Newsletter of the IEEE Robotics & Automation Society

ROBOTICS AND AUTOMATION

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

Society President: Dr. T. J. Tarn
Washington University
1993 Conference Chair: Prof. Wayne Book,
Georgia Institute of Technology

Dr. Michael B. Leahy, Jr.
Air Force Material Command
Robotics and Automation Center of Excellence
SA-ALC/TIEST
KAFB, TX 78241-5000
512-925-3711
mleahy@sadis05.sa.aflc.af.mil

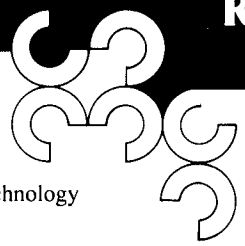
Associate Editors
Prof. A. C. Kak, Purdue University
Dr. Thomas C. Henderson,
University of Utah
Dr. John Baillieul, Boston University

In This Issue

THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC
IEEE

1993 IEEE INTERNATIONAL CONFERENCE ON ROBOTICS AND AUTOMATION

Sponsored by the IEEE Robotics and Automation Society



General Chairperson:	**W.J. Book,** Georgia Institute of Technology	**May 2-7, 1993**
Program Chairperson:	**J.Y.S. Luh,** Clemson University	**Atlanta Hilton and Towers**
Program Vice-Chairperson:	**P.K. Khosla,** Carnegie Mellon University	**Atlanta, Georgia**
	P.B. Luh, University of Connecticut	
Treasurer and Coordinator:	**H. Hayman**	

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. Technical papers presented on Monday, Tuesday and Wednesday, May 3-5, will appear in the bound proceedings. 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

LOCAL ARRANGEMENTS

Atlanta, Georgia invites you to the 10th IEEE International Conference on Roboties 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 Teclmology, govemment and industrial sites. Or, enjoy natural attractions in the north Georgia mountains in addition to the conference.

WORKSHOPS AND TUTORIALS:

The conferenee sessions will be conducted from Monday, May 3, 1993 to Wednesday, May 5, inclusive. Sunday, May 2, Thursday, May 6, and Friday, May 7 will be scheduled for tutorials and workshops. For more information, contact:

Pradeep K. Khosla
Dept. of Electrical & Computer Engr.
Camegie Mellon University
Pittsburgh, PA 15213-3890, U.S.A.
Telephone: (412) 268-5090
FAX: (412) 268-3890 Electronic Mail:
PKK@cs.cmu.edu

EXHIBITION:

There will be a table-top exhibition of current hardware/software products at the conference. For further information contact:

Wiley D. Holcombe
Intelligent Machines Branch
Georgia Institute of Technology
Atlanta, GA 30332, U.S.A.
Telephone: (404) 894-6144
FAX: (404) 894-8051
Electronic Mail: WHOLCOMB@gtriOl.gatech.edu

FOR GENERAL CONFERENCE INFORMATION CONTACT:

Wayne J. Book
George W. Woodruff
School of Mechanical Engineering
Georgia Institute of Technology
Atlanta, GA 30332-0405
Telephone: (404) 894-3247
FAX: 404 894-9342

President's Message

Tzyh-Jong Tarn
Washington University

I have had the privilege of being part of an excellent year for the Robotics and Automation Society. By having outstanding national and international activities, the Society has continued to represent the best of the art, science, and practice of robotics and automation.

We had a very successful 1992 IEEE International Conference on Robotics and Automation which was held in Nice, France in May.

Following that conference, the 1992 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS'92), co-sponsored by the Robotics and Automation Society, was held in Raleigh in July. It was certainly one of the best conferences we have ever had. This was the first year that the IROS was held outside of Japan. Congratulations are due to Professor Ren C. Luo, the General Chairman, Dr.Ichiro Masaki, the General Co-Chairman, and Professor Avi Kak and Dr. Kazuo Tanie, the Program Co-Chairmen, as well as to their various committees. The IROS'92 was truly an international conference. Nearly 350 people worldwide attended. In fact Japan alone had more than 120 attendees.

