communication on “Direct and inverse predictions of linear viscoelasticity based on the Des Cloizeaux time-dependent diffusion model”.
- 12/11/01 Joint Meeting of the Belgian Group of Rheology and Nederlandse Reologische Vereniging (Solvay Research Center, Brussels).
- 9/12/01 11/12/01 TMR meeting ”Dynamics of Polymeric Liquids” in Cambridge, UK. She made a presentation.

Wapperom Peter

- 28/08/00 01/09/00 International Congress on Theoretical and Applied Mechanics in Chicago (USA). He presented a communication.

Wertz Vincent

07/03/00	09/03/00	Visit to Wacker, Munich, Germany.
29/03/00		“Belgium/Fuzzy 2”, Workshop on Fuzzy Logic and Applications, Mons, Belgium.
11/04/00	12/04/00	Participation at the congress of the “Association internationale de la pedagogie universitaire (AIUP)”.
28/04/00		Participation at 'ESANN'2000, Bruges, Belgium.
07/06/00	09/06/00	Visit to Wacker, Munich, Germany.
02/09/00	06/09/00	Visit to Wacker, Munich, Germany.
18/09/00	20/09/00	PBL'2000 Conference, the Link [^] ping University.
09/11/00	12/11/00	Visit to Wacker, Munich, Germany.
13/11/00		PhD thesis committee of P. de Leenheer, University of Gent, Belgium.
23/01/01	04/02/01	Faculty of Sciences in El Jadida to give a course on modelling and systems identification, and PhD thesis committee of Abdou Benayad.
26/03/01	28/03/01	Benelux Meeting on Systems and Control in Houffalize, Belgium.
09/07/01	10/07/01	Wacker for a work session visit.

Winckelmans GrÉgoire

11/01/00		Meeting for the Myrrha project, at SCK-CEN.
11/02/00		Participation in ERCOFTAC one-day seminar on “Unsteady flows : Experiments and simulations”, at VKI.
08/02/00		Meeting for the Myrrha project, at UCL.
24/03/00		Meeting on CFD for liquid metals, in Brussels.
17/05/00		Evaluation of the students in the GRASMECH course on LES, at VKI.
23/05/00	24/05/00	5th National Congress on theoretical and applied mechanics, UCL
08/06/00	09/06/00	“Workshop on large eddy simulation”, Orsay, organized by CNRS.
10/07/00	17/07/00	Visit to CALTECH, as part of our collaboration with profs. A. Leonard and T. Colonius.
18/07/00	20/07/00	Participation in the demonstration of the aircraft vortex spacing system (AVOSS) developed by Nasa Langley, at DFW airport.
16/08/00	18/08/00	Visit of J. Journade, as part of our collaboration on vortex flows with Prof. P. Sagaut.
04/10/00	06/10/00	Euromech colloquium 412 on “LES of complex transitional and turbulent flows”, T.U. Munich and presentation of a seminar “VLES of aircraft wake vortices in a turbulent atmosphere : a study of decay”

16/10/00	17/10/00	4th Wake Net workshop : Wake vortex encounter, at NLR, Amsterdam, and presentation of a seminar “Effect of non-uniform wind shear into vortex wakes : parametric models and comparison with CFD studies”.
24/10/00		“Topical day on R and D activities in support of ADS development”, at SCK-CEN, and presentation of the Myrrha results.
10/11/00		Visit at NUMECA, Brussels, to discuss collaborations in LES.
06/12/00		Participation, as member of the jury, to the defense by Dr. F. Nicoud, at CERFACS, Toulouse, to obtain the habilitation to conduct research (HDR).
13/12/00		Meeting for the Myrrha project, at SCK-CEN.
21/12/00		Meeting of the partners for the european project I-WAKE, in Paris, to work on the elaboration of the proposal.
22/12/00		Participation to the meeting of the scientific committee of SCK-CEN, to discuss the Myrrha project.
19/11/00	20/11/00	“53rd Annual Meeting of the American Physical Society’s Division of Fluid Dynamics (APS/DFD 2000)” in Washington, U.S.A. Communication by Winckelmans, Jeanmart et al. : “LES with and without explicit filtering : comparison and assessment of various models”.
22/11/00		Visit of Antony Beris at the University of Delaware and gave a seminar on “LES with and without regular filtering added to the necessary truncation filtering”.
20/02/01		Meeting of the belgian research group on large eddy simulation, at ULB, and presentation of a seminar “Latest investigations of LES with explicit filtering”.
22/02/01		Visit of prof. B.J. Geurts of U. Twente, The Netherlands, in the framework of our collaboration in LES.
09/03/01		Meeting of UCL with SONACA to exchange on the possible collaborations in research, at UCL (organised by the rector M. Crochet).
14/03/01		Meeting of the partners in the european project I-WAKE in Paris. To work on the elaboration of the proposal.
15/03/01		Meeting for the Myrrha project, at UCL.
02/04/01	03/04/01	Participation in 5th Wake Net Workshop : “Wake turbulence and the airport environment”, DFS Academy, Langen, Germany, and presentation of a communication : “Demonstration of a wake prediction system : the vortex forecast system (VFS)”.
07/05/01		Participation in ULB Colloquium by Prof. P. Main of Stanford University : “Turbulence and its computation”.
17/05/01		Meeting for the Myrrha project, at SCK-CEN.

