



# ROBOTICS AND AUTOMATION

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## President's Message



*Tzyh-Jong Tarn  
Washington University*

It is an honor and a pleasure to again communicate with you in 1993 about the events concerning the Robotics and Automation Society.

A ballot for the election of six members to the Society's Administration Committee (AdCom) was issued in October 1992. The following candidates have been elected for a three-year term, beginning January 1, 1993: Alan Desrochers, Andrew A. Goldenberg, Pradeep K. Khosla, J.Y.S. Luh, Howard Moraff and David E. Orin. Good luck to the newly elected members of the AdCom and thank you to all the candidates for their willingness to serve and for their permission to include their names on the ballot.

Over the next three years, the duties of the AdCom members will involve many different aspects. AdCom decisions influence the long-range success of the society, and I am certain that the six newly elected members and the twelve continuing members will serve the Society with an effective mix of wisdom, energy, innovation, and common sense.

I am pleased to announce that three Chapters have officially been formed in 1992: The Korean Chapter, the Turkey Chapter and the Pittsburgh Chapter. Special thanks go to Drs. B.H. Lee, Okyak Kaynak, and Pradeep Khosla for their efforts in organizing the individual Chapters.

Forming a Chapter is simple. A petition signed by no fewer than twelve Section members, above student grade, must be submitted to the Section Executive Committee via the Section Secretary, for approval. The petition must specify: (1) Name of the Section, (2) Name of the Society, (3) Name and address of the individual serving as the organizer of the Chapter. The petition, together with the written approval of the Section Executive Committee, should then be mailed to: Melvin I. Olken - Staff Director, IEEE Field Services Department, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, U.S.A. Those interested in forming a Section may contact Dr. Harry Stephanou, Vice President for membership, for details.

Dr. Russell Taylor, editor of the IEEE Transactions on Robotics and Automation, continues to enhance the publication. Special issues are being planned. Last year a record number of manuscripts was submitted. In the future, we plan to increase the percentage of high quality application and experimentation papers.

The Newsletter continues to expand and flourish under the editorship of Dr. Michael B. Leahy, Jr., with Rosalyn Snyder as the Managing Editor. We are planning to transform the Newsletter into a Magazine in 1994. Dr. Robert Kelley is currently working with Michael B. Leahy, Jr. and Rosalyn Snyder preparing a proposal for an IEEE Robotics and Automation Society Magazine to be submitted to the IEEE Technical Activities Board for approval.

The Executive Committee of the Robotics and Automation Society held a meeting on December 13, 1992 in Tucson. The Committee decided to establish an Industry, University, and Government Cooperative Committee. Judging from the ever changing infrastructure of the research environment, it is a timely and wise decision. Dr. Patrick Eicker from the Sandia National Laboratories has kindly agreed to be the first chairman of the committee.

It has been an honor for me to serve the Society, and I thank the many members who have provided advice, encouragement, and assistance during the past year.

## From the Editor's Desk

Michael B. Leahy  
Air Force Material Command  
Robotics and Automation Center of Excellence (RACE)



Welcome to another issue of the Newsletter. Best wishes for a happy and productive New Year. The new year will be a busy time the Newsletter staff as we transition the Newsletter into a Magazine. Yes, it is official, the Administrative Council (Adcom) approved the concept of transitioning the Newsletter to a Magazine format. We are busy putting together the formal Magazine proposal for circulation and approval through the IEEE publication processes. We are taking an aggressive path toward approval that would allow us to begin Magazine publication in January 1994. Subsequent issues will keep you apprised of our progress through the IEEE wickets.

So what is this Magazine? The *IEEE Robotics and Automation Society Magazine* will bridge the gap between the *IEEE Transactions on Robotics and Automation* and commercial trade magazines. The Magazine will build upon the existing newsletter base by adding high quality technical articles in the areas of: applied research, state of the shelf solutions and technologies, and education. Articles will be targeted toward the practicing engineer, emphasizing creative solutions to real-world problems. Implementation details will be highlighted. Tuto-

rials will provide the technical and historical knowledge required to appreciate how theory evolved into application and insight into new theoretical developments. A letters section will provide the forum for open exchange of ideas on issues facing the robotics and automation community.

The Magazine will be distributed quarterly in place of the Newsletter. We will start with 48 pages per issue with a goal to expanded to 64 pages within the first three years. The Magazine proposal will be included in the next issue.

With the proposal in review our attention is directed toward creation of an Editorial board and solicitation of technical articles. One of our primary sources of articles will be papers from our annual conference that match the Magazine scope. In fact, I will attend the 93 conference program committee meeting to get a jump on the solicitation process. However, publication in our conference proceedings is **not** a requirement for Magazine publication. We will be searching through other conference proceedings and will accept direct mailings. Please hold off on the direct submissions until we can get an editorial policy and peer-review process in place. We will submit both of those items to the Adcom for approval at the May meeting.

We hope that tutorials will become a regular Magazine feature, but it will not happen without your involvement. If you are an expert in one of the many facets of robotics technology please consider sharing your knowledge with your peers. The history of other magazines shows that a well written tutorial can bring a lot of visibility and paper references to the author. An article in the Magazine is

also a great way to generate interest for tutorials held in conjunction with a conference or symposium. A tutorial article from each of the technical committees is an excellent goal to strive for.

Please continue to send us your newsworthy exploits. We have a year of 32 page issues to devote to your technical committee activities, research laboratory reports, conference write-ups, technical articles, industrial news, and conference and calendar information. As a new feature we will initiate a section on dissertation abstracts. Along with providing the dissertation title and new place of employment of recent graduates we also will publish a 500 word version of the abstract. Past graduates may also avail themselves of this new service.

*Home robots, fact or fiction:* The San Francisco Robotics Society writes about their efforts to address the issues associated with home robot technology. The newsletter is about sharing information on the whole spectrum of robot activities, not just formal laboratory programs. We openly solicit contributions from the *hobbyist* element of the society. Tell us what makes robotics **fun** for you. I would be remiss if I concluded before giving a hearty congratulations to the new IEEE fellows within our Society. A listing of our new fellows is included, and as is our custom, we will run brief biographical sketches and pictures of the new fellows in the spring issue.

Keep those comments and suggestions coming. Please note that my email address has changed. Hope to hear from you soon.



# Where are the Home Robots?

**Brad Smallridge**  
*Director, San Francisco Robotics Society of America*

Imagine coming home after work and your robot has already cleaned the house, watered the plants, mowed the lawn, folded the laundry, made the beds, and prepared dinner. Nice idea? Impossible? If you had asked me 50 years ago, I would have said that making home robots was more possible than, say, putting a man on the moon. We've put a man on the moon, we have robots in our industries, but we don't have home robots.

Across this country, pockets of robot enthusiasts still seek this elusive dream. The San Francisco Robotics Society of America (SFRSA) caters to robot builders in the Bay area. We meet monthly at the Exploratorium to discuss the technologies needed to build robots. Speakers address issues of arm kinematics, printed circuit board design, microcontroller programming, motor control, and electronic sensors. It's a good time to get your questions answered because often a fellow robot builder has had similar experience and can give you a speedy solution.

The SFRSA also holds an annual robot games to promote home robots. It's sort of a mini Olympics for robots. This last September we held three events, the Line Slalom, the Maze, and the Outlet event. These events were also held at the Exploratorium.

The Line Slalom is a fast reckless course that appeals to a large audience. Originally designed as a line following exercise, there's a white tape line on a black floor that weaves a triple figure eight around three pylons. Your robot can look at the line, at the pylons, or can dead

reckon. We even allow manual remote or wire control so that everyone can compete. An Autonomy weight is factored into the score to favor robots that negotiate their environment without line sensors or human guidance. Next year the weight carrying capacity of the robot will also be factored into the score so that the small, light robots don't have unfair advantage.

The Maze is big, with aisles three feet wide, to accommodate a reasonable-sized home robot. The walls are less than a foot high so that the audience can see. The objective of the Maze event is let your robot find its way out. The Outlet Event is a modified Maze event where your robot is searching the maze for an electrical outlet, and then, if it finds it, must plug itself in.

In addition to the contests, robots are exhibited that demonstrate any unusual or interesting abilities. This year we had a robot dancing the Hokey Pokey and a very elegant arm, with wrist force sensors, wiggling pegs into holes. Next year we intend to add a robot arm event.

While the robot games provide a testing ground for beginner robot builders, a veteran robot builder will concentrate on a special area of robot or electronic technology instead of building a generic mobile robot base. Along this line, and within SFRSA, we have Homer, a home robot vacuuming base; BugEyes, an object recognition vision system; Dexter, a mechanical fingerspelling hand; Boris, a six-legged shape-memory-alloy muscle wire robot; and The BodySynth, an electromiogram to

MIDI music interface.

There are global trends in robotics that may spark a resurgence for the home robot. A growing interest in neural networks suggest that we don't have to program every circumstance in step by step progression, a nearly impossible problem for a robot living in a home environment where many unknown factors can come about. There is also the subsumption approach where a number of simpler systems are put together, and then the robot is let free and its behavior is studied. These are a drastic departure from the step by step robot programming of years ago.

We are living in a pre-Wright-Brothers era where home robots don't fly. Who will be the one to put the right combination of mechanical and electronic devices together? It may be a big company but I suspect it may also be a garage-type inventor possibly working in conjunction with a local robot organization.

*Brad Smallridge, director of SFRSA, is an electrical engineer and has been designing mechanical and vision systems for Upstart Robots for seven years. For more information about SFRSA call 415-550-0588 or call our BBS at 415-648-6427. To receive the SFRSA monthly Newsletter by send \$5 per year to the Robotics Society of America, PO Box 1205, Danville, CA 94526-1205.*

# Experimental Robotics Symposia

V. Hayward, McGill University  
O. Khatib, Stanford University

The "First International Symposium on Experimental Robotics" (ISER-I) took place at McGill University, Montréal, in June 1989. The symposium focused on theories applicable to robotics problems which were demonstrated by experiments. A total of 35 papers were included in the program, representing work from Australia, Belgium, Canada, England, France, Germany, Italy, Japan U.S.A., and Yugoslavia.

The program committee included V. Hayward, O. Khatib (Chairs), J. Angeles, R. Chatila, J. Craig, P. Dario, B. Espiau, G. Hirzinger, K. Salisbury, and T. Yoshikawa. A keynote lecture was given by T. Lozano-Perez from MIT.

The Second International Symposium on Experimental Robotics took place in Toulouse, France, June 25-27 1991 on the premises of L.A.A.S. (Laboratoire d'Automatique et d'Analyse des Systèmes).

The program included 42 papers representing Belgium, Italy, France, UK USA, Germany, Canada, Australia, Yugoslavia, Sweden, Japan, Chile, Switzerland, and Denmark.

The program committee included R. Chatila, G. Hirzinger (Chairs), J. Craig, P. Dario, B. Espiau, V. Hayward, O. Khatib, F. Myasclki, K. Salisbury, and T. Yoshikawa. Dr. Roth from Stanford University gave the opening lecture.

The symposia were supported by local companies and various government agencies.

A video production has been edited collecting the contributions of the two first symposia. The organizers are negotiating with several publishers, including IEEE Press, in order to publish and distribute the videotape of the first ISER. They hope to have copies of the videotape for sale by the time of the IEEE Robotics and Automation Confer-

ence in May.

## ISER-III, Kyoto Japan

Future symposia are to be hosted as a series in a rotating fashion around North America, Europe and Asia.

They are organized so as to be truly international events. The third ISER is being organized to take place in Kyoto in October 1993. The program committee is composed of F. Myasaki, T. Yoshikawa, J. Craig, P. Dario, B. Espiau, V. Hayward, O. Khatib, J.-P. Merlet, and K. Salisbury. Those interested in participating should contact the authors:

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La Region Midi-Pyrenees.  
The Proceedings of the symposium are available from Springer Verlag: *Experimental Robotics 1. 1990. Hayward, V., Khatib, O., (Eds.). Lecture Notes in Control and Information Sciences #139 Springer Verlag.*



# The 1992 IEEE International Symposium on Intelligent Control

*Edward Grant, General Chair  
Department of Computer Science  
University of Strathclyde*

The 1992 IEEE International Symposium on Intelligent Control was held in the Forte Crest Glasgow Hotel, Glasgow, Scotland, from 11-13 August 1992. This was the first time that this event was held outside the United States.

