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Simulation of Control Systems

IFAC/IMACS Symposium

Vienna, Austria, Sept. 22-26, 1986

Simulation is a valuable tool in the investigation of various problems in practically all fields of scientific and applied research. Especially in the fields of control engineering and automation, simulation plays an important role in the investigation of various types of problems. Among these, the analysis of plants and of controlled systems as well as the problem of controller design are of great interest.

The aim of the symposium was to present a review of the state of the art and of current problems and solutions in the field of simulation of control systems. Consequently, modelling, control systems analysis and controller design were the main points in the presentations and discussions during the symposium. But on the other hand, new simulation tools were presented as well, especially new simulation software developed to assist the control engineer. Questions in connection with these tools were discussed with great interest.

During the preparation of the Symposium about 135 abstracts were reviewed by the members of the IPC. As a result of this reviewing procedure some ninety authors were invited to submit a full paper. These contributed papers were arranged in twenty Technical Sessions. In addition, eight Invited Papers prepared by L. Ljung (S), W. Ameling (FRG), S. G. Tzafestas (GR), G. C. Vansteenkiste (B), K. Furuta et al. (J), P. M. Bruijn et al. (NL), D. P. Atherton (GB) and A. Fischlin et al. (CH) were presented. Moreover, technical visits to the three computation centers of the University of Technology in Vienna and to the laboratory of the Working Group on Robots were arranged as well as sessions where simulation software was demonstrated by the participants.

The authors of the contributed papers came from 21 countries scattered over four continents. 118 participants from 29 countries from all five continents attended the symposium.

Among the papers presented during the symposium were some of theoretical nature, some had the character of a case study and a third group presented theoretical investigations in connection with a special application, the latter being in most cases of a physical or technical nature. In this respect the main areas, i.e. theory, software and applications, were represented in a well-balanced manner.

The Symposium was the first on this topic sponsored mainly by an IFAC committee, i.e. the one on Theory, but it was indeed the second one on this topic sponsored by IMACS and held in Vienna. At the closing, many participants expressed the hope that there will be a further one on 'Simulation of Control Systems' in some three or four years from now.

Inge Troch
Chairman IPC

From left to right: I. Troch, IPC Chairwoman for the IFAC/IMACS Symposium and L. Ljung, IFAC Theory Committee Chairman.

FIACC
The Roof over Intelligent Products

Excerpts from the draft by Heiner Müller-Merbach, Chairman of FIACC

The characteristic property of modern machinery is functional intelligence. Not only computers, but also motor cars, trucks and traffic control systems, production equipment and flexible production systems, household equipment and communication systems etc. contain more and more intelligent components. This development was foreseen by the representatives of five international federations who founded FIACC, a coordinating committee, in 1970.

Machines with functional intelligence are often called "intelligent products". Such intelligent products require different fields of technical expertise which increasingly overlap:

- **Automatic Control:** Basically intelligent products are characterised by automatic control, i.e. they respond to signals.
- **Information Processing:** Response to signals requires information processing.
- **Measurement:** Signals are data which have to be produced by sensors.
- **Operational Research:** The design of systems - including implementation of new technology in social systems - requires planning based on mathematical models and optimisation, the domain of operational research.
- **Simulation and Computation:** Of particular importance for the design of systems are computation and simulation.

These five fields of technical expertise are represented by the five "Sister Federations" within FIACC:

- IFAC - International Federation of Automatic Control
- IFIP - The International Federation for Information Processing
- IMEKO - International Measurement Confederation
- IFORS - International Federation of Operational Research Societies
- IMACS - International Association for Mathematics and Computers in Simulation

In 1970 they founded:

- FIACC - Five International Associations Coordinating Committee

Structural Similarities

It is not only that the fields of expertise of the five federations overlap. There are also many structural similarities between the federations, such as:

- The federations serve the purpose of international exchange of knowledge, experience, and know-how among experts in the field, to promote their science and technology all over the world, and to support international standardisations.
- The activities of all the five federations started in the second half of the fifties, i.e. 25 to 30 years ago.
- The federations, save for IMACS, accept as members only scientific societies which are dedicated to that particular field of research and technology. These four federations represent member societies of some 40 countries each.
- Each federation organises a comprehensive international World Congress every three years. In addition they organise conferences, symposia, workshops and meetings on specialised topics. These are frequently co-sponsored by one ore more of the sister federations.
- The federations, except for IFORS, have established Technical Committees and Working Groups for special areas of interest.
- Not only technological matters are considered within the federations. They also cover fields of economics and society. Particular attention is paid to educational questions.

