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Newsletter

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Control and Automation Beyond the Century

Keynote Speech given at the Opening of the 14th IFAC World Congress in Beijing, China, P.R., by Jian Song, Chinese Academy of Sciences

It is a great honor for the Chinese science and engineering communities to host the 14th IFAC World Congress in Beijing, PRC, the last congress in this century. I would like, on behalf of the Chinese scientific and engineering communities, to express my warmest welcome to all of you, colleagues, friends and your spouses from all over the world.

IFAC is 42 years old this year. Its Executive Council was established in 1957, and China was one of its founder members. I had to honor to attend the first Congress in Moscow in 1960. I still remember vividly that grand gathering, which finally pronounced the birth of IFAC to the world. Many great contributors to control theory in this century, including Norbert Wiener (1949), Lev Pontryagin (1961) and Rudolf Kalman (1961) attended the forum. Dr. H.S. Tsien (1954), a pioneer for engineering cybernetics was elected a Council member representing China. On that occasion, to the disappointment of many, Dr. Tsien was not able to be present at the Moscow Congress, because he had then been leading China's fledgling space program entrusted by the country's leadership.

In the 1950s Norbert Wiener really enraged some philosophers when he metaphorically equalized living creatures to machines in his book Cybernetics. The downpour denounce that followed was something like the verbal torrential by theologians on Copernicus (1473-1543) after he moved Planet Earth from the Universe's centre to a secluded and cool corner of the solar system. Some philosophers had even scolded cybernetics as a pseudo science.

The situation did not change until Dr. H.S. Tsien published his engineering Cybernetics in 1954. In his book Dr. Tsien expounded systematically on the significance of the new science and its potential impacts on communication, machine-building, aeronautics and astronautics. By 1960, when IFAC convened its first Congress, the anti-cybernetics campaign had faded out, and the critics had sneaked out of the scene. Thus IFAC's first Congress turned into a manifestation and a celebration of the triumph of cybernetics, which we now call control theory.

40 years have elapsed since then. Tremendous progress has taken place in control theory, automation techniques and their applications. Following the miraculous advancement of microelectronics and computer technology, control and automation have proliferated into all industries, including manufacturing, agriculture, communication, astronautics and the service industries. In the manufacturing industry, numerically controlled lathes, flexible manufacturing systems, CAD, CAM and CIMS have all become popular technologies. Robotics has dominated most of the mass production lines. As a result, productivity has increased enormously and man's capacity to invent and innovate enhanced industrial products has improved working and living conditions of human beings to a level beyond expectation.

In all walks of our lives today, automation is ubiquitous. Communication and the financing industries are almost completely computer-automated. The automation level of medical facilities are enhanced daily. Automated home appliances have become indispensable for housewives. In the past 50 years, control theory and automation techniques have contributed tremendously to the advancement of human civilization, so much that it will be remembered for many centuries to come.

The advancement of modern automation has opened up completely new avenues for scientific exploration previously beyond human reach. In the 1990s, robots were sent to explore ocean trenches 10.000 m below the surface of the sea. Space explorers were sent to Venus, Mars, Jupiter and to some asteroids and comets. The Hubble Space Telescope now orbiting the earth has provided astronomers with extraordinary tools and chances to explore the universe, impossible before. In 1997, the Pathfinder vehicle, manufactured and controlled by American scientists, successfully landed on Mars and accomplished a mission of surface investigation. The mission is one of the highest accomplishments of control and automation technology in this century.

We are proud of the remarkable progress in the development of control theory over the past four decades. The new achievements in control theory allow us to design and build much more effective and reliable controlled systems with intrinsic nonlinear objects. (Chen and Guo, 1998; Isidori, 1989) As we know, very few systems can be treated linearly in this world and linear approximation has been employed often as the last resort. Based on differential manifolds, with intrinsic nonlinear framework and rich geometric structure such as Riemannian and Symplectic Geometry, lie group, fiber bundle, a wide class of non-linear dynamic systems may lead control theory to fruitful new avenues and give unexpected vistas. The coming into being of the theory of discrete event dynamical system (DEDS) has greatly enhanced our capacity to describe and analyze discrete control systems, which is of great significance to the manufacturing and service industries (Baletni,et.al, 1993; Ho and Cao, 1991). New breakthroughs in the control theory of distributed parameter systems may facilitate the understanding and building of control systems for objects with continuum media (Li and Yong, 1995; Song and Yu, 1978; Bensoussan, et al., 1992). The H infinite control with uncertainties and the theory of robust systems are of special significance for the design and analysis of controlled systems. It has been seen that theory of methodology of system and parameter identification has an irreplaceable value in processing stochastic information and data of irregular sources (Chen and Guo, 1991; Aström and Wittenmark, 1995). New developments in theories of system self-adaptation, self-correction, self-organization and error tolerance, and a combination of these qualities have added much to the intelligence of control systems and ushered us into a new and promising area of research: The Intelligent Control Theory (Aström and Wittenmark, 1995; ICIA Proceedings, 1993).

The development and wide application of robotics is the highest achievement of automation and control in this century (Luo and Qin, 1997; Cai,

1997). In merely 20 years' time, robots have learned to walk on bipedal from crawling, as against one million years for human beings to stand up. Robots can now operate tools with hands, have the ability to see, listen and speak multilingually. There are millions of robots operational on production lines across the world, more than one thousand firms manufacturing robots and their annual sales revenue is increasing dramatically. Along the Superhighway Internet, robotics has set up high aspirations to permeate every corner of society, to penetrate into the service industries of the 21st century, to serve as taxi drivers, hospital nurses, bank tellers and helpers to families of aged people. Robots are willing to tackle the dirtiest and heaviest jobs and work in a most contented and reliable manner. Had microelectronics gone one step further, the IBM AS/6000 SP could have been squeezed into the head of a robot and run the Deep Blue, which defeated World Champion Gary Kasparov in May 1997, as Isaac Asimov imagined; the robot would have a mathematical wiz, do triple integrals in its head and eat up tensor analysis for dessert! (Asimov, 1991).