There were 116 delegates registered for the symposium, representing at least 22 nationalities: Forty percent were from the United States; most of the remainder came from the European Community with the UK providing the largest delegation. There was strong representation from Germany, Italy, and Israel, and a single delegate who travelled from South Africa. There was also a fine balance between the "young" and the "old"; a third of the registered delegates qualified for reduced rate registration.

## ***"An Introduction to Learning Control"***

The tutorial "An Introduction to Learning Control" was presented jointly by Walter L. Baker and Jay A. Farrell, two enthusiastic staff members from the Charles Stark Draper Laboratory Inc., Cambridge, MA. Their presentation focused on control systems that were explicitly designed to exploit learning behavior.

Delegates began to relate their own experiences with those of the two presenters when the discussion turned to applied learning control, where learning control was shown to be capable of controlling a variety of selected control systems.

First the presenters laid the foundation, demonstrating how learning methods can be used in classical control, through applying learning to gain scheduling, adaptive, and optimal control domains. They presented numerous applica-

tion examples, including underwater vehicle control, flight control, and missile evasion. Overall, this was seen as being a useful session for the experienced practitioner and the novice alike. This was demonstrated by questions being asked continuously throughout the session, and by the lively discussion at the conclusion.

A second tutorial session, which was added late, "Efficient Learning Algorithms for Nonlinear Modeling, Control, and Prediction", by Zlatko Zografski, dealt more specifically with learning robot control.

## **Symposium**

The Plenary Speaker, Professor A. G. J. MacFarlane, Principal and Vice-Chancellor of Heriot-Watt University, Edinburgh, is well known for his contributions to control engineering, in particular in multi-variable control.

His presentation, "Knowledge, Information and Control", began with a review of the role of the human within the "knowledge loop" Drawing on one's own understanding of personal knowledge, of the universe, subjective knowledge, and society, Professor MacFarlane suggested that this could perhaps be converted into objective knowledge in the form of formal representations.

Professor MacFarlane described the various categories of knowledge, and the need for unambiguous user interfaces to connect the human to computerized representations of these categories of knowledge. He continued by addressing the meaning of, and the interrelationships between, intelligence, knowledge and data.

"Put into the context of a dy-

namical system controller," he said, "today's controllers are data-based only: they deal only with the virtual dynamics of the system in order to achieve a more dynamically stable system overall."

In the future, he believes, there will be an increased requirement for controllers that integrate virtual data with instantiated intelligence and knowledge. This will not be a straightforward development. As he drew to a close, Professor MacFarlane discussed the relationship between the theories of uncertainty and complexity, and how to use them when characterizing control systems. He considered that data, intelligence, and knowledge all have their individual limits.

To overcome these current barriers to progress, and proceed towards a more general philosophy of control, we will be required to develop what he termed "knowledge machines". He concluded that to achieve a true balance between data, intelligence, and knowledge, increased emphasis must be placed on research into intelligent machines for control. This is perhaps the best way to develop new, and novel controllers.

## **Technical Sessions**

The technical areas of interest covered by the 24 sessions ranged from robotics to industrial applications, expert controllers to neural networks. If the development and use of novel control systems, and/or novel controllers, was a personal quest, then there was something here for everyone. At the closing session, and in private conversation, there was discussion on the continued need for developing formal architectures. The sessions had shown that there was a wide variety of technical solutions being applied to specific

problems, but that there was no general theoretical foundation available to the user. A call was made for the theoretical and applied practitioners to collaborate more closely. Were this to occur, then the community might incrementally move towards developing a general theory together. There were also clear indications of a lack of understanding of the contributions made by human operators in control situations where they are "in-the-loop". Clearly in these situations the human is the most "intelligent controller" available and there is still a need to "capture their soul" such that we can automate their actions by computational means.

Generally, the "intelligent control" community is producing new, and novel, research continuously. If they are to make significant progress they will obviously need continued financial support but, equally importantly, they will need enhanced infrastructure support. Many of the "demonstrations of principle" of the work presented in the sessions used robots. However, the current world-wide reduction in financial support for robot-based research could seriously affect the future effectiveness of the "intelligent control" community.

The Symposium was sponsored by the IEEE Control Systems Society. The Program Chair was Tom Henderson of the University of Utah. Local Chairs were Ken Hunt (Local Arrangements), Bill Leithhead (Finance). Generous support was provided by The City of Glasgow, the universities of Strathclyde, Glasgow, Utah, and Heriot-Watt, The Turing Institute Ltd, the Bank of Scotland and sister organizations, such as the Institution of Mechanical Engineers, and the Institution of Electrical Engineers, both in the UK. The 1993 IEEE International Symposium on Intelligent Control will be August 25-27, The Knickerbocker Hotel, Chicago ILL. General Chair is Panos J. Antsaklis, University of Notre Dame. Program Chairs are Kevin M. Passino and Umit Ozguner, Ohio State University.

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# Grand Challenges in Electrotechnology

*Ronald J. Pogorzelski  
Division IV Representative  
IEEE New Technology Directions Committee*

The New Technology Directions Committee (NTDC) is a standing committee of the IEEE Technical Activities Board (TAB). Its charter is to identify emerging technology areas not currently addressed by IEEE entities and to encourage and facilitate the formation of appropriate ad-hoc intersociety committees in such areas.

The Committee currently consists of a maximum of seventeen members. They are the Chair, the immediate Past Chair, a representative of each of the ten IEEE Divisions, and five Members-at-Large which are to broaden the representation by including other professional societies, government, etc. Recently, at the suggestion of the TAB Structure Review Ad-Hoc Committee, each of the IEEE Societies and Technical Councils was invited to appoint a corresponding member to the NTDC. These corresponding members provide a key technical link between the NTDC and the Societies. Because of this new linkage, the 1993 committee will consist of five standing members and 37 corresponding members.

The current activities of the NTDC include the development of a set of "Grand Challenges" in electrotechnology. They are:

1. To be or not to be reachable anytime, anywhere (wire-free and fiberless communication)
2. To have instant access to all information (databases, high-speed links, flat panel displays and interfaces)
3. To be present or absent anytime,

anywhere (virtual presence and reality)

4. Abundant, clean, safe and affordable energy
5. Intelligent highways and transportation systems (personal global navigation)
6. The paperless office (flat panel displays, pen and tablet)
7. The cashless society (electronic purse and wallet)

In addition to these lofty goals, the committee is considering a number of near-term activities in support of new technologies. For example, an Ad-Hoc Committee of NTDC is exploring the possibility of co-sponsoring, with the IEEE Atlanta Section, an interdisciplinary New Technologies Conference with possible emphasis on environment, health, and safety issues.

NTDC is also compiling a list of video tapes on emerging technologies currently in production. Several of the Societies have indicated interest in expanding production of such tapes.

In the interest of preparing a "portfolio" of emerging technologies, NTDC has solicited from each Society a summary of emerging technologies related to its technical purview. Several fascinating summaries have been received and will form the basis of the portfolio.

NTDC recognizes that as Engineers we must emphasize that the new technologies which we promote must be incorporated into new products which fulfill the needs of humanity.

Thus, we must not merely study new phenomena but must study their application for the good of mankind. Interestingly, the fastest growing IEEE Society is currently the Vehicular Technology Society. This rapidly growing area is certainly among those having a positive impact on Society. This growth has spread to the related areas of signal processing, information theory, and communications all of which are areas of interest to specific IEEE Societies.

As mandated by its charter, the NTDC has formed an Ad Hoc Committee on "Energy" chaired by Thomas Pinkham, our Division VII Representative. This Committee is to include representation from a number of Societies. This relates to the fourth "Grand Challenge" listed above.

NTDC also recognizes its relationship to lifelong learning. Practicing engineers must be encouraged to become proficient in the emerging technologies identified by the committee. Educational materials must be made available by the IEEE through its cognizant Societies and through IEEE Press. NTDC continues to meet and plan promotion of new technologies within IEEE and welcomes your suggestions in this regard.

## NATIONAL ENGINEERING WEEK: Showcasing the 'Minds and Hands' Of America's Engineers

"Our future depends on the minds and hands of engineers." So stated Martha Sloan, chair of National Engineers Week '93 and president of The Institute of Electrical and Electronics Engineers (IEEE), in launching activities for National Engineers Week, the largest-ever annual program celebrating the engineering profession's contributions to American life.

The 1993 event, scheduled February 14-20, is dedicated to the theme "Engineers: Turning Ideas into Reality." Exploring various dimensions of that theme is a series of major events designed both to highlight the achievements of engineers' minds and hands, and to enlist them in furthering the education of tomorrow's technological pioneers.

The fourth annual Discover"E" program will see "thousands of engineers reach into their communities and local schools to show how the engineering professional contributes to our quality of life and to interest youngsters in the technological world around them," according to Kenneth T. Derr, honorary chair of National Engineers Week and chairman of Chevron Corporation. An estimated 30,000 engineers will conduct programs emphasizing "Engineering Energy" in elementary, junior and senior high schools across the country. Chevron's Derr will lead this year's contingent of "All-Stars," engineers who have become prominent leaders in many areas of American life and who now seek to

pass on their visions and ideals to the rising generation. This year's roster includes IBM president Jack D. Kuehler, NASA administrator Daniel Goldin and former astronaut Mary Cleave, among many others.

Engineers of tomorrow is also the focus of the first annual Future City Competition, which teams engineers, teachers and seventh and eighth grade students to design a computer-simulated city of the 21st century. "Students will learn the pros and cons of different sources of energy and see first-hand how engineers turn ideas into reality," said The IEEE's Sloan. Teams will use SimCity™, software donated by Maxis, to compete for prizes, including personal computers provided by IBM Corporation, for winning schools in the regional and national contests. Regional winners will travel to Washington, D.C., to compete in the national finals on February 17 at the U.S. Department of Energy.

The week's activities will climax at the Evening Gala on February 17, tentatively scheduled at Intelsat's futuristic corporate headquarters in the nation's capital. Students will join representatives of engineering societies and other special guests in a festive celebration of engineering as a profession. Winning models of the Future City Competition will be on display, along with winning entries in the "Powers of Energy Visions of Technology" photo contest for practicing engi-

neers and engineering students, highlighting engineering contributions toward the development of safe and efficient energy. Another display sure to attract interest will be the "Marsville" demonstration, a student project sponsored by the Challenger Foundation that will present creative solutions to the various challenges posed by a human habitat on Mars.

National Engineers Week '93 is jointly sponsored by 18 engineering societies and 10 major corporations, with the cooperation of hundreds of businesses, colleges and government agencies. In 1993 the lead sponsoring society is the IEEE and the lead corporate sponsor is the Chevron Corporation. National Engineers Week has been an annual event since it was founded in 1951 by the National Society of Professional Engineers.





**The Institute of Electrical and Electronics Engineers, Inc.**  
**United States Activities**  
*Announces the 21st annual competition for*  
**1993-1994**  
**IEEE-USA Congressional Fellowships.**

**PROGRAM:** Electrical and Electronics Engineers and Allied Scientists are competitively selected to serve a one-year term on the personal staff of individual Senators or Representatives or on the professional staff of Congressional Committees. The program includes an orientation session with other Science-Engineering Fellows, sponsored by the American Association for the Advancement of Science (AAAS).

**PURPOSE:** To make practical contributions to more effective use of scientific and technical knowledge in government, to educate the scientific communities regarding the public policy process, and to broaden the perspective of both the scientific and governmental communities regarding the value of such science-government interaction.