In the past year the Society was able to fund the Distinguished Lecturer program for the local chapters, and to co-sponsor a new journal devoted to technical characteristics and research associated with Micro Electro Mechanical Systems. The MEMS Journal is a joint IEEE/ASME publication whose first issue appeared in March 1992. The MEMS area is one of the new and exciting fields in Robotics, and has many possible applications to diverse systems.

The Video Proceedings initiated by the Robotics and Automation Society in 1991 enjoyed its second year of success in our Nice Conference. I have heard and received much praise for it.

I foresee that in the future we will be compelled to compete with others on skills, innovations, marketing and manufacturing. However, it will be a warfare which stresses cooperation instead of fighting. Countries must cooperate so that local economies will benefit and develop intelligent manufacturing systems which are globally useful.

The Robotics and Automation Society has the opportunity to look forward and to respond to changing world events. It possesses not only the infra-structure, but also the expertise to face the challenges of the future.

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From the Editor's Desk

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

Greetings fellow roboticists! I hope that you all had an enjoyable and productive summer. Down in the heart of Texas we still have our air conditioners on, but even here the weather is getting colder. Daytime highs only in the high eighties. On a serious note about the weather, the newsletter staff wishes those members affected by the recent natural disasters a speedy recovery.

The summer months were hectic. Along with the usual workload I attended an Air Force training class on acquisition while playing the annual US government organization funding game. My staff also suggested, only half in jest, that my reserved parking spot be moved out to the airport. On the positive side we should have the equipment to develop our prototype center and have initiated a study through the Jet Propulsion Laboratory on a generic telerobotic architecture for remanufacturing applications. After a year of learning about our customer's problems, we are convinced that telerobotics will play a primary role in a wide range of solutions. The challenge is to define a generic architecture that is compliant with a wide range of remanufacturing applications. An architecture that supports a diverse set of control modes from simple teleoperation through shared control and full automation is required. We are initiating a three phase study to: define the user requirements, survey the industry and laboratories, and then prepare a draft performance specification. If you are interested in contributing to this study, please contact my office.

Another reason to drop me a line is to provide your comments on the merits of expanding the newsletter to a magazine format. The newsletter staff is investigating the transition and will make a recommendation to the Adcom at the annual winter meeting. The basic format we are leaning toward has three main components: the current newsletter content, two-three experimental or application related papers per issue, and assorted educational topics. The paper section would complement, not compete with, the Transactions.

A major objective of the magazine is to provide a proper forum for the results of, and encourage participation, in experimental and applied research. Applications papers demonstrate how individual technical components are blended into solutions to real problems. Those solutions highlight our achievements and point to areas of continued research.

The objective of the educational section is to broaden our understanding of the many technical sub-areas, outside of our specific fields of expertise, yet vital to a complete successful robot or automation system. We also continue to solicit editorial type articles on any robot or automation topic a members feels strongly enough to write about. A healthy exchange of ideas about some of the less theoretical aspects of our profession would be refreshing. Questions or comments, please.

In this issue you will find our usual diverse range of information. Calendar information consumes its normal large page count. With the annual robotics and automation paper deadline behind us, the conference announcements target future opportunities. No one can attend all the meetings, but we could all benefit from the insights gained by our colleagues. In this issue there are articles on the International Conference on Intelligent Robots and Systems (IROS) held in North Carolina USA this summer, and the Workshop on Geometric Uncertainty in Motion Planning Workshop in California USA. I am sure those authors are as busy as the next person, but not too busy to make a contribution to their profession. Can you follow their lead? If you have the opportunity to attend a conference please consider writing a short article about the conference. The newsletter is only as interesting as you make it. Also in this issue is information from the Robotics Industries Association and an article on the Applied Robotics Technology (ART) facility.

A reminder to Technical

See *Editors Desk:* P. 6

AFMC Advanced Robotics Technology Insertion Program

Major Michael B. Leahy, Jr.