The worries about causing unemployment and anti-automation trend of thoughts in the 1960s have been proven groundless. The countries that employ the highest number of robots do not suffer from the highest unemployment rates. Even if there were a rise, no one would blame control scientists and engineers. It is the financers and politicians who are to blame. On the contrary, the wide application of intelligent automation technology is helpful to improve the quality of life, to increase labour productivity and to create more job opportunities.

Control theory, its concepts and methodology, associated with computer science, have gone far beyond the industrial production and military equipment which had once been the main sectors of service 40 years ago. Automation and control are now found applicable in all political, military and social sciences. In fact, economists have benefited much from control theory for decades. The concepts and jargons of control theory, like negative/positive feedback, bifurcation, nonlinear system, system engineering, etc. have been widely accepted and borrowed over by all disciplines of natural and social sciences. Moreover, this situation has often led to unexpected new discoveries. Universities the world over have made control theory a compulsory course for students of engineering schools and an optional course for students of social sciences.

To the delight of control scientists, in recent years, many politicians and state leaders have begun to understand the importance of this theory, its concepts and methodology. Many of them use control language in their speeches and papers to explain social and political issues. One case in point is the American Vice-President Al Gore: In his book "Earth in the Balance" (Gore, 1992), control concepts and language are widely used to discuss social items. when statesmen are cornered in thorny political issues, they often pin hopes on control scientists and expect them to lend a helping hand, even though the latter's research never touches upon politics. This situation gives system control scientists comfort.

In the last two decades, control theory and system science have indeed exerted tremendous influence on the social and political life of international communities. I would like to cite the development of population control theory as one of the typical examples.

Since 1789, when Thomas Malthus published his First Essay on Population (Malthus, 1789), scientists and politicians debated on the population issue for almost 200 years. In the 20th century, especially after the Second World War, the explosive increase of the world population caused deep concern within the scientific communities. In September 1994, the United Nations convened a summit in Cairo to discuss human population issues. How to control population growth was the main theme. Today, the world's population is (almost) 6 billion, as against 3 billion before the Second World War, and will continue to grow at an alarming rate of 80 million annually. According to the UN projection, the global village may have to accommodate more than 10 billion people in the second half of the 21st century. The increase will be mainly in the developing countries, particularly in Asia and Africa. Asia will have 6 billion, as against 3.6 billion today, 57 per cent of the present total. Two thirds of Asians today are Chinese and Indian, totalling over 2 billion. Scientists fear that, if population growth is not controlled, it will soon surpass the carrying capacity of the Earth. It is a common belief that sustainable development would remain a dream in the 21st century until population growth is brought under control.

In the 20th century, many demographers have studied population issues quantitatively (Polard, 1973, Keyfitz, 1977; Coales, 1972). Since the 1980s, control scientists have stepped in with unexpected new findings (Coales, 1972; Song and Yu, 1988; Song, 1982; Yu and Zhu, 1993, Song, 1995). they found out the criteria of stability for population dynamics and the formula of its calculation based on standard census data. It appears that in demographic census, there is a key index, called Total Fertility Rate (TFR), meaning the average childbirths per female in a lifetime. Armed with the theory of system stability, it is easy to prove (Song and Yu, 1988; Yu and Zhu, 1993) that for the TFR of every nation, there exists a critical value, or what we call double-edged limit of fertility. If TFR is greater than its critical value for long, the first eigen-value of the equations of population dynamics becomes positive, then the population size will be increasing intrinsically. If TFR is controlled below its critical value, the eigen-value becomes negative, and the population size will go down. If TFR is kept at the critical value, the population size will be stabilized at some level sooner.

We are pleased that the Chinese government has accepted the above theory and thus formulated China's family planning policy. China's TFR was 2.7 in the early 80s, but dropped to 1.8 in 1977, well below the critical value of 2.1. If the current policy is continued, China's population will cease to grow within 30 years. At least we are safe to say now that China will not have a "population explosion".

Standing at the threshold of the 21st century, it would be useful to look back upon the modern history of human civilization. If we say that, in the 19th century, physical labour was mechanized and man's physical power was extended, then in the 20th century, mechanized labour was automated. It brought about a leap in productivity, improved living conditions and an extended life expectancy. The capability of generating social wealth is greater than at any time in history. A complete change of the mode of living and of production has taken place within society. It fills us with pride that control scientists and engineers were among those who have contributed the lion's share. It is expected that, in the 21st century, automation will continue to be at the forefront of high-tech developments and the core force of the new technological revolution. The manufacturing and service industries will continue to be the main sectors for control scientists to win glory. The manufacturing and service industries are and shall forever be the pillars to sustain the world economy and to prop up human progress. The manufacturing sector generates 30 per cent of the GDP even in the developed world today.

Looking into the 21st century we cannot but notice that a number of strategic issues have emerged that warrant attention of the world. The first challenge is to guarantee food security and the supply of daily necessities when the world population is doubled. Production and the safe supply of material wealth will forever be fundamental for human existence and development. We cannot forget that 80 percent of the present world population still live in developing countries, and one billion people are starving. The UN passes resolutions every year and scientific communities appeal repeatedly to all national governments to take the responsibility to ensure food security for all in the next century. It will continue to be a formidable task for us to advance, disseminate and popularize automation technology in manufacturing, farming and all walks of life in order to raise social productivity and eliminate poverty.

We have noticed a new argument made by some writers recently, advocating "immaterial economic growth" and that mankind will use more bytes and fewer atoms. I believe that the role of the information technology in the 21st century can never be overestimated.