Such similarities are helpful conditions for the cooperation of the five sister federations.

The Function of FIACC

Neither scientific societies nor international federations carry out research and development themselves. This would be the task of individuals and teams of them in universities, research institutions and enterprises. Instead scientific societies and international federations serve the purpose to support communication among the individuals on a broad scale.

This understanding applies to FIACC as well. There are no scientific results of FIACC to report. FIACC merely serves the cooperation between the sister federations and builds bridges between the experts of the five fields.

- FIACC does not organize conferences, but coordinates mutual sponsorships of conferences between the sister federations.
- FIACC does not publish proceedings, monographs, textbooks, or journals, but supports the mutual information about the publications of the five federations.
- FIACC does not even publish a newsletter, but channels the mutual exchange of news between the sister federations.

The FIACC Representatives of the sister federations meet only once a year. The chairmanship of FIACC rotates among the sister federations every other year.

The purpose of FIACC is indirect in that through this Committee bridges between the five overlapping fields are provided. These bridges are documented in the many proceedings of joint conferences of the sister federations.

Tutorial Workshops Before and After the Munich IFAC-Congress

The Carl-Cranz-Gesellschaft (CCG) is a non-profit organization for continuing education in engineering. In its series "Dynamical Systems" three tutorial workshops will be offered in the weeks before and after the Munich IFAC congress. The location is Oberpfaffenhofen, 25 km west of Munich, in the DFVLR research center.

July 20-24, 1987:

Recent Advances in the Theory of Adaptive Control
(A. S. Morse, K. S. Narendra,
B. D. O. Anderson, P. V. Kokotovic,
G. C. Goodwin)

Aug. 3-6, 1987:

Nonlinear Control
(A. Isidori, A. De Luca, G. Meyer)

Aug. 3-4, 1987:

Stochastic Optimal Control and Estimation with Applications to Flight Vehicles
(J. L. Speyer)

Attendance is limited to 30 participants in each workshop. For further information and registration please write to:

Carl-Cranz-Gesellschaft
D-8031 Wessling-Oberpfaffenhofen
Phone: 08153 - 28-413

Economics and Artificial Intelligence
IFAC/IFIP/IFORS/IASC Conference
Aix-en-Provence, France, September 2-4, 1986

About 250 AI researchers and economists assembled in Aix-en-Provence in early September 1986 for the first International Conference. They explored the cross-fertilisation between Social Sciences (as represented by Economics, Management, Organization Theory) and Artificial Intelligence. It is important to note that they came from 25 different countries and six different scientific areas: Statisticians, management scientists, computer scientists, economists, systems engineers and neuro-scientists. It is noticeable that those differences do not prevent them from communicating and being able to understand each other: their languages appear to be rather similar although they did not perceive themselves initially as belonging to a common culture.

The weeklong Conference, sponsored by IFAC with the co-sponsorship of IFIP, IFORS and IASC, included 60 papers as well as a number of tutorials, demonstrations and poster sessions.

The keynote adress, presented by F. Varela on "Science and Technology of Cognition: Emergent Directions", charted the relationships among the neurosciences, AI, cognitive psychology and epistemology.

The final open meeting unanimously decided that the coordination of work in economics and AI should be vigorously pursued: a second conference on the same topic will be held in two or three years.

Adaptive Systems in Control and Signal Processing

2nd IFAC Workshop

Lund, Sweden, July 1-3, 1986

The first special IFAC activity on adaptive control was a Symposium on Optimization and Adaptive Control in Rome, 1962. This was followed by a symposium on Theory of Self-Adaptive Systems in Teddington in 1965 and the symposium on System Sensitivity and Adaptivity in Dubrovnik in 1968. After that adaptive control was discussed in other symposia, mainly in the very successful symposium series on Identification and Process Parameter Estimation initiated in Prague in 1967.

In 1981 the Theory Committee of IFAC created a working group on adaptive control chaired by Prof. Landau. This group initiated several activities in adaptive control. One goal was to try to bring the communities of control and signal processing closer together. A result of the activity was to organize workshops. The first workshop was called Adaptive Systems in Control and Signal Processing 1983. It was held in San Francisco. The second workshop in the series was held last year in Lund.