**CRITERIA:** Fellows shall be selected based on technical competence, on ability to serve in a public environment, and on evidence of service to the Institute and the profession. Specifically excluded as selection criteria are age, sex, creed, race, ethnic background, and partisan political affiliations. However, the Fellow must be a U.S. citizen at the time of selection and must have been in the IEEE at Member grade or higher for at least four years. Additional criteria may be established by the selection committee.

**AWARDS:** IEEE-USA plans to award at least two Congressional Fellowships for the 1993-1994 term. Additional funding sources may permit expansion of awards.

**APPLICATION:** Further information and application forms can be obtained by calling W. Thomas Suttle (202) 785-0017 at the IEEE-USA Office in Washington, D.C. or by writing:

**Secretary, Congressional Fellows Program**  
**IEEE**  
**1828 L Street, N.W.**  
**Washington, D.C. 20036**

**Applications must be postmarked no later than March 31, 1993 to be eligible for consideration.**

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## **IEEE/ACM Transactions on Networking**

The mushrooming science of computer networks is the subject of a new bi-monthly journal to be published jointly by the IEEE Computer and Communications Societies, and the Association for Computing Machinery (ACM) and its Special Interest Group on Data Communication (SIGCOMM).

The first issue of *IEEE/ACM Transactions on Networking* will appear in February, 1993. The journal will include articles of interest to computer network researchers, designers and users, especially those whose corporations and organizations—such as governments and financial institutions—transmit masses of information.

Editor of the new journal is **Dr. James Kurose**, Professor of Computer Science at the University of Massachusetts, Amherst.

Kurose foresees a global audience for Transactions on Networking, with significant numbers of readers in Europe and the Pacific Rim. "An estimated half trillion dollars (\$500 billion) is spent each year worldwide on telecommunications equipment and services," he said. A more tangible example, Kurose pointed out, is the recent growth of Internet, which 10 years ago connected some 200 computers and now serves well over 750,000.

Kurose also noted that the networking industry in recent years has exploded exponentially. This has been made possible, he said, by the confluence of technical advances in a number of areas, including transmission technologies, switching, and design methodologies.

Correspondence should be addressed to Kurose at: Department of Computer Science, University of Massachusetts, Amherst, Mass., USA 01003.

# R&A Standards Committee Report

**Leonard S. Haynes**  
**Intelligent Automation, Inc.**  
**R&A Standards Committee Chairman**

*This report was abstracted from the September 1992 Robotic Industries Association (RIA) Standards Report written by Mr. James A. Payton. The RIA is approved by the American National Standards Institute (ANSI) as an "Accredited Sponsor" to develop consensus on Draft Standards and serves, through ANSI, as the Administrator and Secretariat for the U.S. Technical Advisory Group (USTAG) for the International Standards Organization (ISO)/TC184/SC2 - Robots for the Manufacturing Environment. Additional sections of this report were written by Leonard S. Haynes for the IEEE Robotics and Automation Society Standards Committee. All approved standards listed below are available through ANSI, or through the Robotic Industries Association at nominal costs. Draft standards can also be obtained through the RIA, and all standards committee meetings are open to all interested parties.*

*December 14, 1992*

## 1. Robotic Industries Association

### R15.01 Electrical Interface

The R15.01 Subcommittee on Electrical Interfacing has authored the standard entitled *Industrial Robots and Robot Systems—Common Identification Methods for Signal and Power Carrying Conductors* which was approved by ANSI as an American National Standard on May 14, 1990 and was published by ANSI on November 16, 1990. The R15.01 Subcommittee is chaired by Peter Deschner, Olfex Wire and Cable Co.

### R15.02 Human Interface

The R15.02 Subcommittee on Human Interfaces has completed ANSI/RIA RI 5.02 1990 *Human Engineering Design Criteria* for Robot Control Pendants. The standard received ANSI approval on December 28, 1990 and was published by ANSI on September 12, 1991. The Subcommittee Chair is open.

### R15.03 Mechanical Interface

The R15.03 Subcommittee has authored draft Standard BSR/RIA R15.03-1, Revision 7, *Circular Mechanical Flange Interface*. It was submitted to the RIA R15 Executive Committee for Standards Approval vote. The voting period ended on September 9, 1991. The results are currently being evaluated. This draft is similar to ISO 9409-1 which is in the process of being revised. Since the RIA policy is to harmonize its standards with ISO standards, R15.03 will delay further action on R15.03-1 until the ISO 9409-1 revisions are completed.

R15.03 has also developed another draft standard BSR/RIA R15.03-2, Revision 5, *Mechanical Shaft Interface*. Before submitting this draft to the Executive Committee for Standards Approval, another revision will be made to harmonize our draft with a Japanese draft on a *Shaft*

*Mechanical Interface*. The Japanese draft is dated August 27, 1991.

R15.03 is Chaired by Dr. Hadi Akeel, Vice President/Chief Engineer at GMFanuc Robotics.

### R15.04 Communication/Information

The R15.04 had completed a Robot Companion Standard for the ISO/IEC 9506 *Manufacturing Message Specification*. At that point, the R15.04 document was submitted to ISO/TC184/SC2/WG6 as a U.S. contribution. WG6 has used the R15.04 document as a base document which has now been developed into the ISO 9506/3 *Robot Companion Standard* to the MMS document. For a period after that submission, R15.04 became inactive.

Recently R15.04 has been reactivated to develop a position on the ISO/TC184/SC2/WG4 proposal for a Programming Language for Robots (PLR). R15.04 will advise the USA Technical Advisory Group for ISO/TC184/SC2. R15.04 will also develop USA initiatives on robot programming language issues such as user interfaces and application packages. The R15.04 Chair is currently open.

### R15.05 Performance

The R15.05 Subcommittee has produced the *American National Standard for the Evaluation of Point-to-Point and Static Performance Characteristics of Industrial Robots and Robot Systems* which was approved by ANSI on September 13, 1989 and published by them in May, 1990 as ANSI/RIA R15.05-1-1990. The objective of this standard is to provide meaningful technical information that robot users can utilize in the selection of the proper robot for their specific application needs.

R15.05 also maintains full liaison with the ISO/TC 184/SC21WG2 Performance Criteria and Related Testing



Methods working group, which has developed the ISO 9283 *Standard Manipulating Industrial Robots—Performance Criteria and Related Test Methods*.

R15.05 is now in the process of developing a standard to cover Dynamic Robot Performance. BSR/RIA

R15.05-2-199X *Proposed American National Standard for Industrial Robots and Robot Systems—Evaluation of Path-Related Performance Characteristics* was submitted to the RIA R15 Executive Committee for Standards Approval and is scheduled to be submitted to the American National Standards Institute in late 1992.

R15.05 is Chaired by Tom Helzerman of Ford Motor Company.

### **R15.05-WGI - Reliability**

This Working Group of R15.05 has developed a proposed reliability standard intended to replace a multiplicity of robot user test/specifications that now exist. It is expected that both users and manufacturers will benefit from the cost reductions associated with the common acceptance and use of only one test verification requirement.

This BSR/RIA R15.05-3- 199X *Proposed American National Standard for Industrial Robots and Robot Systems—Infant Mortality Life Test* was submitted to the RIA R15 Executive Committee for Standards Approval for vote on May 24, 1991. Voting closed on August 27, 1991. The draft was submitted to the American National Standards Institute in July 1992 for approval.

R15.05 is Chaired by Jim Wells of General Motors Corp.

### **R15.06 Safety**

The R15.06 Subcommittee has completed the landmark Robot Safety Standard ANSVRIA R15.06- 1986 *American National Standard for Industrial Robots and Industrial Robot Systems - Safety Requirements*. The 1986 standard has been revised in the areas of illustrations, training, applications, attended continuous operation, and risk assessment. The revised standard, ANSVRIA R15.06 - 1992 was approved on August 19, 1992.

This Subcommittee also closely monitors activities and documents developed by the ISO/TC 184/SC2 WG3 on Safety, such as ISO 10218, *Industrial Robot Safety*.

R15.06 is Chaired by Howard Kutcher, Senior Technical Specialist, Aluminum Company of America.

### **R15.07 Simulation/Off-line Programming**

The R15.07 Subcommittee is developing a comprehensive model of robot characteristics in order to identify necessary information for simulation and off-line programming entitled *Draft Technical Report on Industrial Robots—Simulation/Off-line Programming—Terms, Notations and Data Requirements for Modelling*. The Technical Report was sent to the Standards Approval Committee in the fourth quarter, 1991. Publication is expected in December 1992.

R15.07 is Chaired by Nathan Yoffa of Deneb Robotics, and Mark Hornick ABB Robotics.

## **2. Automated Imaging Association**

The Automated Imaging Association was formed by the Robotic Industries Association in 1984. It established the AIA Standards Committee in 1985 in response to the desire of AIA membership to effectively apply machine vision technology in industry through technical participation by the industrial community. The AIA is now accredited by the American National Standards Institute to develop American National Standards.

### **A15.01 System Communication**

The A15.01 Subcommittee is striving to develop communication standards and protocols which will simplify the exchange of information between machine vision systems and other devices. The Subcommittee has constructed a system model which distinguishes the interfaces between the Recognition, Identification, or Measurement (RIM) device and the other components of the model: the sensor, the user, the host/controller, and the machine/process functions. This model was approved by the A15 Standards Committee.

A15.01 will concern itself primarily with the host/controller interface, and will conform to the Open System Interconnection (OSI) conventions whenever possible. The A15.01 Chair is open.

### **A15.05 Performance**

The A15.05 Subcommittee received ANSI approval for its first American National Standard: ANSI/AVA A15.05/1 - 1989: *Automated Vision Systems - Performance Test—Measurement of Relative Position of Target Features in Two-Dimensional Space*.

Current A15.05 activity is made up of the following Working Groups:

- 1) WGI - Working Group 1 is preparing a Machine Vision Acceptance Methodology, which will define acceptance procedures as well as give statistical criteria for the acceptance of machine vision systems;
- 2) WG2 - Working Group 2 is developing a Machine Vision Camera Data Sheet along with A15.08 - Sensor Interfaces. This project requires the group to identify key camera attributes and either identify or develop standard performance tests to quantify these attributes;
- 3) WG3 - Working Group 3 is drafting an optical Character Recognition Performance Test in conjunction with A15.09 Marking and Labeling;
- 4) WG4 - Working Group 4 is preparing further measurement tests based on ANSVAVA A15.05/1- 1989. WG4 has completed an initial draft of a one-dimensional target test and has circulated the draft for Subcommittee review.

A15.05 is Chaired, pro-tem, by Robert Dewar, Perceptron Inc.

### **A15.07 Terminology**

The A15.07 Subcommittee develops terminology standards which will facilitate machine vision communication including person-to-person, data communication, and user interfaces. The Subcommittee is now focusing on defining categories of machine vision applications. A revised AIA *Glossary of Machine Vision Terms* was published in April, 1991. A15.07 is Chaired by Joe Christenson of Pattern Pro-

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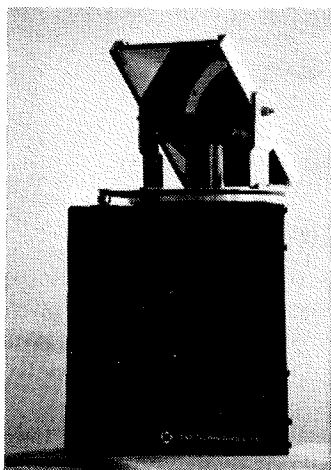
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- ISO9004 *Quality management and quality system elements - Guidelines;*
- ISO/DIS 90042 *Quality management and quality system elements -Part2: Guidelines for services;*
- ISO10011-1 *Guidelines for auditing quality systems - Part 1: Auditing;*
- ISO10011-2 *Guidelines for auditing quality systems - Part 2: Qualification criteria for quality systems auditors;*
- ISO10011-3 *Guidelines for auditing quality systems - Part 3: Management of audit programmes;*
- ISO/DIS 10012-1 *Quality assurance requirements for measuring equipment - Part 1: Management of measuring equipment.*

The American Society for Quality Control (ASQC) maintains a list of organizations that currently offer Quality System Registration. Their number is (414)272-8575.