It is irrefutable that applications of control theory and automation should continue to expand in the 21st century. Control scientists are to be invited to step forward and lend a hand in finding solutions to many issues of global importance, such as the prevention of financial crises, population control, food security, protection of the eco-system, the forecast and control of climate changes, etc., in short, to study and find solutions for large-scale or mega-systems.

Today, system modelling, or system analysis and simulation have become indispensable tools for almost all fields of research. Other concepts and methodology, such as system identification, filtering, parameter estimation, optimal control, fuzzy control and robust analysis, are often found useful and employed extensively by professionals outside control and automation. State leaders of many countries have sincerely invited control experts to help in the research on major social and political issues. This trend is expected to become much stronger in the next century.

Let me cite one convincing example. Climate change is one of the hottest issues nowadays. After the clamor in the news media over recent years, people have developed a keen awareness, and the United Nations has put it at the top of its agenda. First it was acid rain, then the ozone hole, now the global warming, sea-level rising, scorching heat in the summer, chilling coldness in the winter, melting ice caps, etc. Hardly does a day go by without news reports announcing that the world is doomed. In fact, everything we hear about climate changes comes from system analysis and computer simulation made by meteorologists and climatologists.

The principal model used for long-term prediction of climate change is called General Circulation Model (GCM) (Houghton, 1994; Crispin, 1986; Houghton, 1996; Weber, 1994; Yan, 1997; Wang, 1997; Gates, 1995; David, 1987; Lorenz, 1984). It includes over 10 groups of partial differential equations covering atmosphere, oceans, heat, vapour, rain clouds, the boundary conditions of the surface temperature of the earth, sources and sinks of vapour, and initial conditions of cross feedback between oceans and atmosphere. (Yan, 1997; Wang, 1997; Williamson, 1987) For computer simulation of short- and mid-term meteorological forecast there are about 200 million algebraic equations to be solved, up to 20.000 sets of surface boundary conditions and 70.000 sets of satellite remote sensing data need to be processed every time. Meteorologists admit that there are many uncertain elements in this model, even to the extent that "up till now we have not truly understood the mechanism of global climate change" (Yan, 1997). Moreover, meteorologists have all used their own models and over 40 different models exist, including 14 in the USA alone (Gates, 1995).

We should pay high respect to meteorologists and climatologists for their brave initiatives to crack a hard nut, and hail what they have achieved so far. We can really understand the grandeur and arduousness of the issue they are confronted with, when recalling the great number of jokes on short-term weather forecasts. Dr. E. Lorenz, a famous meteorologist, had no alternative but to call them "butterfly effect" and "chaos" (Lorenz, 1991).

The meteorologists, armed with the most advanced and powerful computer systems in the world, have yet to come to satisfactory results with respect to mid-term weather forecasts for some weeks, let alone for the weather of the next season, not to speak of forecasts beyond several decades or 100 years. It is my firm belief that this situation needs participation of or a helping hand from control scientists and mathematicians, in the way as was given by Lev Pontryagin (1961) and C. Shannon (1949) for control theory 40 years ago.

As early as in the 1950s, people found out that computers could do many other things in addition to numerical calculation, such as logical inference, databank, image processing and chess games. There appeared then a new topic of research, i.e. artificial intelligence (AI). The first International Joint Conference on Artificial Intelligence, held in the USA in 1969 (Walker and Norton, 1969), inaugurated the studies on computational intelligence. Meanwhile, the monumental breakthroughs in molecular biology and life science, the discovery of the double helix structure of DNA in chromosome - the key mechanism of life heredity, has given rise to new enthusiasm for the investigation into artificial life.

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It has been a long-sought goal for natural sciences to understand the scientific principles of life (Kolmogorov, 1962; Prigogin, 1980; Gellmann, 1994; Davies, 1989; Badii and Politin, 1977; Eigen and Schuster, 1979). The perfect performance of control systems in living organisms, which ensures the emergence, development, metabolism, immunity and heredity in the animal world, has attracted the attention of scientists for many decades. Only when people started serious discussions on the essence of life and artificial intelligence, did they realize that in the control theory and in the large amount of automated facilities there already exist elements of life and artificial intelligence (Kolmogorov, 1962; Gellmann, 1994; Davies, 1989). A consensus has now been reached in the scientific community that control theory and automation have played their role in the understanding of life.

Driven by the advancement of life science and artificial intelligence, there was a growing trend to increase intelligence of the control system. In 1992, a new organization, the International Federation on Intelligent Automation was established, indicating that intelligent control had entered the forefront of scientific studies. There is some consensus about the orientation and common principles for the future study of intelligent control systems. I will list some of them.

First, investigation and emulation of human intelligence is our ultimate goal. By calling a control system intelligent, we emphasize its ability to reason or understand signals received (visual, audio and verbal), to learn new knowledge during its operation and to make decisions by inductive and deductive inference.

Second, to build high-level intelligent control systems will depend on a multi-discipline research and new qualitative breakthroughs. A deeper understanding of the mechanisms and functions of the human neural system, the ability of self-organization, immunity and heredity in living systems, is absolutely necessary for the creation of new theory and design of intelligent control systems. This is primarily the topic of study for biochemists and geneticists, but control scientists and engineers can contribute their share.

Third, the growth of intelligence of a system comes not solely from the pile-up of subsystems. It shall rather come from the organizing principle "the whole is greater than the sum of its parts". It is not enough to rely on nonlinear effect either. The higher the intelligence, the more complex is the system. A complex system is bound to have hierarchical structures and behaviours. A harmonic unification of the functions of the subsystems and the whole should be the fundamental principle determining the vital feature of control in living organisms. Every level in the hierarchy should have its own qualities and up-and-down compatibility with friendly interface to neighbours. The extraction of macroscopic state of gases derived from the dynamics of molecules in statistical mechanics is an outstanding example of the differentiation of hierarchical levels. This provides the best explanation of what physicists call "coarse-graining" extraction.