There were three plenary sessions and 192 submitted papers. We believe that this reflects the increasing interest in adaptive control. The papers were selected on the basis of extended abstracts. Of the submitted papers 83 were accepted. Five papers were withdrawn later. To maintain a workshop spirit in spite of the large number of papers we decided to run two applications sessions in parallel and we also introduced two poster sessions. They were held in two rooms each with about 10 papers presented. The sessions were very well attended and very well received, there was a lively spirit with lots of discussions particularly in the poster sessions. Many participants said that next time they would prefer to have their paper presented at a poster session.

There were 188 participants from 24 countries. We would like to thank the IPC, the speakers and all attendees for their contributions to a good workshop. Because of the great interest it has now been decided to expand the workshop to a symposium. The next meeting in this series will be held at the University of Strathclyde.

Karl Johan Åström
Chairman of the IPC

Gustaf Olsson
Chairman of the NOC

Distributed Computer Control Systems - DCCS-86

IFAC Workshop

Mayschoss/Bad Neuenahr, FRG, 30 September - 2 October 1986

The workshop convened approx. 50 specialists from 12 countries in a setup especially suited for intense work and communication.

The scientific program (24 papers) set up by the IPC chaired by Mike G. Rodd, was following lines given by the ongoing discussion in the "DCCS-family", a very active and creative group of persons. The continuity was displayed in the opening session which consisted of a state-of-the-art survey given by Greg Suski, chairman of the previous (85) DCCS, followed by a vivid discussion led by Mike Rodd — a new idea in IFAC.

The time between this session and the bracketing final panel discussion showing the results of the workshop was filled with working sessions on specific topics structured into 2 or 3 papers, followed by short individual discussions, and a general discussion on the whole subject. The main issues were "Construction" (Languages, Design, Simulation, Databases), "Communication" (especially MAP), "Fundamental Issues" (Hard Real Time, Fault-Tolerance, Scheduling) and "Applications for Accelerators and in Industry".

ADA seems to be no more of special interest for control people. This impression could be deducted both from the low number of ADA-papers and from the analysis given in Goldsack's contribution: ADA cannot help in distributed real time; but on the other hand there is no significantly better tool available. A very good contribution to "real things" was Windauer's paper on Distributed Real Time-Databases.

Quite different was the style of the communications sessions. Really hot topics were addressed and very good presentations given. MAP as it stands is not the communication means for hard real time distributed systems and is the common result of research done by Minet e.al., Janetzky/Watson, Damsker and Weehuizen/Rodd (due to performance shortcomings). Positive criticism came up in the very intense panel discussion. Grossniklaus described an interesting and operational alternative.

Sessions on Fault Tolerance and Scheduling were dominated by discussions on the definition of basic terms. Quantification of "error", "MTBF", "SRU" etc. in complex systems controlled by complex systems is necessary. While some theoretical presentations were not convincing (where is the relevance for the real control world), industrial reports and especially H. Kopetz' paper (together with the Mayer/Mc. Leod/Rodd paper mentioned below) were well accepted.

A very interesting and consistent group of papers was presented on accelerator control. They gave a full overview over these very complicated applications together with detailed analysis.

From the Industrial Applications session "The Design of Shoptalk" turned out to be one of the best papers of the Workshop: well presented, technically and theoretically sound, and showing real implementations.

Klaus D. Müller from KFA Jülich and his crew organized the event in a first class hotel in beautiful landscape 30 km outside Bonn; the management of sessions, technical visits, accommodation, meals and transportation, ladies and social program was perfect and highly appreciated by the attendees.

In general a very positive workshop, showing current work and trends. It should continue to be an annual event, and could attract also other typical DCCS application people, e.g. from aerospace and manufacturing.

V. H. Haase
Comput Chairman

Control and Real-Time Programming

IFAC Course

Shanghai, PRC, September 8—20, 1986

Organized by Prof. Ding Jiping from the Academia Sinica in Beijing, and Dr. Wu Qidi from the Tongji University in Shanghai, the course was taught by Dr. G. Maier, Prof. M. Mansour (IFAC Treasurer), and Prof. W. Schaufelberger (EDCOM Chairman), all from the Swiss Federal Institute of Technology in Zürich, Switzerland. The course was sponsored by IFAC through the Committee for the Support of Control Engineering Education in Developing Countries.