A great deal of material relevant to EC standards can be obtained from the

**Robotic Industries Association**

900 Victors Way  
Ann Arbor, MI 48106  
or from

**Intelligent Automation, Incorporated**  
1370 Piccard Drive, Suite 210

Rockville, MD 20850.

**The National Institute of Standards and Technology**, Gaithersburg, MD, 20899, has a recorded hotline message, updated weekly by NIST, which reports on directives and standards under development by the EC and Brussels-based standards development organizations, CEN, CENELEC, and ETSI. The information is broken down by subject or product, and tells the caller where to obtain review copies of drafts and deadlines for comments.

A quarterly newsletter called **Europe Now** highlights EC events and U.S. Government export programs. The newsletter is published by the U.S. Department of Commerce and is available free of charge from

**Europe Now**  
U.S. Department of Commerce,  
Room 3036  
Washington, DC 20230  
Tel: (202)377-5376.

## Robotics and Automation Society Newsletter Editorial Policies

The IEEE Robotics and Automation Society Newsletter publishes news items, letters, and reports on conferences, research institutes, and work progress. The editor reserves the right to solicit technical reviews and to reject any contribution which is inappropriate for this newsletter.

Announcements for noncommercial scholarly conferences, workshops, etc. will be published gratis in our Calendar as space is available with priority given to events sponsored by the IEEE Robotics and Automation Society.

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## Publications Committee Update

**Robert B. Kelley, Rensselaer Polytechnic Institute**  
*R&A Society Publications Committee Chair*

### • ASK-IEEE Document Delivery Service

Publishing Services Staff Director Phyllis Hall announced IEEE's new document delivery service "ASK IEEE," a full-service document delivery with special rates to IEEE members. ASK-IEEE will also provide documents from other publishers. It will be an income source for the General Fund as well as for the societies. She noted that IEEE is the first primary publisher to deliver its own materials.

### • Electronic Dissemination of Information Experiment

Beginning in 1993, IEEE will make a number of databases avail-

able. This will be a joint project of Communications Society, the Computer Society, and Publishing Services. These will include

- An advanced abstract database
- A table of contents database
- A key volunteer/staff directory
- An advance conference information — including on-line reservation for select conferences.
- An on-line version of THE INSTITUTE.

### • TAB/IEEE Press Book Series

A new book series will begin a three-year trial in 1993. Three new book series will be developed jointly by TAB, Societies/Councils, and IEEE PRESS. They are: Emerging

Technologies, Design and Applications, and Tutorials. TAB will encourage workshops within the societies and the workshops will lead to IEEE PRESS books carrying both PRESS and Society imprints.

*Are you interested in getting involved in this new series, or in establishing a new Robotics and Automation series? Are you an author looking for a publisher? Are you interested in helping as a reviewer? If your answer is YES, or you would like to know more about the opportunities afforded by the IEEE Press, contact me.*

Tel: 518/276-2653  
Fax: 518/276-8715  
Email: kelley@ral.rpi.edu

## IEEE Neural Networks Council AdCom Report

**Wesley E. Snyder, Bowman Gray School of Medicine**  
*Robotics and Automation Society Neural Networks Council Liaison*

The Robotics and Automation Society is one of the 14 participating societies in the NNC. The following is a summary of upcoming NNC activities of particular interest which were discussed at the December 5 meeting of the NNC Administrative Committee. The Council sponsors the *IEEE Transactions on Neural Networks* and other activities.

### NNC Conferences:

- ICNN93/FUZZ93 will be San Francisco March 28-April 1, 93
- ICNN 93 Nagoya in October will include an "industrial forum" for managers who are not familiar with the field.
- 1993 Forum on applications of NN to power- April 93, Japan, NNC is cooperating.
- The IEEE Conference on Virtual Reality will be held in Seattle September 18-22, 1993
- Robot-human communication workshop-Nov 93-Japan Techni-

cal co-sponsorship requested-referred to committee.

- 1994 World Congress on Neural Networks will be held in Orlando
- 1995 ICNN - Perth, Australia
- 1996 ICNN - Washington, DC
- 1996 FUZZ - New Orleans (Tentative)
- 1997 2nd World Congress San Diego (proposed)

### Regional Interest Groups

The council has established Regional Interest Groups (RIGs). There are currently 6 RIGs: 3 in Australia, NC, Arizona, Korea. The Standing Committee on RIGs is chaired by Rick Alan of TRW Safety Systems.

### Standing Committees

A letter is going to all society presidents to support travel for society representation to the Virtual Reality Technical Committee.

In 1994, all IEEE Conf. Proceedings will be on CDROM through 93; NNC will do same. NNC appointed a committee to get all 1992 and 1993 conferences on CDROM before IEEE is geared up.

### Publications

- The first issue of the NNC-sponsored *IEEE Transactions on Fuzzy Systems* will appear in February 1993. James Bezdek is editor
- Two Council-sponsored video tutorial series are out: Pioneer Series and Fuzzy Systems.
- NNC considered a recommendation for a *Transactions on Applications in Computational Intelligence*. A committee was appointed to develop an editorial policy.

For more information contact Wesley Snyder, RA NNC liaison at (919)716-3908 or wes@relito.medeng.wfu.edu.

## R&A IEEE Fellows

Congratulations to the following members of the Robotics and Automation Society who have recently been named Fellows of the IEEE. The status of Fellow is awarded through an arduous evaluation process to members who have demonstrated outstanding contributions to the field and are nominated by other Fellows. Only about 250 of the more than 300,000 members of the IEEE are named as Fellows each year. We will have more about these new Fellows in the next issue.

- **John Baillieul:** For contributions to nonlinear control theory, robotics, and control of complex mechanical systems
- **J. Thomas Cain:** For leadership and contributions to computer science and engineering education.
- **C.S. George Lee:** For contribution to computational algorithms and architectures in robot kinematics and dynamics, and for leadership in robotics education
- **David E. Orin:** For contributions to the computation of robot kinematics and dynamics
- **Robert F. Stengel:** For contribution to the analysis and design of aerospace control systems
- **Nukala Viswanadham:** For contributions to the modeling and performance of analysis of flexible manufacturing systems.

## Troy Nagle: 1993 IEEE President-elect

**H. Troy Nagle**, a professor of electrical and computer engineering at North Carolina State University in Raleigh, has been elected 1993 President-elect of The Institute of Electrical and Electronics Engineers, Inc. (IEEE). Nagle will assume the presidency of the IEEE on

Jan. 1, 1994.

Nagle, who joined the IEEE in 1966, was named an IEEE fellow in 1983. He served on the Board of Directors from 1987-90, and was Vice President - Technical Activities, 1989-90.

## On the Move

**Harry H. Cheng**, formerly with Research and Development, United Parcel Service, Inc. is now Assistant Professor, Department of Mechanical, Aeronautical and Materials Engineering, University of California, Davis, CA 95616, Tel: (916)752-5020, Fax: (916)752-4158, Email: chengh@ch.engr.ucdavis.edu

## New Arrivals

*Congratulations to the following students who have been awarded the Ph.D. Beginning with the next issue, we will include 500-word abstracts of Ph.D. Theses.*

- **Yilin Zhao**, The University of Michigan, Ann Arbor. *Thesis:* "Theoretical and Experimental Studies of Mobile-Robot Navigation." *Advisors:* Spencer L. BeMent and Chinya V. Ravishankar. *Currently:* Motorola Inc., 4000 Commercial Avenue, Northbrook, IL 60062, USA. *E-Mail:* yilin@navhawk99.ivhs.mot.com
- **Angel P. del Pobil**, University of Navarra, Spain. *Thesis:* Robot Motion Planning based on Artificial Intelligence Techniques: A Spherical Model", July 1991 *Advisor:* Professor Miguel A. Serna *Currently:* Associate professor at the Department of Computer Science, Jaume I University, Spain. *Email:* pobil@inf.uji.es

## IEEE Robotics and Automation Society Email Directory

Name	Affiliation	Email	FAX
<b>Changes</b>			
Michael Leahy	RACE, Kelly AFB, TX	mleahy@sadis05.kelly.af.mil	(210) 925 4916
Larry J. Keating	Metropolitan State College	keating@zeno.mscd.edu	
Harry H. Cheng	Univ. of California, Davis	chengh@ch.engr.ucdavis.edu	(916)752-4158
<b>New</b>			
Zheng	Intelligent Automation Inc	geng@eesun.gwu.edu	(301) 990 2409
David Stanton	Univ. of Surrey, UK	d.stanton@surrey.ac.uk	+44 483 3006039
Banavar Sridhar	NASA Ames Res. Ctr.	bsridhar@windchime.arc.nasa.com	
Richard Klafter	Temple Univ.	v5442e@vm.temple.edu	(215)787-6936
Angel P. del Pobil	Jaume I University, Spain	pobil@inf.uji.es	+34.64-345.670
Yilin Zhao	Motorola, Inc.	yilin@navhawk99.ivhs.mot.com	

Send Email Directory and Calendar items to Rosalyn Snyder,  
Managing Editor, roz@relito.medeng.wfu.edu,  
7621 Penland Dr., Clemmons NC 27012, 919-766-6210 (Note new address)



## Robotics and Machine Vision Industries "Fight Back with Automation"

Manufacturing firms seeking automation solutions will find help at the **International Robots and Vision Automation Show and Conference** at Cobo Center in Detroit, April 6-8, 1993.

The Conference features eight in-depth tutorials, 25 conference sessions, and two user-vendor roundtable discussions. The Show features leading robotics and machine vision products.

Also featured are two applications workshops focussed exclusively on a single application that is currently difficult to perform, but potentially can provide significant savings. The workshop topics are **Grinding and Deburring Operations** and **Robotics for Hazardous Operations**.

A special session, the International Service Robot Congress, will feature presentations on apply robots for commercial cleaning, health care, surgery, security, and hazardous handling. Included will be a debate on "The Household Robot: How Soon ant at What Cost?" Joseph F. Engelberger, Chairman, Transitions REsearch Corporation, will present the challenge to industry that a useful household robot can be developed in three years for just \$15 million in R&D.

The show is sponsored by Robotics Industries Association, the Automated Imaging Association, the National Service Robot Association, and the Global Automation Information Network.

Visitors to the show will receive free admission to IPC '93, featuring programmable controls, which runs concurrently. For details, contact RIA, PO Box 3724, Ann Arbor MI 48106, telephone (313)994-6088, FAX (313)994-3338.

## RIA Engelberger Awards

- Four robotics leaders have won the 1992 Engelberger Robotics Award. The award is presented annually by Robotic Industries Association (RIA).
- **Dr. Ing. Rolf D. Schraft**, Vice Director, Fraunhofer Institute, Stuttgart, Germany, received the 1992 award for application. The Institute specializes in applied research. Schraft heads the Automation Division, which has made significant developments in areas such as robots for cleaning aircraft, intelligent mobile robots, off-line programming, and robots for clean rooms.
- **Dr. John Craig**, Vice President of Research and Development, Silma, Inc, Cupertino, CA, won the 1992 award for education. Dr. Craig authored *Introduction to Robotics*, a robotics textbook now in use at more than 90 universities. Craig is also an instructor at Stanford University and a seminar leader for corporations and government agencies throughout the world.
- **Lothar Rossol**, President and Chairman, Trellis Software and Controls, Rochester Hills, MI received the 1992 award for technology development. At General Motor Research Lab, he founded a vision and robotics research group which pioneered the development of vision guided robots. He then joined GMFanuc Robotics in 1982, where he led the development of the AREL programming language and other major products.
- **Eric Mittelstadt**, President and CEO, GMFanuc Robotics

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GMF	A-1

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Puma	260

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GMF	S-108
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Instruments	RT3000
USA, Inc.	TT4000SC
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IBM	7576
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IBM	7545
IBM	7540
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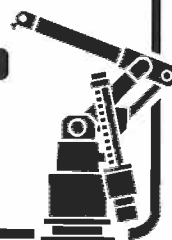
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Corporation, Auburn Hill, MI, won the 1992 award for industry leadership. He has been a forceful advocate for improving U.S. industrial competitiveness through advanced manufacturing methods, and a strong voice in support of a national industrial policy.