18/05/01		Meeting of the partners in the european project ATC-WAKE, at NLR, Amsterdam, to work on the elaboration of the proposal.
30/05/01		Meeting of the ERCOFTAC Belgian Pilot Center, to organize the one-day seminar.
31/05/01		Meeting for the Myrrha project, at UCL.
22/06/01		Meeting of the partners in the european project ATC-Wake, in Paris, to work on the elaboration of the proposal.
18/07/01	20/07/01	Participation in the Workshop on direct and large-eddy simulation IV (DLES-4) at University of Twente, the Netherlands, and presentation of an invited plenary lecture : "Assessment of some models for LES without and with explicit filtering".
01/08/01		Participation, as member of the jury, to the Ph.D thesis defense of Louis Dufresne, at University Laval, QuÈbec.
24/08/00		Meeting for the Myrrha project, at UCL.
04/09/01	07/09/01	European Congress on Computational Methods in Applied Sciences and Engineering ECCOMAS Computational Fluid Dynamics Conference 2001 in Swansea, Wales, UK. He presented an invited contribution on " "VLES of aircraft wake vortices in a turbulent atmosphere: a study of decay" for the session entitled " Very Large Eddy Simulation for Engineering and Geophysical Flows".
11/09/01	14/09/01	Conference on Capacity and Wake Vortices, Imperial College of Science in London, UK. He presented a contribution on the operational system developed in collaboration with the Canadians and the Russians between 1993 en 2000. This contribution was entitled : The Vortex Forecast System (VFS): prediction of trajectories and decay for aircraft wake vortices in an operational environment.
27/09/01		Meeting at PWC Brussels, of the partners for the creation of a research center in aeronautics (CENAERO) in Hainaut, as part of Phasing Out, Objective I.
28/09/01		Meeting of the partners in the european project ATC-WAKE, to finalize the proposal.
03/10/01		Meeting of the partners for the creation of CENAERO, at UCL.
08/10/01		Meeting for the Myrrha project, at UCL.
11/10/01		Meeting of the partners for te creation of CENAERO, at UCL.
26/10/01		Meeting of the partners for the creation of CENAERO at Samtech, LiÈge.
14/11/01	15/11/01	Plenary meeting of the european project AWIATOR, in Bremen, Germany, to elaborate the description of work.
22/11/01		Plenary meeting of the partners for the creation of CENAERO, at IGRETEC, Charleroi.

- 29/11/01 Meeting of the partners in task of the european project AWIA-TOR, at NLR, Amsterdam.
- 03/12/01 Aerodynamisches Institut, RWTH Aachen, upon invitation of Prof. Wolfgang Schröder. He gave a seminar on “I. Assessment of some models for large-eddy simulation; II. Recent developments for the lagrangian simulation of unsteady flows”.
- 06/12/01 Negotiation meeting of all partners for the european project ATC-WAKE with EC, Brussels.
- 07/12/01 ERCOFTAC One-Day Seminar on Advanced Heat Transfer Modelling for Industrial Flows, Leuven.
- 10/12/01 Scientific meeting of the partners for the creation of CENAERO, at SONACA.
- 17/12/01 Meeting of the partners for the creation of CENAERO, at IGRETEC, Charleroi.