In August, the United States Air Force Material Command *(AFMC)* Robotics and Automation Center of Excellence *(RACE)* received the Advanced Robotics Technology Insertion Program *(ARTIP)* Program Action Directive *(PAD)* from HQ AFMC. Before receiving the PAD, RACE was operating with the authority of a letter from HQ AFLC/XP *(Air Force Logistics Command Office of Plans and Programs)* designating SA-ALC the lead ALC on advanced robotics and supporting automation technology. The PAD formalizes RACE's role as the program manager *(PM)* for advanced robotics and supporting hardware and software automation with the responsibility for applied technology research and implementation of robotics and supporting automation technologies. The following is an excerpt from the scope and responsibilities sections of the ARTIP PAD.

Scope

San Antonio Air Logistics Center *(SA-ALC)*, as the ARTIP PM, will serve as the center for advanced (applied research) robotics and supporting automation technologies within the AFMC. Each logistics center will actively participate and support the ARTIP PM in achieving the Command's advanced robotic objectives. The centers are already involved to some degree with applied robotics and supporting automation technologies. This involvement will dramatically increase to champion further development and promote new cost effective industrial processes as they relate to old and new weapon system applications.

The purpose of this assignment is to utilize emerging robotics and supporting automation technologies to address and solve reliability and maintainability *(RM)* problems associated with supporting existing Air Force weapon systems and to develop industrial capabilities by judicious applications. Developing AFMC capability will aid greatly in the supportability of future weapon systems, which need the new or emerging robotic technologies.

Solutions to RM problems will be accomplished by applied technology insertion projects at all of the centers. Technology insertion projects will be developed and solutions simulated and prototyped, utilizing advanced robotic and supporting automation technologies. Capabilities throughout the Command will be enhanced by advanced robotics technology demonstrated through prototypes and simulations, mechanisms, distribution of training material, transition and cross-feed of technology reference data. SA-ALC will lead this effort so as to minimize duplication and ensure that all centers benefit from advanced robotic technology.

SA-ALC will implement the RACE.

Responsibilities

SA-ALC will:

- Appoint a PM for the ARTIP to develop and expand the Command's capability in the application and support of ARTIP. This will include administrative and management support to the PM in the development of robotic programs and modifications of weapon systems.
- Establish an ARTIP to develop center expertise, capability, and supportability of robotic technologies. These goals will be accomplished through technology insertion efforts to solve RM problems in support of existing and future weapon systems through applied technology transfers.
- Plan, program, and budget for command resources required to ensure prompt and effective attainment of AFMC ARTIP

Glossary

AFLC	Air Force Logistics Command (has been replaced by AFMC)
AFMC	Air Force Material Command
ALC	Air Logistics Center
ARTIP	Advanced Robotics Technology Insertion Program
PAD	Program Action Directive
PM	Program Manager
RACE	Robotics and Automation Center of Excellence
RM	Reliability and Maintainability
SA-ALC	San Antonio Air Logistics Center
XP	Office of Plans and Programs

goals. This includes applied technology prototype implementation funding. Identify all Program Objective Memorandum funds sufficient to maintain and support the ARTIP.

- To further delineation of responsibilities in any ARTIP Memorandums of Understanding as necessary.
- Serve as consultants to the command directorates to ensure judicious insertion of robotics technologies into center industrial processes.
- Work in cooperation with other centers in identifying opportunities for inserting robotics technologies into industrial processes.
- Establish and maintain the capability to prototype emerging and applied robotic and supporting automation, including artificial intelligence application technologies.
- Acquire and sustain the capability to simulate/visualize robotic solutions to Command requirements.
- Gather, evaluate, and disseminate robotic related information from industry, academia, and DoD organizations.
- Promote development of standardized robotics and supporting automation interfaces.
- Champion applied research and development of hardware and software tools for rapid prototyping of robotic systems.
- Promote development and prototyping of generic modular robots adaptable to industrial and weapon system support applications.
- Assist in establishing and training robotic operators and software programmers certification programs.
- Chair the Command Robotic Implementation Working Group (RIWG) with representation from product divisions and centers.
- Establish a close interface and cooperation with the center's Chief Scientist and Engineering offices for the identification and initiation of new robotic and supporting automation applications.

Action addressees will:

- Identify a robotics and supporting automation focal point. Said individual will serve on the AFMC RIWG.
- Assist in identifying advanced (applied research) robotics implementation opportunities to SA-ALC.
- Coordinate all center proposals for robotic projects with AFMC/EN and SA-ALC.
- Request and budget appropriate funds for initial lay in of depot maintenance equipment.