Fourth, the evolution of any form of life takes shape gradually. It took 10.000 years for mankind to hobble from the Neolithic era to the era of mechanization. However, it only took 100 years to step up from mechanized to electronic automation. It may still take several decades to reach intelligent automation and to uplift the IQ level of robots to that of the early Homo Sapiens. The astonishing achievements of microelectronics, life science and automation technology in the second half of the 20th century have created a sound starting point for the advancement of intelligent control and automation into the next century. To this end we need not only innovation in technology, but also new breakthroughs in scientific thinking and theory.

Many scientists argue that in this context we need to discover new principles or modify the known laws of physics. Only by doing so could human intelligence be fully understood and imitated, and highly intelligent automatic control systems be designed and manufactured. In any case, the process has already started. It might be imagined that 50 years later, when IFAC convenes its 31st Congress, human productivity would be 10 times higher than today; each old person would then have a robot server to look after his or her daily life, and each congress participant would have a robot secretary instead of today's electronic notebook.

The 21st century will be a historical period of particular importance for mankind. The world population will stabilize at a fairly high level (e.g. 12 billion, twice the present size). The scientific community and especially control scientists and engineers will have to make their own contribution to survival and the sustainable development of mankind and of our home - the Earth. This is a nature-endowed mission to us to ensure that our future generations live more happily in a world free of shortage, hunger and pollution. We believe that, in the foreseeable future, the evolution of nature including mankind will give way to the advancement of science and civilization of human society. The word cybernetics comes from the Greek language, meaning helmsman. We are qualified to be scientific advisor or assistant to the helmsman at least. It is our pleasant duty to play a greater role in promoting social progress in the next century.

In conclusion, I sincerely wish our IFAC family and community ever greater prosperity in the new century, and our 14th Congress a complete success.

IFAC Outstanding Service Award OSA

In the last issues of the IFAC Newsletter we have written a lot about the various awards, given by IFAC as a Federation, by the Congress organizers and by Elsevier, the IFAC publisher. All these awards are presented for technical achievements, for excellence in scientific work and presentation. But there is another award, called Outstanding Service Award, which was first presented at the IFAC World Congress in Tallinn in 1990. This award is not accompanied by a monetary prize, but is given solely to acknowledge many years of service to IFAC. Most of you will know that serving in a function to IFAC is a voluntary activity, involving a lot of work, travel and organization by the person concerned, but no financial compensation whatsoever. Not even the expenses of travelling to IFAC administrative meetings are covered by the Federation. The only remunerated positions are the ones at the IFAC Secretariat in Laxenburg. But the office of the Secretary is again one for which only compensation for travelling and time is paid. Over the years this has helped to make IFAC a financially sound organization, in addition to being a huge success from the scientific point of view.

A way was then sought, at the end of the 1980s to acknowledge all those who have served IFAC in a voluntary position over many years and criteria were worked out who should be eligible for such a distinction. One major criterion is that the person such distinguished must have served IFAC three three-year terms (9 years altogether) in specific offices, including the offices of Council members, Executive Board members, Technical Board members. Every persons meeting these criteria receives a lapel pin and a certificate. So far the OSA presentation has taken place four times, starting at the World Congress in Tallinn. Since this award is not given for scientific achievements, it is not usually presented at the opening or closing ceremonies of the Congresses, but rather at a more informal occasion. But we believe that the IFAC community should know who the persons were and are who work for IFAC, in addition to many other volunteers on Technical Committee and Executive Committee level. This is why this Newsletter will give a survey of the persons who have received the Outstanding Service Award so far.

1990
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1993
A.van Cauwenberghe (BE), G. Hencsey (HU), L. Keviczky (HU), M. Kümmel (DK), B. Levine (US, L. Ljung (SE)

1996
D.P. Atherton (UK), E.J. Davison, V. Kucera (CZ), Y.Z. Lu (CN), M.G. Rodd (UK), P. Uronen (FI)

1999
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WHO IS WHO IN IFAC

Prof. Denis Dochain, IFAC Council Member

Denis Dochain was born in Mont-sur-Marchienne on July 31, 1956. He received his degree in Electrical Engineering in 1982 from the Université Catholique de Louvain, Belgium. He completed his Ph.D. thesis in 1982 and a « thèse d'agrégation de l'enseignement supérieur » in 1986 and 1994, respectively, also at the Université Catholique de Louvain, Belgium. He was CNRS associate researcher at the LAAS (Toulouse, France) in 1989, and Professor at the Ecole Polytechnique de Montréal, Canada in 1987-88 and 1990-92. He has been with the FNRS (Fonds National de la Recherche Scientifique, National Fund for Scientific Research), Belgium since 1990. Since September 1999, he is Professor at the CESAME (Center for Systems Engineering and Applied Mechanics), Université Catholique de Louvain, Belgium, and Honorary Research Director of the FNRS. He is associate editor of the "Journal of Process Control", and member of the International Advisory Board of the "Canadian Journal of Chemical Engineering".

His main research interests are in the field of distributed parameter systems, nonlinear systems, parameter and state estimation, and adaptive control with application to bioprocesses, chemical processes, pulp and paper processes, polymerisation reactors, and electric systems.

He was elected member of the IFAC Council at the General Assembly in Beijing, July 1999.

The IFAC Homepage

Over the past three years, the IFAC homepage, to be found at

http://www.ifac-control.org

has developed into a widely used tool for the dissemination of news and information about IFAC. Now, at the beginning of the new triennium and at the start of the new millennium, IFAC has updated the information on the homepage to provide the most up-to-date facts and current news. The calendar of IFAC events, links to meetings homepages, deadlines and contact addresses are updated on a continuous and regular basis. The IFAC Newsletter is now also available in electronic form, in addition to the printed version. We offer the mailing of the printed version and, as alternative or in addition, the e-mailing of the electronic version or the e-mail note that the Newsletter is available on the homepage.