RIA is now accepting nominations for the 1993 Engelberger Robotics Awards. For further details, contact RIA at P.O. Box 3724, Ann Arbor, MI 48106, telephone (313)994-6088, fax (313)994-3338.



# Calendar

•February 14-18 1993, Medical Imaging VII. Newport Beach CA. *Contact:* SPIE, Box 10, Bellingham WA 98227-0010. Tel 206 676 3290; Fax: 206/647-1445; Internet: spie@nessie.wvu.edu; Compuserve: 71620,2177

•February 15 - 19 1993 IAS-3: International Conference on Intelligent Autonomous Systems *Contact:* Mrs. Patty Mackiewicz, Robotics Institute, Carnegie Mellon University, Pittsburgh PA 15213 email paty@ri.cmu.edu

•March 10-11, 1993. Advanced Robotics and Intelligent Machines. Salford, Manchester, England. *Sponsors:* E.C. Comett Inst., IEE, and IEEE. *Contact:* Mrs. Cath Gorman, Continuing Education, University of Salford, Manchester, MS 42T, UK.

•March 10, 1993 12th APEC Micro-mouse Contest. San Diego. *Contact:* Melissa Widerkehr, Courtesy Associates, 655 Fifteenth ST. NW, Washington DC 2005 USA Tel 202 347 5900.

•March 28-April 1, 1993 ICNN93: IEEE International Conference on Neural Networks. San Francisco *Contact:* Ms. Nomi Feldman, Meeting Management, 5665 Oberlin Drive, Suite 110, San Diego CA 92121 Tel 619 453 6222; Fax 619 535 3880

•March 28-April 1, 1993. FUZZ-IEEE: 2nd Int. Conf. on Fuzzy Systems. San Francisco. *Sponsor:* IEEE Neural Networks Council. *Contact:* Meeting Management, 5665 Oberlin Drive, Suite 110, San Diego CA 92121 Tel 619 453 6222; Fax 619 535 3880.

•April 6-8, 1993. International Robots and Machine Vision Automation Show and Conference. Detroit. *Contact:* RIA, PO Box 3724, Ann Arbor MI 48106, Tel. (313)994-6088, Fax: (313)994-3338

•April 12-16, 1993 Applications of Artificial Intelligence XI: Machine Vision and Robotics Orlando FL. Part of SPIE's OE/Aerospace Science & Sensing. Submissions dead-

line was September 14 but may have been extended. *Contact:* Kim Boyer: kim@ee.eng.ohio-state.edu or Louise Stark: stark@csee.usf.edu. Registration: SPIE, PO Box 10, Bellingham WA 98227-0010; Tel 206/676-3290; Fax 206 647 1445.

•April 26-29 1993: 5th Topical "Meeting on Robotics and Remote Handling". Sponsored by the American Nuclear Society and others and in coop. with the IEEE Robotics and Automation Society. *Contact:* Fifth Topical Meeting on Robotics and Remote Handling, PO Box 200001, Oak Ridge TN 37831.

•Apr 27-30, 1993. IEEE Int'l Conference on Acoustics, Speech and Signal Processing. *Contact:* Keshab Parhi, Dept. of Electrical Engineering, University of Minnesota, 200 Union Street SE, Minneapolis MN 55455, Tel. 612.624-4116, email: sobelman@ee.umn.edu.

•May 2-9, 1993. IEEE International Conference on Robotics and Automation. Atlanta Hilton and Towers,



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Atlanta GA. General Chair: W.J. Book, Georgia Institute of Technology, George W. Woodruff School of Mechanical Engineering, Georgia Institute of Technology, Atlanta GA 30332-0405 USA; Tel 404 894 3247; Fax: 404 894 9342; Email wbok@gt-me.courier.gatech.edu.

•May 9-14, 1993. IS&T's 46th Annual Conference, Cambridge Mass.

Sponsor: Society for Imaging Science and Technology. Contact: Michael R. Lee, Publications Chair, Polaroid Corp., 1265 Main St. W4-2G, Waltham MA 02154 1799. Tel 617 684 5391; Fax: 617 684 4396.

•May 10-12, 1993. SPANN'93: IMACS

Symposium on Signal Processing and Neural Networks. Montreal, Canada. Contact: Prof. Z. Jacyno, Department of Physics, University of Quebec at Montreal, P.O.Box 8888, Station A, Montreal, P. Quebec, Canada, HC 3P8.

•May 19-21, 1993 Solid Modeling '93:

Second ACM/IEEE Symposium on Solid Modeling and Applications. Montreal, Canada. Contact: Mary Johnson, CII 7015, RPI, Troy NY 12180. Ph(518)276-6751.

•June 1-4, 1993. IEA93AIE: 6th Int'l Conf. on Industrial & Engineering Applications of Artificial Intelligence & Expert Systems. Contact:

Paul Chung, Dept. of Chemical Engineering, Loughborough University of Technology, Loughborough, Leicestershire, England, UK, LE11 3TU, Email: p.w.h.chung@lut.ac.uk.

•June 7-10, 1993 Transducers'93:

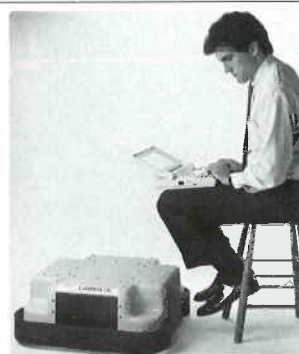
Solid State Sensors and Actuators Yokohama, Japan. Sponsors: Institute of Electrical Engineers of Japan and Japan Science Foundation. Contact: Secretariat TRANSDUCERS '93, c/o SANSEI International Inc., Fukide Bldg. No. 2, 1-21 Toranomon 4-chome, Minato-ku, Tokyo, 105 Japan.

•June 13-16 1993. CBMS 93: IEEE

Computer Based Medical Systems Symposium. Ann Arbor Michigan. Sponsors: IEEE and Engineering in Medicine and Biology Society. Contact: Timothy J. Kriewall, Ph.D., Sarns, 3M Health Care, 6200 Jackson Road, Ann Arbor MI 48106; 313 741 6276.

•June 15-17, 1993 IEEE Conference on Computer Vision & Pattern Recognition June 15-17, 1993

Contact: Yiannis Aloimonos, Computer Vision Laboratory, Center for Automation Research, A. V. Williams



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•June 16-18. International Unmanned Ground Robotics Competition (See call for papers)

• June 21-25, 1993 PetriNets'93: 14th Int. Conf. on Application and Theory of Petri Nets. Chicago. Submissions: Contact: Marco Ajmone-Marsan, Dipartimento di Elettronica, Politecnico di Torino, Corso Duca degli Abruzzi 24, I-10129 Torino Italy. Tel.: 39 11 5644032. Fax 39 11 5644099 email: ajmone@itopoli.bitnet.

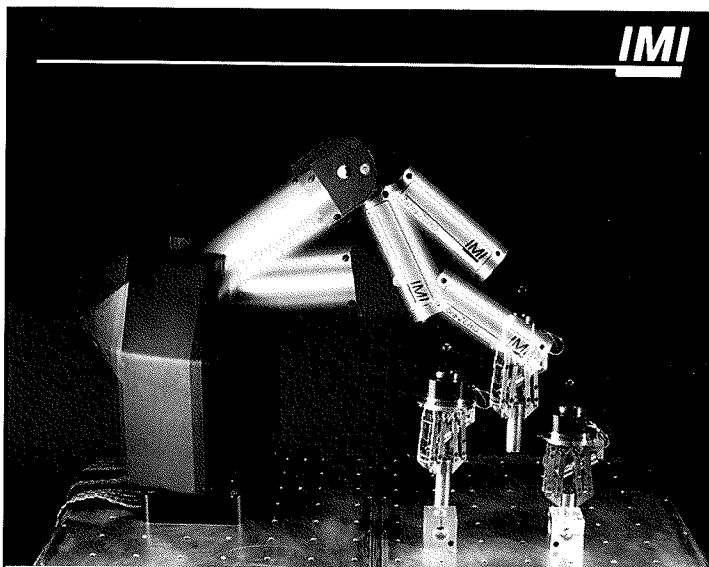
•July 14-16 1993 Intelligent Vehicles '93. Tokyo. Sponsor: IEEE and SAE. Contact: Ichiro Masaki, Computer Science Dept., General Motors' Research Laboratories, 30500 Mound Road, Warren MI 48090-9055 USA. Tel: 313-986-1466; Fax 313 986 9356; email masaki@gmr.com

•July 14-16 Robots for Competitive Industries. Brisbane, Queensland, Australia. Sponsor: Australian Robot Association and the International

Federation of Robotics. Deadline was Jan 15, but contact Hartmut Kaebernick, School of Mechanical and Manufacturing Engineering, University of New South Wales, PO Box 1, Kensington NSW 2033, Australia, fax +61 2 663 1222. Registration: Australian Robot Association, INC, GPO Box 1527, Sydney NSW 2001 Australia, Tel.: 61 959 3239. Fax 61 2 959 4632; email: michael@extro.ucc.su.oz.au

•July 26-30 IROS 93: Int'l Conf. on Intelligent Robots and Systems. Yokohama Japan Contact: Masatsugu Kidode, Kansai Research Lab., Toshiba Corp., 8-6-26 Motoyama-Minami-cho, Higashinada-ku, Kobe; 658 Japan, tel: 81 78 435 3502; fax 81 78 435 3678 or Tomomasa Sato, Research Center for Advanced Science and Technology, University of Tokyo, 4-6-1 Komaba, Meguro-ku, Tokyo, 153 Japan, Tel 81 3 3481 4479 Fax: 81 3 3481 4584.

•July 30-31, Nagoya Japan. IEEE/Nagoya University Workshop on Multiple/Distributed Robotic Systems: Architecture and Control for Coordination and Cooperation



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*Contact:* Kazuhiro Kosuge, General Chair, WWW on MDRS, Dept. Mechano-Informatics and Systems, Nagoya University, Furo-cho, Chikusa-ku, Nagoya 464-01, Japan, Tel: 81 52 781 5111, Ext. 6783; Fax 81 52 782 9243.