Forty professors and graduate students from many different Chinese universities and related institutions took part, i.e. from Shanghai, Beijing, Nanjing, Qingdao, Chuanchow, Shaanxi, Kunming, Hefei.

The following topics were treated in the course:

- Introduction, fundamentals of programming
- Development of computer science, Modula-2
- Development of control theory
- Development of artificial intelligence
- Software engineering
- Advanced topics in control
- CACSD, simulation
- Real-time programming
- Software for teaching
- Laboratories for teaching
- Applications: complex systems, power systems.

Lectures with broad overviews on the main topics were delivered from 9 to 11 in the mornings. Then one hour was spent to prepare the exercises which were carried out from 2 to 5 p.m. in a classroom with 20 IBM personal computers. The following programming languages and packages were introduced and used: Pascal, Modula-2, Forth, List (Xlisp), Prolog, Matlab. Some 20 papers that were duplicated and distributed formed the rather informal text material for the course.

In general, the course was certainly a success, as far as this can be stated by the teachers. The weak points that might be improved in the future are the following: There was too wide a spread in the knowledge of the participants. Due to the broad spectrum many participants were only interested in part of the material. Too many different subjects and languages were introduced for a two week course. Less would probably have been more.

The good cooperation with our Chinese colleagues and the kind hospitality during our stay in China made the course a unique experience for the teachers.

W. Schaufelberger

PLEASE NOTE

The last Newsletter No. 1, Feb. 1987 ran a survey on the Newsletter mailing list. Please be reminded to return the survey to the IFAC Secretariat, Schlossplatz 12, A-2361 Laxenburg, Austria, before

June 10, 1987.

In case of non-reply by that date your free of charge subscription will be automatically cancelled.

Components, Instruments and Techniques for Low Cost Automation and Applications, LCA '86

IFAC Symposium

Valencia, Spain, November 27-29, 1986

The LCA '86 IFAC Symposium was attended by 167 participants from 26 countries, among them were 86 from the host country.

It was sponsored by the IFAC Technical Committee on Components and Instruments, and co-sponsored by the TCs on Applications, Education and Developing Countries. The Symposium was organized by the "Comité Español de Automática" (CEA) the IFAC National Member Organisation for Spain, and the Department of Systems Engineering, Computers and Control of the Politechnical University of Valencia. The aim was to evaluate the possibilities of low cost control components, instruments and techniques for the development of reliable, multipurpose and easy-to-apply automation systems.

The International Programme Committee was composed of 26 members from 19 countries. A total of 137 abstracts were submitted from which a selection of 97 papers was included in the technical programme. A further 4 invited papers were also included in the programme.

Opening addresses were given by M. H. J. Lerma, President of the Autonomic Government of Valencia, Prof. J. Nieto, Rector of the Politechnical University of Valencia, Prof. M. Thoma, President of IFAC, and Prof. K. Reid, Chairman of the International Programme Committee.

A keynote address on Low Cost Automation was given by Prof. G. Ferraté, President of CEA. The other plenary sessions were given by Prof. R. W. Jones (Self Tuning Control: Towards Industrial Viability), A. Aguado (Microcomputer Controllers: Simplified Adaptive Control Algorithms) and J. W. Book (Low Cost Automation with Lighter Versatile Machines).

Most of the papers dealt with applications or were applications-oriented.

Two round tables were also included in the programme. The first one, chaired by Professor P. Albertos, dealt with low cost automation as viewed from different countries. The subject of the second one, chaired by Professor M. Najim, was the impact of LCA in developing countries. This subject raised the interest of UNESCO, which sent a representative to participate in the panel discussion.

One impression of the Symposium was that there is growing interest in the topic mainly because low cost automation is to some extent equivalent to practical application of automation. In this sense it is significant that over 60% of reported works deal with applications. Proceedings of the Symposium will be published by Pergamon Press.