IFAC Information Brochure Edition 1999

The 1999 edition of the IFAC Information Brochure is now ready and can be obtained from the IFAC Secretariat.

IFAC FORTHCOMING EVENTS

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Title	2000	Place	Deadline	Further Information
IFAC Workshop Aerospace Applications of the Global Positioning System	Jan. 31 – 02 Feb.	Breckenridge CO, USA	30 November 1999	Ms. Angie Bukley, SMC/TMAC The Aerospace Corporation, 3300 Target Road, Building 760 Kirtland AFB, New Mexico 87117, USA FAX: +1/505/846 1675 e-mail:bukley@plk.af.mil http://www.estec.esa.nl/CONFANNOUN/gps/index.html
IMACS/IFAC Symposium 3rd Mathematical Modelling – MATHMOD 2000	Feb. 2 – 4	Vienna Austria	–	Prof. Inge Troch, Vienna Univ. of Technology Wiedner Hauptstrasse 8 - 10 A-1040 Vienna, Austria FAX: +43/1/586 29 59 e-mail: inge.troch@tuwien.ac.at http://simtech.tuwien.ac.at/3rdMATHMOD
IFAC Workshop Programmable Devices and Systems – PDS 2000	Feb. 8 – 9	Ostrava Czech Rep.	–	VSB-Technical Univ. of Ostrava 17, Iistopadu 15, CZ-70833 Ostrava,Czech Rep FAX: +420/69/699 3138 e-mail: karel.vlcek@vsb.cz
IFAC Workshop Lagrangian and Hamiltonian Methods for Nonlinear Control	March 16 – 18	Princeton NJ, USA	–	Prof. Naomi E. Leonard Princeton Univ, MAE Dept, Equad. Rm.D209 A Princeton, NJ, 08544 USA FAX: +1/609/258 6109 e-mail: naomi@princeton.edu http://graham.princeton.edu/~auvlab/workshop.html
IFAC/(IMEKO) Symposium Modelling and Control in Biomedical Systems – BIOMED 2000	March 30 – April 1	Karlsburg Germany	–	IFAC Biomedical Symposium Secretariat Institute of Diabetes „G. Katsch" Karlsburg e.V. Greifswalder Str. 11 e D-17495 Karlsburg, Germany FAX: +49 38355 68444 e-mail: diab@rz.uni-greifswald.de http: www.diabetes-karlsburg.de
IFAC Workshop Digital Control: Past, Present and Future of PID Control	April 5 – 7	Terrassa Spain	–	Comite Espanol de la IFAC (CEA-IFAC) Secretary of PID'00 R. Sant Nebridi, 10, E-08222 Terrassa, Spain FAX: +34/93/739 86 28 e-mail: pid00@esaii.upc.es http: www-esaiiterrassa.upc.es/pid00
IFAC/CIGRE Symposium Power Plants and Power Systems	April 26 – 29	Brussels Belgium	–	IBRA/BIRA Federation Attn. Mr. F. Desclefs – General Secretary Ravensteinstreet 3, B-1000 Brussels, Belgium FAX: +32 /2 /511 7004 e-mail: ifac2000@skynet.be http: www.fpms.ac.be/~ibra/
IFAC Workshop 6th Algorithms and Architectures for Real-Time Control – AARTC2000	May 15 – 17	Palma de Mallorca, Spain	15 December 1999	Prof. Vicente Hernandez Garcia Dept. of Information Systems and Computation Polytechnic University of Valencia Camino de Vera s/n, E-46020 Valencia, Spain FAX: +34 96 3877359 e-mail: vhernand@dsic.upv.es http://www.disca.upv.es/aartc2000
IFAC Workshop Real Time Programming – WRTP2000	May 17 – 19	Palma de Mallorca, Spain	15 December 1999	Prof. Alfons Crespo Dept. of Information Systems and Computation Polytechnic University of Valencia Camino de Vera s/n, E-46020 Valencia, Spain FAX: +34 96 3877 579 e-mail: alfons@disca.upv.es http://www.disca.upv.es/wrtp2000
IFAC Workshop Instability Resolution in Regions of Long Confronted Nations – SWIIS 2000	May 22 – 24	Skopie Macedonia	20 February 2000	Dr. Mile J. Stankovski Fac. of Electrical Engineering Karpos 2 B.B., POB 574 MK-91000 Skopje, Rep. of Macedonia FAX: +389/91/364262 e-mail: milestk@freemail.org.mk
IFAC Symposium (9th) Control in Transportation Systems 2000	June 13 – 15	Braunschweig Germany	–	Prof. E. Schnieder Inst. f. Regelungs- und Automatisierungs-technik, Langer Kamp 8 D-38106 Braunschweig, Germany Fax: +49/531/391 5197 e-mail: trans-system2000@tu-bs.de http: //www.ifra.ing.tu-bs.de/ifac/
IFAC Symposium Fault Detection, Supervision and Safety for Technical Processes – SAFEPROCESS 2000	June 14 – 16	Budapest Hungary	–	Prof. Andras Edelmayer Computer and Automation Institute H A S, Kende u. 13 – 17 H-1111 Budapest, Hungary FAX: +36/1/386 9378 e-mail: edelmayer@sztaki.hu http://www.sztaki.hu/conferences/safeprocess2000
IFAC Symposium Advanced Control of Chemical Processes – ADCHEM 2000	June 14 – 16	Pisa Italy	–	IFAC ADCHEM 2000 Prof. Alessandro Brambilla Dip. of Chem. Engg., University of Pisa Via Diotisalvi, 2, I-561226 Pisa, Italy FAX: +39/50 511266 e-mail: adchem2000@ing.unipi.it http: //adchem-2000.diccism.unipi.it http://adchem-2000.ing.unipi.it