- **August 2-4, 1993 ICAM'93: Int'l Conf. on Advanced Mechatronics Yokohama, Japan.** *Contact:* Jun'ichi Takeno, School of Science and Technology, Meiji University, 1-1-1 Higashi-ita, Tama-ku, Kawasaki-shi, Kanagawa-ken 214, Japan, Tel 044 934 9454; 044 934 7912 (Japan) International Tel/Fax 81 44 934 2880.
- **August 25-27 IEEE Int'l Symposium on Intelligent Control** (*See call for papers*)
- **August 29-Sept. 3, 1993. IJCAI'93: Int'l Joint Conf. on Artificial Intelligence.** Chambéry Savoie France. *Contact:* Ms. Catherine Vidonne, Danzas/IJCAI 93. 14 rue des Bains, BP431 - 43104 Aix-Les-Bains Cedex France. Tel 33 79 5 66 22; fax 33 79 61 36 92; email: vidonne@imag.fr.
- **Aug 30-Sept. 3 1993. Software Engineering Standards Symposium.** '93 Brighton, England. *Sponsor:* IEEE Computer Society. *Theme:* Internationalization of Industrially Useful Software Engineering Standards (SES) *Contact:* Sal Mamone, Nynex Corp., 500 Westchester Ave, White Plains NY USA. Tel +1 914 644 2237 Fax +1 914 644 2191
- **September 7-9, 1993. IEEE Workshop on Neural Networks for Signal Processing.** Baltimore MD. (*See call for papers*)
- **September 13-16 1993. ICANN'93: International Conference on Artificial Neural Networks (ICANN'93).** Amsterdam, (*See call for papers*)

- **September 13-16, 1993. 2nd IEEE Conference on Control Applications.** Vancouver, BC Canada. *Sponsor:* IEEE Control Systems Society. *Contact:* Dr. C. de Silva, Dept. of Mechanical Engineering, University of British Columbia, Vancouver, BC Canada, V6T 1Z4. For further information contact S. Atadan at the same address. Fax: (604)822 2403.
- **September 18-22, 1993, VRAIS'93: Virtual Reality Annual Symposium.** Seattle, Washington. *Sponsor:* IEEE Neural Networks Council. *Contact:* Meeting Management, 5665 Oberlin Drive, Suite 110, San Diego, CA 92121 Tel: 619 453 6222, fax: 619 535- 3889. *Video submissions:* Send 1 high quality copy of 2-3 minute video by February 1 1993 to the above address.
- **October 5-8, 1993. IPCC'93: Int'l Professional Communication Conference.** Philadelphia. *Information:* Michael B. Goodman, General Chair: Tel. (201)593-2402 Fax (201)593-8510; *Registration:* W.P. Kehoe, IPCC93 Finance, JHU/APL, 6-379, Johns Hopkins Road, Laurel MD 20723 Tel. (301)953-5000, ext 7944; Fax (301)95305937.
- **October 1993, ISER'93: Int'l Symposium on Experimental Robots.** (*See call for papers*)
- **November 4-6, 1993 ISIR: Int'l Symposium on Industrial Robots.** *See Calls for Papers*
- **December 15-17, 1993, 1993 Computer Architectures For Machine Perception (CAMP'93) Workshop,** New Orleans, Univ. of Maryland, College Park, MD 20742, USA. *Contact* Johanna Weinstein by e-mail at: camp93@umiacs.emd.edu.

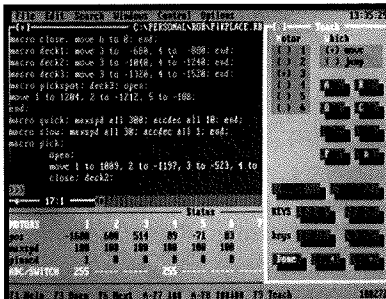
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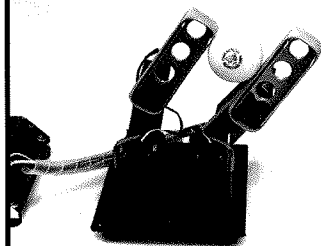
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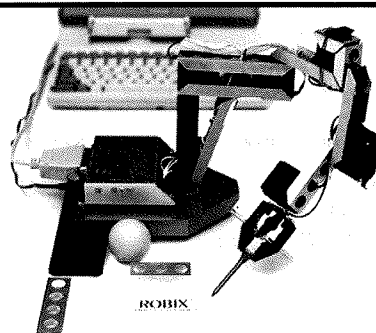
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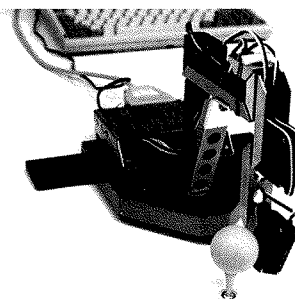
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# Calls for Papers

*Note: Fax and email submissions are usually not acceptable. Please contact Program Chair for specific details regarding paper preparation and deadlines before submitting papers.*

• **International Unmanned Ground Robotics Competition June 16-18.** Rochester Michigan. *Sponsor:* Association for Unmanned Vehicle Systems (AUVS). \$10,000 prize to the university team for the best Autonomous Unmanned Ground Vehicle. *Contact:* Ka C. Cheok or Candy McClellan, Oakland University, School of Engineering & Computer Science, 248 Dodge Hall, Rochester MI 47398-4401. Tel. (313) 370-2231, Fax: (313)370-4261.

• **Fifth International Conference on Genetic Algorithms. July 17-22.** University of Illinois at Urbana-Champaign, *Sponsor:* The International Society for Genetic Algorithms, *Contact:* Prof. Stephanie Forrest, Dept. of Computer Science, University of New Mexico, Albuquerque, N.M. 87131-1386, phone: (505) 277-3112, fax: (505)277-0813, email: icga93@unmvax.cs.unm.edu *Submissions:* Four (4) complete copies (hardcopy only, 12 point, single-spaced, 10 pages maximum, separate title page for anonymous review), postmarked by February 1, 1993

• **1993 IEEE/Nagoya Workshop on Multiple/Distributed Robot Systems. July 30-31 Nagoya Japan.** *Submissions:* Abstract by March 31, 1993 to Prof. Kazuhiro Kosuge, WWW on M.D.R.S., Dept. of Mechano-Informatics and Systems, Nagoya University, Furo-cho, Chikusa-ku, Nagoya 464-01 Japan. Tel: 81-52-781-5111 ex. 6783; Fax: +81-52-781-9243.

• **IEEE Int'l Symposium on Intelligent Control August 25-27 Chicago.** *Sponsor:* IEEE Control Systems Society. *Submissions:* 5 copies of full paper by March 15 to Kevin M. Passino, ISIC'93, Dept. Electrical

Engineering, Ohio State University, 2015 Neil Ave., Columbus Ohio 43210-1272. Tel. (614)292-5716. email:

passino@eagle.eng.ohio-state.edu.  
*Workshop & Tutorial Proposals:* Panos J. Antsaklis. Tel. (219)239-5792; Fax (219) 239-8007; email flxfsn@irishmvs.cc.nd.edu

• **IEEE Workshop on Neural Networks for Signal Processing. September 7-9, 1993. Baltimore MD.** *Submissions:* 4 copies of extended summary by February 15 to Gary Kuhn, NNSP'93, Siemens Corporate Research, 755 College Road East. Princeton, NJ 08540.

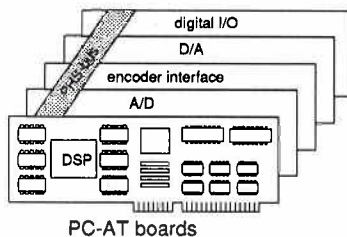
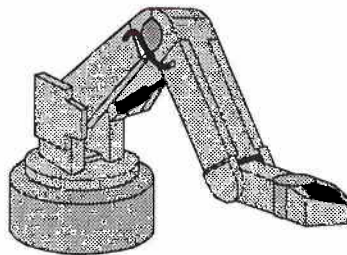
• **ICANN'93: International Confer-**

**ence on Artificial Neural Networks (ICANN'93). September 13-16 1993.** Amsterdam. Topics include: Computational principles from neurobiology, Physical and Mathematical theories, Cognitive connectionism, Robotics, Applications. Submission deadline for papers: February 1 1993. *Contact:* ICANN'93 Secretariat, Novep, Paulus Potterstraat 44, 1071 DB Amsterdam, The Netherlands. Tel. 31-20-6714814, Fax 31-20-6628136, email ican-n@mbfys.kun.nl

• **1993 IEEE/Nagoya Workshop on Learning and Adaptive Systems. October 22-23. Nagoya, Japan.** *Submissions:* Abstract by July 1, 1993 to Fumihito Arai and Toshio Fukuda, Nagoya University, Furo-

## Get your robot on the track

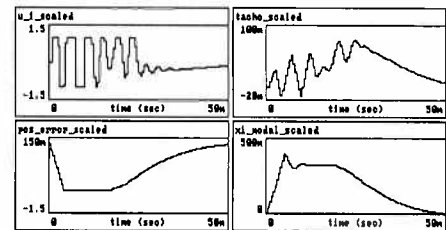
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cho, Chikusa-ku, Nagoya 464-01 Japan. Tel: 81-52-781-5111 ex. 6783; Fax: +81-52-781-9243. A limited number of travel awards will be granted.

•**ISER'93: International Symposium on Experimental Robots. October 1993 Kyoto, Japan.** *Submissions:* Contact: Oussama Khatib SAIL, Robotics Division Department of Computer Science, Stanford University Stanford, CA 94305 U.S.A.; Prof. J. K. Salisbury, MIT Artificial Intelligence Laboratory, 545 Technology Square, Cambridge, MA: 02139 U.S.A.; or Prof. V. Hayward, McGill University, Research Center for Intelligent Machines, 3480 University, Montreal, Quebec, H3A 2A7 Canada Video submissions in addition to papers are encouraged.

•**'93 ICAR: Int'l Conference on Advanced Robotics. November 1-2, 1993, Tokyo.** *Submissions:* 4 copies of full paper and abstract by March 1, 1993 to The Working Committee of '93 ICAR, c/o Robotics Society of Japan, Bunkyo Shogaku Bldg., 6F 1-15-4 Hongo, Bunkyo-ku Tokyo 113 Japan. *Contact:* Ms. Kazuko Higuchi, Fax +81 3 3812 4628.

•**ISIR'93 24th Int'l Symposium on Industrial Robots November 2-5, 1993, Tokyo.** *Submissions:* 400 word abstract by Jan 31 to Secretariat of 24th ISIR, Japan Industrial Robot Association, Kikai Shinko Kaikan Bldg., 3-5-8, Shiba-Koen, Minato-ku, Tokyo 105, Japan. Tel.: +81 3 3434 2919; Fax: +81 3 3578 1404.

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• **MATH MOD Vienna: Int'l IMACS Symposium on Mathematical Modelling. February 2-4, 1994, Vienna, Austria.** *Submissions:* Abstract by May 1, 1993 to Univ. Prof. Dr. Inge Troch, Technische Universitaet Wien, Wiedner Hauptstrasse 8-10, A-1040 Wien, Austria.

## IEEE Robotics and Automation Society LOGO DESIGN CONTEST



IEEE      Robotics and Automation

We are proud to announce a competition to create a logo to be used in the new IEEE Robotics & Automation Society magazine and other publications, announcements, letterhead, tee shirts, beach towels, and other memorabilia. The winning artist will be awarded a \$100 prize and lots of glory.

Designs should fit into a square, be one-color only, reversible, and legible when reduced to sizes as small as 1/4" on a side.

Send hand drawn or computer generated design to

Rosalyn Snyder  
Managing Editor  
7621 Penland Drive  
Clemmons NC 27012  
919 766 6210  
roz@relito.medeng.wfu.edu

**The deadline for submissions is July 15, 1993.**





# Call for Papers

# IECON '93 HAWAII



Nineteenth Annual Conference of the IEEE Industrial Electronics Society  
In Technical Co-Sponsorship with the Society of Instrument and Control Engineers of Japan (SICE)  
November 15-19, 1993 • Hyatt Regency-Maui, Lahaina, Maui, Hawaii

**IECON '93** is an International Conference on industrial applications of power electronics, controls, robotics, signal processing, instrumentation, automation, artificial intelligence, and emerging technologies. The objectives of the conference are to attract high quality papers and to promote professional interactions for the advancement of science, technology, and fellowship. The technical program will be organized around the following five conference themes (tracks):

**POWER ELECTRONICS:** Power electronics devices and systems, high frequency power converters, digital control of power electronics, energy systems, electrical drives, static var and harmonic compensations, and analytical and simulation methods.

**ROBOTICS, VISION and SENSORS:** Advanced robotics, intelligent sensors, machine vision and intelligence, actuators and motion control, micro electro-mechanical systems, multisensor fusion and integration, and autonomous mobile robots.

**FACTORY AUTOMATION:** Factory communications, flexible manufacturing, manufacturing system architectures, industrial automation, process automation, CAD/CAM/CAT/CIM, and LAN.

**SIGNAL PROCESSING AND CONTROL:** Advanced control and measurement, computer and microprocessor based control, data reduction and signal processing, estimation and identification techniques, instrumentation electronics, modeling and simulation, automotive electronics, human interface, software design and tools, and non-linear control and systems.