P. Albertos
IPC Vicechairman

J. A. de la Puente
IPC Member

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The Journal of IFAC the International Federation of Automatic Control

Papers from the Next Issue — May 1987

Papers

A Microcomputer Based Control System for the Total Artificial Heart
(J. C. Wang, P. C. Lu, B. C. McInnis)

A Linear Quadratic Gaussian Control Algorithm for Sulphide Ore Grinding
(R. Ylinen, A. J. Niemi, T. Iivarinen)

Flight Test of a Digital Controller Used in a Helicopter Autoland System
(D. R. Downing, W. H. Bryant)

Optimization of an Enhanced Oil Recovery Process with Boundary Controls — A Large-Scale Nonlinear Maximization
(Z. Fathi, W. F. Ramirez)

A Multistage Reduction Technique for Feedback Stabilizing Distributed Time-Lag Systems
(Y. A. Fiagbedzi, A. E. Pearson)

On Robustness of Lurie Systems with Multiple Nonlinearities
(Lj. T. Grujic, Dj. Petkovski)

Decision Theory for Fault Diagnosis in Electric Power Systems
(L. Mili, Th. Van Cutsem, M. Ribbens-Pavella)

Optimal Control Problems over Large Time Intervals
(B. D. O. Anderson, P. V. Kokotovic)

Optimal Feedback Control of Nonlinear Systems
(H. Bourdache-Siguerdidjane, M. Fliess)

Brief Papers

Robust Micro-processor Control of Robot Manipulators
(M. W. Spong, J. S. Thorp, J. M. Kleinwaks)

Leak Detection Methods for Pipelines
(L. Billmann, R. Isermann)

Nonlinear Model Following
(E. Noldus)

Existence Condition of Positive-Definite Solutions for Algebraic Matrix Riccati Equations
(H. Kano)

Root Exclusion from Complex Polydomains and Some of Its Applications
(D. Hertz, E. I. Jury, E. Zeheb)

Technical Communiques

Book Reviews

Feedback Control of Dynamic Systems by G. F. Franklin, J. D. Powell, and A. Emami-Naeini
(S. J. Kahne)

Principles and Practice of Automatic Process Control by C. A. Smith and A. B. Corripio
(C. G. Proudfoot)

Nonlinear Control Systems: An Introduction by A. Isidori
(D. Hill)

Control Systems Engineering by S. P. Banks
(B. Wittenmark)

WHO IS WHO IN IFAC

Dipl.-Ing. Dr. sc. techn. h.c.
Dietrich Ernst
Chairman of the
National Organizing Committee
of the 10th IFAC World Congress

Born in Breslau, Germany, Dietrich Ernst took his Dipl.-Ing. degree in electrical engineering from the Stuttgart Technical University in 1954. In the same year, he joined Siemens in Erlangen, FRG, in the area of power plant engineering. In 1973, he became a Vice President of Siemens AG and Head of the "Systems Engineering Development Division" in the "Power Engineering and Automation Group". Today, the Systems Engineering Development Division employs about 2400 technicians, engineers, and scientists who are engaged in all fields of automatic control.

Dietrich Ernst has been an active participant in the development and realization of new automation approaches, especially in power plant technology. The introduction of integrated circuits into industrial electronics and the development of converter and drive engineering were all closely associated with his name, as are now the expansion and further development of process and production automation. His special goal has always been to streamline and rationalize the increasingly complex systems engineering and software production. In 1977, he received the honorary doctorate of technical sciences from the ETH Zürich in recognition of his outstanding efforts toward the automation of complex production systems.

Dietrich Ernst's publications include works on analog computers and industrial electronics. Through his great technical knowledge and experience, demonstrated in more than 75 papers – national and international –, he has had a decisive impact on automation development.

Mr. Ernst also plays a significant role in many federations and technical organizations. From 1976 – 78, he served as President of the VDI/VDE Gesellschaft Meß- und Regelungstechnik (now: Gesellschaft Meß- und Automatisierungstechnik, the German NMO of IFAC); 1979 – 80, he was Vice President of the Board of Directors of VDE (Verband Deutscher Elektrotechniker); and from 1981 – 82, President of VDE. From 1978 – 80, he served as member of the Presidency of Interkama and Head of Interkama-Congress 1980. Since 1985, he has been Chairman of the "Board of Trustees of Fraunhofer Institutes at Karlsruhe" and member of the "Max-Planck-Gesellschaft for the Advancement of Science". Presently, D. Ernst acts as Chairman of the National Organizing Committee for the 10th IFAC World Congress in Munich, 1987.