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Title	2000	Place	Deadline	Further Information
IFAC Symposium (7th) Automated Systems Based on Human Skill – Joint Design of Technology and Organization	June 15 – 17	Aachen Germany	1 Jan. 2000	VDI/VDE GMA IFAC – NMO Secretariat POB 10 11 39 D-40002 Düsseldorf, Germany FAX: +49/211/6214 161 e-mail: rosenzweig@vdi.de http://www.vdi.de./gma/call-joint-design.htm
IFAC Conference Control Systems Design	June 18 – 20	Bratislava Slovak Rep.	–	Prof. Stefan Kozak, Ilkovicova 3 SK-81219 Bratislava, Slovak Rep. FAX: 42/7/65429734 e-mail: kozak@kasr.elf.stuba.sk http://www.kasr.elf.stuba.sk/csd2000
IFAC Symposium Robust Control Design – ROCOND 2000	June 21 – 23	Prague Czech Rep.	–	Dr. Michael Sebek Institute of Information Theory and Automation CZ-18208 Prague, Czech Rep. FAX: +420/2/6884554 e-mail: msebek@utia.cas.cz
IFAC Symposium 12th System Identification – SYSID 2000	June 21 – 23	Santa Barbara CA, USA	–	SYSID 2000 Secretariat Dept. of El.& Comp. Engineering University of California Santa Barbara, CA, 93106, USA FAX: +1/805/893 3262 e-mail: sysid2000@ece.ucsb.edu http://www.ece.ucsb.edu/ccec/SYSID2000
American Control Conference ACC2000 (in cooperation with IFAC)	June 28 – 30	Chicago, IL USA	–	Prof. A. Haddad, AACC Secretariat Dept. of ECE, North Western Univ. 2145 Sheridan Road Evanston, IL 60208-3118, USA FAX: +1/647/491 4456 e-mail: acc00@ece.nwu.edu http:che.vill.edu/acc.2000./acc.html
IFAC Workshop Control Applications of Optimization	July 3 – 6	St. Petersburg Russia	1 Jan. 2000	CAO 2000 Organizing Committee St. Petersburg State University Fac. of Applied Mathematics and Control Processes, Bibliotechnaya pl. 2, Petrodvorets St. Petersburg 198904, Russia FAX: +7/812/428 7189 e-mail: cao2000@apmath.spbu.ru http: http://www.apmath.spbu.ru/cao2000/
Asian Control Conference ASCC 2000 (in cooperation with IFAC)	July 4 – 7	Shanghai China	–	The Secretariat of ASCC'2000 c/o Dept. of Automation Shanghai Jiaotong University Shanghei 200030, China FAX: +86/21/629 32045 e-mail: secretariat@ascc2000.sjtu.edu.cn http://ascc2000.sjtu.edu.cn
IFAC Conference Technology Transfer in Developing Countries Automation in Infrastructure Creation	July 5 – 7	Pretoria South Africa	–	Prof. Ian K. Craig Dept. of Electrical and Electronic Engg. University of Pretoria, Pretoria, South Africa FAX: +27/12/362 5000 e-mail: icraig@postino.up.ac.za http://www.ee.up..ac.za/decom/
IFAC/(IFIP/IEEE) Conference 2nd Management and Control of Production and Logistics – MCPL 2000	July 5 – 8	Grenoble France	–	Prof. B. Descotes-Genon L A G, ENSIEG-INPG, BP 46 F-38402 Saint Martin-d'Heres-Cedex, France FAX: +33/04/76826388 e-mail: mcpl@lag.ensieg.inpg.fr http://www-lag.ensieg.inpg.fr/conferences/mcpl2000
IFAC Conference Modelling and Control in Agriculture Horticulture and Post-Harvest Processing – AGRICONTROL 2000	July 10 – 12	Wageningen Netherlands	–	Congress Office Wageningen Agricultural Univ., Costerweg 50 NL-6701 BH Wageningen, Netherlands e-mail: Joost.Meulenbroek@alg.vl.wau.nl http://www.aenf.wau.nl/conf2000
IFAC Conference Manufacturing Modelling, Management and Control – MIM 2000	July 12 – 14	Patras Greece	15 Dec. 1999	MIM 2000 Symposium Secretariat Lab. for Automation and Robotics Dept. of El. & Computer Engg. GR-26500 Rion Patras, Greece FAX: +30/61/997309 e-mail: groumpos@ee.upatras.gr http://www.lar.ee.upatras.gr/mim2000/
IFAC Workshop Future Trends in Automation of the Mineral and Metal Processing	August 22 – 24	Cruise liner Silja Serenade Helsinki/Stockholm	1 January 2000	Finnish Society of Automaiton MMM2000 Secretariat Asemapäällikönkatu 12 B FAX: +358/9/146 1650 e-mail: atufin@ibm.net http.://kepo.hut.fi/IFACMM_Workshop2000/
IFAC Conference (5th) Manoeuvring and Control of Marine Craft – MCMC 2000	August 23 – 25	Aalborg Denmark	20 January 2000	Prof. Mogens Blanke, Dept. of Control Engg. Aalborg University, Fredrik Bajers Vej 7C DK-9220 Aalborg, Denmark FAX: +45/98/151739 e-mail: mcmc2000@control.auc.dk http://www.control.auc.dk/MCMC2000
IFAC Symposium (8th) Computer Aided Control Systems Design – CACSD 2000	Sept. 11 – 13	Salford UK	–	CACSD 2000 Sec, IEE Control, Savoy Place London WC2R 0BL, UK FAX: +44/171 497 3633 e-mail: j.o.gray@eee.salford.ac.uk http://www.iee.org.uk/Control/CACSD2000/