**EMERGING TECHNOLOGIES:** Industrial applications of neural networks, fuzzy systems, concurrent engineering, industrial applications of intelligent systems, artificial intelligence and expert systems, and intelligent mechatronics.

**Submission of Papers:** Submit an abstract and summary, formatted as follows. First page: title, authors, mailing address, telephone number, FAX number, electronic mail address of each author, preferred topical area and subject area. Second page: title, authors, 100 word abstract. Third and succeeding pages: title, 1000-word summary, figures and references. The authors are encouraged but not required to submit full manuscript at the time of submitting the abstract and summary. Submit five copies of each, in English, to one of the following contacts:

Papers from N. and S. America:  
(IEEE Regions 1-7 and 9)

Dr. C. J. Chen  
AT&T Bell Labs  
Room 3E226C  
Whippany Road, P.O. Box 903  
Whippany, NJ 07981-0903 U.S.A.  
(201)386-3095 (office)  
(201)386-2942 (FAX)

Papers from Europe, Middle East,  
and Africa: (IEEE Region 8)

Prof. Javier Uceda  
Universidad Politecnica  
de Madrid  
E.T.S. Ingenieros Industriales  
Jose Gutierrez Abascal, 2  
E-28006 Madrid SPAIN  
34-1-411-7517 (office)  
34-1-564-5966 (FAX)

Papers from Rest of World:  
(IEEE Region 10)

Prof. Rokuya Ishii  
Div. of Electrical and Comp. Eng.  
Yokohama National University  
Tokiwadai, Hodogaya-ku,  
Yokohama, 240 JAPAN  
81-45-335-1451 (phone)  
81-45-338-1157 (FAX)

Tutorials:

(All IEEE Regions)

Prof. Alfred C. Weaver  
Dept. of Computer Science  
Thornton Hall  
University of Virginia  
Charlottesville, VA 22903 U.S.A.  
(804)982-2201 (office)  
(804)982-2214 (FAX)

Special Sessions:

(All IEEE Regions)

Prof. Russell J. Niederjohn  
Dept. of Elec. & Computer Engineering  
Marquette University  
Milwaukee, WI 53233 U.S.A.  
(414)288-6820 (office)  
(414)288-7082 (FAX)

**Special Sessions and Tutorials:** The conference will feature special sessions and tutorials on topics of special interest. To propose a special session, contact the Special Sessions Co-Chairmen and provide the session name and a list of 6-10 potential papers and authors. All Special Session papers will be reviewed. To propose a tutorial, contact the Tutorials Co-Chairmen and identify the topic, speaker, length of tutorial (half a day or full day), abstract of tutorial, and type of supporting materials (overheads, textbooks, handouts, etc.).

**Paper Acceptance:** Accepted papers must be presented at the conference within a 20-30 minute period. A paper submitted for consideration implies a commitment to present the paper in Hawaii. All conference participants, including authors and session chairpersons, must pay the conference registration fee and travel expenses. Papers submitted to IECON '93 will be considered for publication in the IEEE Transaction on Industrial Electronics upon request of the Author.

**Author's Schedule:**

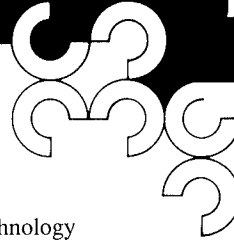
Deadline for special sessions and tutorial proposals:	February 15, 1993
Deadline for submission of paper summaries:	March 8, 1993
Notification of acceptance:	May 25, 1993
Deadline for submission of final manuscripts:	August 14, 1993

**General Co-Chairmen:**

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May 2-7, 1993  
Atlanta Hilton and Towers  
Atlanta, Georgia

## ADVANCE ANNOUNCEMENT

MONDAY, MAY 3 TO WEDNESDAY, MAY 5, 1993

The theme of the 1993 Conference is “**Integration of Intelligent Robots with Automated Manufacturing Systems**”. The aim of the Conference is to report and explore the technical advancement and achievement in the field of flexible automation including the coordination of intelligent robotics systems in automated manufacturing systems. The conference will provide a forum for the exchange of ideas and discussion of future directions in robotics and automation. The topics will include but are not limited to:

- Application of robotics and automation in industry, construction, agriculture, and medicine
- Application to nuclear, space, underwater and other hazardous environments
- Robot sensing, data integration, and sensor fusion
- Multisensory perception and workspace modelling
- Autonomous manipulation and mobility with sensing
- Robot group coordination
- Telerobotics and autonomous robots
- Modelling and performance evaluation of manufacturing and other discrete event systems
- Scheduling and control of manufacturing systems
- Analysis of manufacturing system dynamics
- Information engineering for CIM
- Concurrent design of products and automated manufacturing
- Micro-electro mechanical systems
- Control and dynamic analysis addressing unresolved robotic issues

### ASSOCIATED TUTORIALS AND WORKSHOPS

#### **Tutorial S1 (Sunday, May 2, 1993-8:30 AM to 12:30 PM): Friction in Robotic Manipulation and Assembly**

Friction is responsible for both the upper and lower performance limits in manipulation and assembly. Significant progress has been and continues to be made in overcoming the challenges posed by friction. The purpose of this tutorial is to make accessible to the robotics community the current results from friction modeling, analysis and compensation as they relate to the planning and control of manipulation, grasping and assembly.

Friction occurs internally, in components such as transmissions, bearing and seals, as well as externally, through contact with the

environment. Internal friction modeling, analysis and compensation techniques will be surveyed and classified by control task, machine component and lubricant. External friction modeling will also be covered along with the associated theory and analysis techniques for motion planning and control in dexterous manipulation, assembly and fixturing.

#### **Organizers:**

**Pierre E. Dupont**, Boston University  
**Brian Armstrong-Helouvry**, University of Wisconsin

#### **Speakers:**

**Brian Armstrong-Helouvry**, University of Wisconsin  
**Mark Cutkosky**, Stanford University  
**Pierre Dupont**, Boston University  
**Robert Howe**, Harvard University  
**Daniel Whitney**, Charles Stark Draper Laboratory



### **Workshop S2 (Sunday, May 2, 1993-1:30 PM to 5:30 PM): Robotic Technologies for Environmental Restoration and Waste Management in DOE Nuclear Sites**

Over the past two years, the Department of Energy (DOE) has launched a new robotic program for environmental restoration and waste management (ERWM) in the nuclear sites of this nation. The plan has placed emphasis on the development and standardization of the robotic technologies to be used broadly across all the areas of the ERWM operations. This emerging area of application has brought both challenge and opportunity to the robotics community. The purpose of this workshop is to familiarize the workshop attendees with this new program, the existing robotic technologies and new technologies needed by this ERWM program. Four topics will be presented by five experts in the area. The topics are:

- a) Cross Cutting and Advanced Robotic Technology
- b) Decontamination & Decommissioning Robotics
- c) Robotic Technology for Waste Facility Operations
- d) Laboratory Automation Techniques

#### **Organizers:**

**Joe Byrd**, University of South Carolina

**Yuan F. Zheng**, The Ohio State University

#### **Speakers:**

**Joe Byrd**, University of South Carolina

**William Hamel**, Oak Ridge National Laboratory

**Raymond Harrigan**, Sandia National Laboratory

**Robert Hollen**, Los Alamos National Laboratory

**Clyde Ward**, Westinghouse Savannah River Technical Center

### **Workshop S3 (Sunday May 2, 1993-8:30 AM to 5:30 PM): Workshop on Geometric Algorithms for Manufacturing**

This workshop will focus on computational geometric algorithms for industrial manufacturing, including applications to assembly, fixturing, parts feeding and component design. The challenge is to formulate mathematical problems that make realistic assumptions and yet admit elegant solutions (e.g. with polynomial time complexity), or to prove that seemingly simple problems are intractable. Accordingly emphasis will be on well-posed problems with a direct bearing on low-level automation. For example, given an assembly of polyhedra, describe the set of translations that will separate the components (Wilson and Latombe). In the problem of a grid with  $P$  being a  $2 \frac{1}{2}D$  rectilinear part whose cross-sectional polygon has edges all of length of 4 units or more, how many clamps are required to insure form closure (Mishra)?

We will discuss work-in-progress and identify new research questions. Each speaker will review the necessary background and present recent results. In the remaining time, there will be an open discussion of new problems.

#### **Organizer:**

**Ken Goldberg**, University of Southern California

#### **Speakers:**

**Randy Wilson**, Stanford University

**John Canny**, University of California, Berkeley

**Matt Mason**, Carnegie Mellon University

**Bruce Donald**, Cornell University

**Ken Goldberg**, University of Southern California

### **Workshop S4 (Sunday May 2, 1993-8:30 AM to 4:30 PM): Force Display in Virtual Environments and its Application to Robotic Teleoperation**

The purpose of this workshop is to review the state-of-the-art in force display problems in virtual environments and its applications to

teleoperation. Virtual reality technology enables humans to enter realistic simulated environments through the senses. This provides a powerful tool for constructing a simulator for off-line task teaching systems for industrial robots and a predictive display used to solve the time delay problem in space telerobotic systems. When such display systems are used for robotics a force display function should be implemented in addition to a visual display function. The Workshop will discuss several topics concerning force display problems, including force display devices, virtual force calculation algorithm, force reflection method, tactile display teleprogramming using virtual environments, applications to space telerobot systems and macro-micro teleoperation.

#### **Organizers:**

**A.K. Bejczy**, Jet Propulsion Laboratory

**Gerhard Hirzinger**, DLR, Germany

**Kazuo Tanie**, Mechanical Engineering Laboratory, Japan

#### **Speakers:**

**A.K. Bejczy**, Jet Propulsion Laboratory

**G. Burdea**, Rutgers University

**M. Bergamasco**, Scuola Superiore S. Anna, Italy

**K. Tanie**, Mechanical Engineering Laboratory, Japan

**M. Minsky**, Media Laboratory, Massachusetts Institute of Technology

**B. Hanaford**, University of Washington

**G. Hirzinger**, DLR, Germany

**R.P. Paul**, University of Pennsylvania

**M. Mitsuishi**, University of Tokyo, Japan

### **Tutorial S5 (Sunday, May 2, 1993-8:30 AM to 4:30 PM) Force and Contact Control in Robotic Systems: A Historical Perspective and Current Technologies**

Force and contact control has been a major subject since robotics was born as an academic research field. It has a wide range of practical applications, such as manufacturing, construction, and agriculture and many important research works continue to take place.

The Goal of this tutorial is to put the state-of-the-art of force and contact control technologies in a coherent historical perspective and to show the audience a clear picture of them. This tutorial will expose application engineers to force and contact control, and provide an understanding of what can be done in the field. For researchers and students in robotics, this is an excellent opportunity to understand the historical perspective and identify future research problems.

#### **Organizers:**

**Miomir Vukobratovich**, Institut Mihajlo Pupin Boegard, Yugoslavia

**Yoshihiko Nakamura**, University of Tokyo, Japan

#### **Speakers:**

**Alessandro DeLuca**, Universita degli Studi di Roma "La Sapienza", Italy

**J. DeSchutter**, Katholieke Universiteit Leuven, Belgium

**A. Goldenberg**, University of Toronto, Canada

**Neville Hogan**, Massachusetts Institute of Technology

**N. Kircanski**, Institut Mihajlo Pupin Boegrad, Yugoslavia

**Harvey Lipkin**, Georgia Institute of Technology

**Yoshihiko Nakamura**, University of Tokyo, Japan

**Miomir Vukobratovich**, Institut Mihajlo Pupin Boegrad, Yugoslavia

**Kenneth Waldron**, The Ohio State University

**Tsuneo Yoshikawa**, Kyoto University, Japan





## **Workshop T1 (Thursday, May 6, 1993-8:30 AM to 5:30 PM):**

### **Needs for Research in Cooperating Robots**

This workshop will provide a forum for robotics researchers and users to discuss application requirements for cooperating robot systems as well as high-impact research agendas to meet these requirements. Discussion topics include: performance requirements for cooperating robots; mapping application requirements to multi-robot system characteristics; benchmark experiments and performance characterization; and other issues in enabling technologies including multi-agent control, distributed sensing, and communications. There are few doubts as to the intellectual challenge associated with developing methodologies required to accomplish cooperation among multiple robots. Concerns, however, do exist as to the advisability or real need for cooperating robots from a practical point of view. Another often voiced-concern addresses the merit of research into cooperating robots when the reliable control of a single robot in a dynamic environment with uncertainties remains an area of active research for many groups.