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Title	2000	Place	Deadline	Further Information
IFAC Workshop Linear Time Delay Systems	Sept. 11 – 13	Ancona Italy	15 January 2000	Prof. Giuseppe Conte Dip. di Elettronica e Automatica Universita di Ancona, Via Brecce Bianche I-60131 Ancona, Italy FAX: +39/071/2804334 e-mail: gconte@popcsi.unian.it http://dipmat.unian.it/LTDS2000
IFAC Symposium (4th) Intelligent Components and Instruments for Control Application – SICICA 2000	Sept. 13 – 15	Buenos Aires Argentina	–	AADECA, Av. Callao 220 1o B 1022 Buenos Aires, Argentina FAX: +54/1/372-3780 e-mail: gerencia@aadeca.net http://www.aadeca.org
IFAC Conference Mechatronic Systems	Sept. 18 – 20	Darmstadt Germany	–	VDI/VDE-GMA, Mechatronics 2000 POB 10 11 39, D-40002 Düsseldorf, Germany FAX: +49/211/6214-161 e-mail: mechatronics2000@vdi.de http://www.vdi.de/gma/mechatronics2000.htm
IFAC Symposium Robot Control – SYROCO 2000	Sept. 21 – 23	Vienna Austria	29 Feb. 2000	SYROCO 2000 Inst. for Handling Devices and Robotics Vienna University of Technology Favoritenstrasse 9, A-1040 Vienna, Austria e-mail: syroco@ihrt1.ihrt.tuwien.ac.at http://www.ihrt.tuwien.ac.at/SYROCO/
IFAC Symposium Artificial Intelligence in Real-Time Control – AIRTC 2000	October 2 – 4	Budapest Hungary	–	Prof. Imre Rudas, Nepszinhaz u. 8 H-1081 Budapest, Hungary FAX: +36/1/333 9183 e-mail: rudas@zeus.banki.hu
Latin American Control Conference (in cooperation with IFAC)	Nov. 1 – 3	Cali Colombia	18 February 2000	Prof. F. Naranjo Perez e-mail: fnaranjo@verne.cuao.edu.co
IFAC Workshop Bio-Robotics, Information Technology and Intelligent Control for Bio-production Systems – BIO-ROBOTICS II	Nov. 25 – 26	Osaka area Japan	1 February 2000	Prof. Naoshi Kondo Faculty of Agriculture Okayama University 1-1-1, Tsushima-Naka Okayama 700-8530, Japan FAX: +81/86/251-8351 e-mail: nkondo@cc.okayama-u.ac.jp
IFAC/IEEE Symposium (5th) Advances in Control Education ACE – 2000	Dec. 17 — 19	Gold Coast Australia	30 January 2000	Dr. Ljubo Vlacic School of Microelectronic Engg. Griffith University, Nathan, Qld. 4111, Australia FAX: +61/7/3875 5384 e-mail: ace2000@me.gu.edu.au http.//www.gu.edu.au/centre/icsl/ace2000/

Title	2001	Place	Deadline	Further Information
IFAC Workshop Advances in Automotive Control	March 28 – 30	Karlsruhe Germany	30 June 2000	Prof. U. Kiencke Univ. of Karlsruhe, Institut f. Industrielle Informationstechnik, Hertzstrasse 16 D-76187 Karlsruhe, Germany FAX: +49/721/608-4500 e-mail: kiencke@iiit.etec.uni-karlsruhe.de
IFAC/IFAC/IEEE Conference Feature Modelling And Advanced Design- For-The-Life-Cycle-Systems FEATS2001	June 12 – 14	Valenciennes France	15 Dec. 1999	The Secretariat of FEATS2001 University of Valenciennes LAMIH/GIL Le Mont Houy – BP 311 F-59304 Valenciennes Cedex, France FAX:+33/327 14 12 88 e-mail: feats2001@univ-valenciennes.fr http://www.univ-valenciennes.fr/LGIL/ FEATS2001/Welcome.htm
IFAC/CIGR Workshop Artificial Intelligence in Agriculture	June 4 – 6	Budapest Hungary	15 Nov. 2000	Prof. I. Farkas Dept. of Physics and Process Control Univ. of Agricultural Sciences Pater K. 1, H-2100 Gödöllo, Hungary e-mail: ifarkas@fft.gau.hu
IFAC Symposium 6th Dynamics and Control of Process Systems – DYCOPS 6	June 4 – 6	Cheju Island Korea, Rep.	15 Sept. 2000	Mr. En Sup Yoon School of Chemical Engineering Seoul National University Seoul 151-742, Korea FAX: +82/2/884 0530 e-mail: esyoon@pslab.snu.ac.kr
IFAC Workshop 4th On-Line Fault Detection and Supervision in the Chemical Process Industries	June 8 – 9	Seoul Korea, Rep.	15 Sept. 2000	Mr. En Sup Yoon School of Chemical Engineering Seoul National University Seoul 151-742, Korea FAX: +82/2/884 0530 e-mail: esyoon@pslab.snu.ac.kr
American Control Conference- ACC01 (in cooperation with IFAC)	June 18 – 20	Arlington Virginia, USA		Bruce H. Krogh e-mail: krogh@des.ece.cmu.edu
IFAC Conference Computer Applications in Biotechnology – CAB 8	June 24 – 27	Quebec City Canada	1 Sept. 2000	Prof. Michel Perrier Dept. of Chemical Engineering Ecole Polytechnique, POB 6079 Station Centre-ville Montreal, Quebec H3C 3A7, Canada FAX: +1/514 340-4159 e-mail: Michel.Perrier@urcpc.polymtl.ca .

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Title	2001	Place	Deadline	Further Information
IFAC Symposium Nonlinear Control Systems – NOLCOS 2001	July 4 – 6	St. Petersburg Russia	15 Nov. 2000	Prof. A. L. Fradkov Institute for Problems of ME Russian Academy of Sciences 61, Bolshoy, V.O., 199178 St. Petersburg,Russia FAX: +7/812/321 4771 e-mail: nolcos@ccs.ipme.ru
IEEE/ASME Intl. Conference Advanced Intelligent Mechatronics (AIM'01) – in cooperation with IFAC –	July 8 – 11	Como Italy	*	Prof. Bruno Siciliano Dip. di Informatica e Sistemistica Universita degli Studi di Napoli Federico II Via Claudio 21, I-80125 Napoli, Italy Fax: +39/081 768-3185 e-mial: siciliano@unina.it http://www.AIM01.unina.it
IFAC Conference Control Applications in Marine Systems – CAMS 2001	July 17 – 20	Glasgow UK	January 2001	Prof. M.J. Grimble Industrial Control Centre University of Strathclyde, Graham Hills Bldg. 50, George Street Glasgow G1 1QE, Scotland, UK FAX: +44/141 548 4203 e-mail: system@icu.strath.ac.uk
IFAC Symposium Large Scale Systems	July 18 – 20	Bucharest Romania	18 July 2000	Prof. Sergiu S. Iliescu Technical University Politehnica Bucuresti Dept. Control & Computer Science Spl. Independentei 313, Sector 6 RO-77206 Bucharest, Romania FAX: +40/1/333 4030 e-mail: sil@info.cni.ro
IFAC Workshop Intelligent Control for Agriculture Applications	August 22 – 24	Bali Indonesia	1 Nov. 2000	Dr. Kundang B. Seminar Dept. of Agriculture Engineering FATETA-IPB, POB 220 Bogor 16002, Indonesia FAX: +62/251/623026/622202 e-mail: kseminar@indo.net.id
IFAC Workshop Periodic Control Systems	August 27 – 28	Como Italy	1 Nov. 2000	Prof. Sergio Bittanti, Polit. di Milano Pza L. da Vinci, 32, I-20133 Milano, Italy FAX: +39/02/23993412 e-mail: bittanti@elet.polimi.it http://www.elet.polimi.it/PSYCO
IFAC Workshop Adaptation and Learning in Control and Signal Processing	August 29 – 31	Como Italy	1 Nov. 2000	Prof. Sergio Bittanti, Polit. di Milano Pza L. da Vinci, 32, I-20133 Milano, Italy FAX: +39/02/23993412 e-mail: bittanti@elet.polimi.it http://www.elet.polimi.it/ALCOSP2001.html
IFAC Symposium System Structure and Control	August 29 – 31	Prague Czech Rep.	31 October 2000	Dr. Petr Zagalak, UTIA-AVCR POB 18, CZ-18208 Prague, Czech Rep. FAX: +420/2/688 4903 e-mail: zagalak@utia.cas.cz
IFAC Symposium Automatic Control in Aerospace	Sept. 2 – 7	Forli Italy	1 October 2000	Prof. Gianni Bertoni, D E I S University of Bologna, Viale Risorgimento, 2 I-40136 Bologna, Italy FAX: +39/051/209 3073 e-mail: gbertoni@deis.unibo.it http://ars-sun1.ars.fh-weingarten.de/ifac/events.html
European Control Conference – ECC 2001 (in cooperation with IFAC)	Sept. 4 – 7	Porto Portugal	1 October 2000	Prof. Martins de Carvalho FEUP, DEEC, Rua dos Bragas P-4099 Porto Cedex, Portugal e-mail: ecc2001@fe.up.pt http://www.fe.up.pt/~ecc2001/
IFAC Symposium Automation in Mining, Mineral and Metal Processing – MMM 2001	Sept. 4 – 6	Tokyo Japan	15 October 2000	Prof. K. Uchida Dept. of El., Electronics & Comp. Engineering Waseda University, Okubo 3-4-1, Shinjyuku Tokyo 169 8555, Japan FAX: +81/3/5273 9507 e-mail: kuchida@uchi.elec.waseda.ac.jp
IFAC/IFIP/IFORS/IEA Symposium Analysis, Design and Evaluation of Man-Machine Systems MMS'2001	Sept. 18 – 20	Kassel Germany	1 January 2001	Dr. B. Borys, University of Kassel Lab. Systems Engg & Human Machine Systems Mönchebergstrasse 7, D-34109 Kassel,Germany FAX: +49/561/804 3542 e-mail: borys@imat.maschinenbau.uni-kassel.de
IFAC/(IFIP/IFORS/IFR) Symposium Information Control Problems in Manufacturing Technologies – INCOM 2001	Sept. 20 – 22	Vienna Austria	31 January 2001	Dr. Robert Probst Institute for Handling Devices and Robotics (E318), Technical University Favoritenstr. 7-9, A-1040 Vienna, Austria FAX: 43/1/58801/31899 e-mail: e318@ihrtl.ihrt.tuwien.ac.at
IFAC Workshop Control Applications in Post-harvest and Processing Technology – CAPPT 2001	Oct. 3 – 5	Tokyo Japan	31 March 2001	Prof. Dr. Yasuhisa Seo Graduate School of Agr. and Life Sciences The University of Tokyo Yayoi 1-1-1, Bunkyo-ku Tokyo 113-8657, Japan FAX: +81/3/5689-8095 e-mail: aseo@hongo.ecc.u-tokyo-ac.jp
IFAC Conference New Technologies for Computer Control	Nov. 19 – 22	Hong Kong China	15 December 2000	Dr. C.W. Chan, Dept. of Mech. Engineering University of Hong Kong Pokfulam Road Hong Kong, China FAX: +857 2858 5415 e-mail: mechan@hkucc.hku.hk