#### **Organizers:**

**Reinhold C. Mann**, Oak Ridge National Laboratory

**Shin-ichi Yuta**, Tsukuba University, Japan

#### **Speakers:**

**P. Eicker**, Sandia National Laboratories

**S. Holland**, General Motors

**D. Lavery**, National Aeronautics and Space Administration

**E. Mettala**, Defense Advanced Research Project Agency

**H. Asama**, RIKEN

**R. Arkin**, Georgia Institute of Technology

**A. Bangs**, Oak Ridge National Laboratory

**J. Crowley**, LIFIA, France

**P. Khosla**, Carnegie Mellon University

**L. Parker**, Massachusetts Institute of Technology

**J. Wang**, University of California, Riverside

**S. Yuta**, Tsukuba University, Japan

## **Workshop T2 (Thursday, May 6, 1993-8:30 AM to 5:30 PM)**

### **Assembly and Task Planning**

This workshop provides an informal forum for researchers in industries, universities, and government laboratories to discuss recent progress and future research directions in assembly and task planning. Topics of interest include: CAD and geometric issues in assembly, tolerance analysis of assembly, evaluation functions for assembly design automation, stability analysis in assembly, automated assembly planning for maintenance, concurrent design and planning, reactive reasoning and planning, algorithmic and knowledge-based approaches to design and redesign, and implementation issues. Each speaker will deliver a short presentation, and the attendees will participate in an hour long discussion at the end of all the presentations.

#### **Organizers:**

**Kesh Keshavan**, Northrop

**Luiz Homen de Mello**, Jet Propulsion Laboratory

**Sukhan Lee**, University of Southern California

**Damian Lyons**, Philips Laboratory

#### **Speakers:**

**Mark Cutkosky**, Stanford University

**Thomas de Fazio**, Charles Stark Draper Laboratory

**Luiz Homem de Mello**, Jet Propulsion Laboratory

**Kesh Keshavan**, Northrop

**C.S. George Lee**, Purdue University

**Sukhan Lee**, University of Southern California

**Damian Lyons**, Philips Laboratory

**A.A. Requicka**, University of Southern California

**Arthur C. Sanderson**, Rensselaer Polytechnic Institute

**David Strip**, Sandia National Laboratory

**Herb Voelcker**, Cornell University

**Jan Wolter**, Texas A&M University

## **Tutorial T3 (Thursday, May 6, 1993-8:30 AM to 5:30 PM):**

### **Miniature and Micro Robotic Machines: Technology, Design and Applications**

The tutorial will focus on the area of micro robotics in order to identify fundamental unsolved problems and to stimulate research efforts in the required directions. The goals of the tutorial include: defining the field; presenting basic fabrication technologies; discussion problems related to subsystem design, system integration and control; and critically surveying present and future applications. The speakers have been selected based on their expertise in the field, and their ability to convey to the participants the feeling of collegiality across the disciplines.

#### **Organizers:**

**Paolo Dario**, Scuola Superiore S. Anna, Italy

**Ronald Fearing**, University of California, Berkeley

**Toshio Fukuda**, Nagoya University, Japan

#### **Speakers:**

**Paolo Dario**, Scuola Superiore S. Anna, Italy

**Ronald Fearing**, University of California, Berkeley

**Toshio Fukuda**, Nagoya University, Japan

**Kris Pister**, University of California

**Isao Shimoyama**, University of Tokyo, Japan

**Jan Smits**, University of Boston

**Blake Hannaford**, University of Washington

**William Trimmer**, Princeton University

**Nico De Rojij**, University of Neuchatel, Switzerland

## **Tutorial T4 (Thursday, May 6, 1993-8:30 AM to 5:30 PM):**

### **Behavior-Based, Reactive Robotic Systems**

This tutorial will examine the need, rationale, motivation, and techniques available for developing real-time, behavior-based reactive control systems. In this paradigm, the immediate use of sensor data can be used to avoid the cumulative errors between abstract models of the world and the actual state of the world. The goal is to highlight the value of reactive behaviors with respect to the complexity of planning, the fidelity of model-referenced control and the flexibility in the system response to novel and unexpected circumstances.

We will discuss the motivating influences for behavior-based robotics systems and its roots in neuroscience, psychology, and ethology. We examine the role of sensing and representation under this paradigm and describe how observation can be coupled directly to control. A survey of behavior-based systems is then presented with a critical analysis of each. Finally, examples derived from the Autonomous Robot Architecture (AuRA) at Georgia Tech related to mobile robot control, and the University of Massachusetts Laboratory for Preceptual Robotics work on reactive controllers for multifingered manipulators are presented.

#### **Organizers and Speakers:**

**Ronald C. Arkin**, Georgia Institute of Technology

**Roderic A. Grupen**, University of Massachusetts



### **Tutorial T5 (Thursday, May 6, 1993-8:30 AM to 5:30 PM)**

#### **Concurrent Engineering Approach and Application of AI to Manufacturing**

This tutorial will focus on simulation, evaluation, and design of advanced manufacturing systems. It is expected that the tutorial will benefit people involved in designing, evaluating and implementing manufacturing environments. It will also be useful to researchers and graduate students engaged in study or research in this area. Topics to be covered include: Flexible manufacturing cells and systems, knowledge based simulation of FMS, modeling of manufacturing systems, manufacturing cell simulation and scheduling (including Petri-nets), blackboard architecture and cooperating expert systems. The tutorial will conclude with a case study.

#### **Organizers:**

**G. Kovacs**, Hungarian Academy of Sciences

**N. Vishwanadham**, Indian Institute of Science

**I. Mezgar**, Computer and Automation Institute, Hungary

#### **Speakers:**

**G. Kovacs**, Hungarian Academy of Sciences

**N. Vishwanadham**, Indian Institute of Science

**I. Mezgar**, Computer and Automation Institute, Hungary

**A. Desrochers**, Rensselaer Polytechnic Institute

#### **Local Tours:**

On Thursday, May 6, tours of local industry are planned. You will have the option of taking morning tours, afternoon tours, or both. The immediate Atlanta area is home to internationally recognized automobile assembly plants (Ford Taurus and G.M.), communications equipment (AT & T), food and beverage (Coca-Cola), and air frame (Lockheed Georgia) manufacturers. Consult the Advanced Program for final tour information and to reserve your place.

On Tuesday, May 4, tours of the Manufacturing Research Center, Material Handling Research Center, and the Graphics, Visualization and Usability Laboratory, all at Georgia Tech, will be provided. Convenient transportation (15 minutes) to and from the conference site will be provided.

## **ORDER FORM FOR 1993 VIDEO PROCEEDINGS**

Mail to: Beth A. Murray, IEEE, 445 Hoes Lane, PO Box 1331, Piscataway, NJ 08855-1331, U.S.A.

- ☐ Send me the 1993 Video Proceedings of the International Conference on Robotics and Automation (HVO327-7 PCD) (\$80 member price, \$130 non-member), plus handling and sales tax if applicable (See below)
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## Registration Form

**May 2-7, 1993**Atlanta Hilton and Towers  
Atlanta, Georgia

Please complete and return this form (with your check made payable to "Robotics and Automation" to:

Robotics and Automation Telephone and FAX Contact:  
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**(Checks must be in U.S. Dollars drawn on a U.S. Bank)**

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City/State/Zip/Country \_\_\_\_\_

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IEEE Membership Number \_\_\_\_\_

Please register me as follows: (Circle appropriate fee)

	Member fee	Non-Member fee	Student fee
Conference	\$230	\$280	\$110
Conference (plus Video)	\$295	\$345	\$175
Tutorial S1 (half day)	\$100	\$125	\$100
Workshop S2 (half day)	\$100	\$125	\$100
Workshop S3 (full day)	\$125	\$150	\$125
Workshop S4 (full day)	\$125	\$150	\$125
Tutorial S5 (full day)	\$125	\$150	\$125

Workshop T1 (full day)	\$125	\$150	\$125
Workshop T2 (full day)	\$125	\$150	\$125
Tutorial T3 (full day)	\$125	\$150	\$125
Tutorial T4 (full day)	\$125	\$150	\$125
Tutorial T5 (full day)	\$125	\$150	\$125
Total	\$_____	\$_____	\$_____

Please circle applicable fees for those sessions you desire to attend, then add together to determine total fee which should be included with your registration. For registration after April 20, add \$50 late fee (\$20 for Students). Payment may be made by check in U.S. Dollars on U.S. Bank, or payment may be made by VISA, Master Card, or Eurocard. (Other credit cards are not acceptable)

Payments Enclosed \$ \_\_\_\_\_

Visa or Master Card No. \_\_\_\_\_

Expiration Date \_\_\_\_\_

Signature \_\_\_\_\_

The tutorials and workshops include coffee breaks and notes. Conference registration includes the proceedings, coffee breaks and social functions. Student registration for the conference only (does not include social functions, but includes coffee breaks and proceedings). To qualify for student rate, students must be IEEE student members, and must not be employed full time. Students will be required to show their IEEE membership Card when picking up their registration. Registration fees may be refunded in full if a written request is received before April 15. A 50% penalty charge will be levied on those who request a refund after that date and before April 30. After April 30 there **WILL BE NO REFUNDS**. Late registration will be accepted beginning Sunday, May 2, 1993 at the Atlanta Hilton.

Note: The Conference plus video includes a copy of the video presentation which will be presented at the Conference video theater.

## 1993 IEEE INTERNATIONAL CONFERENCE ON

ROBOTICS AND  
AUTOMATION

Sponsored by the IEEE Robotics and Automation Society



## HOTEL REGISTRATION FORM

**May 2-7, 1993****Atlanta Hilton & Towers  
Atlanta, Georgia**

Name \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City/State/Zip \_\_\_\_\_

Country \_\_\_\_\_

Daytime Phone Number \_\_\_\_\_

Fax Number \_\_\_\_\_

Arrival Date and Time \_\_\_\_\_

Departure Date and Time \_\_\_\_\_

A block of rooms for this conference is reserved until April 3, 1993. Reservations will be accepted after this date based on availability of accommodations and will be confirmed at the convention rate.

Guest Room Rates

Single, Double, or Twin - Main Hotel \$105 - Tower \$130

Please indicate No. of rooms

and whether tower and single, double or twin. \_\_\_\_\_

To guarantee your reservation, please enclose first night's room+tax (to be credited to your account), or a credit card number in the space provided below. Failure to arrive on that day without notification will result in cancellation and forfeiture of deposit or, one night's room charges will be billed to your credit card.

Cardholder's Name \_\_\_\_\_

Card Type \_\_\_\_\_

Card No. \_\_\_\_\_

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Signature \_\_\_\_\_

Mail to: The Atlanta Hilton &amp; Towers

Attn: Reservations Department

Courtland and Harris Streets, N.E.

Atlanta, GA 30303

Telephone: (404) 659-2000

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Atlanta, Georgia invites you to the IEEE International Conference on Robotics and Automation. As the first site of this conference, Atlanta proudly marks one decade of progress in automation. The city provides outstanding national and international access by air. The historical charm of the "Old South", and a progressive cultural, social and economic environment will enhance your visit. Preview the site of the 1996 Summer Olympics. Tour research laboratories at nearby Georgia Institute of Technology, government and industrial sites. Or, enjoy natural attractions in the north Georgia mountains in addition to the conference.



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