For additional information on ARTIP please contact Major Michael B. Leahy Jr., SA-ALC/ TIEST, KAFB, TX 78241-5000.

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IEEE Press Warehouse Sale

The IEEE Press is offering IEEE members savings of up to 90% of list price on selected titles. The list includes several new or forthcoming titles as well as titles from the late'70s and 80s.

Among the new titles, which can be ordered now at 15-50% below the regular member price, are *Robot Control: Dynamics Motion Planning, and Analysis*, edited by Mark W. Spong, F.L. Lewis, and C.T. Abdallah; *Discrete Event Dynamic Systems*, edited by Y.C. Ho; Neural Networks: *Theoretical Foundations and Analysis*, edited by Clifford Lau, and *Fuzzy Models for Pattern Recognition: Methods that Search for Structures in Data*, edited by James C. Bezdek and Sanhar K. Pal.

Many older reference books, such as Frequency-Response Methods in Control Systems (1979) and The World of Large Scale Systems (1982) are offered at five and ten dollars each.

To place an order or obtain the complete list call 1 800 678 IEEE.

From the Editor's Desk (cont. from p. 4)

Committee (TC) chairmen:. We are looking for your contributions for the "year in review" section of the winter issue. The objective is a one page article overviewing the important developments over the last year in your particular technology niche. References are encouraged. Of course, any information on TC events is always welcome. Thanks to those TC members who are sharing information about their activities in this issue.

I would like to close on a personal note. You will notice several small changes on my portion of the masthead. The Air Force Logistics Command (AFLC) and the Air Force Systems Command (AFSC) have merged into the Air Force Material Command (AFMC). A single command, AFMC, is now responsible for cradle to grave acquisition management of major weapon systems. The laboratories that perform and sponsor basic research and the depot maintenance activities are now formally united.

My promotion to Major is finally official. The next time you see me at a conference I will have gold oak leafs on my shoulders instead of silver bars. Also please read the short description of the Advanced Robotic Technology Insertion Program (ARTIP) included in this issue. Both the industrial and academic communities will find the salient aspects of our mission interesting. This outline first appeared in an infogram that the RACE distributes to its customers and laboratory associates. If you would like to be added to our mailing list just send me an email.

Geometric Uncertainty in Motion Planning

Ken Goldberg and Ari Requicha, University of Southern California
Matt Mason, Carnegie Mellon University

Introduction:

In robotics, the problem of planning "collision-free" motions has received considerable attention in the past decade; results have now been collected into a textbook (Latombe, 1991). For manufacturing however, robots must bring parts into contact for grasping, packing and assembly. As noted by Latombe, the problem of planning reliable "collisions" is complicated by geometric uncertainty: things differ from their ideal shapes, and they are not where they're supposed to be. Since human programmers have difficulty keeping track of all possible conditions, automated planning methods are needed so that robots can become more reliable and practical for industry.

There is a formal approach to planning that addresses uncertainties arising from: sensor noise, control error, and inaccurate models of the environment. This approach, based on the geometry of configuration space, is sometimes called "fine motion planning" due to a seminal paper by Lozano-Perez, Mason, and Taylor (1984).

With the support of several NSF programs (particularly Robotics and Machine Intelligence and Dynamic Systems and Control) the Catalina workshop brought together a group of researchers and representatives from industry to review past work, assess its impact on industry, and recommend priorities for future research.

Geometric Uncertainty in Motion Planning
Catalina Island, CA, June 15-17, 1992 (Sponsored in part by National Science Foundation grant IRI-9208161)

Organizers:
Ken Goldberg, USC
Matt Mason, CMU
Ari Requicha, USC
NSF Coordinator:
Howard Moraff, NSF IRIS Div.
Participants:
Amit Agraval, USC
Randy Brost, Sandia
Alec Cameron, Philips
John Canny, UC Berkeley
Brian Carlisle,
Adept Technology Inc.
Mike Erdmann, CMU
Susan Gottschlich, RPI
Jim Jennings, Cornell
Jean-Claude Latombe,Stanford
Tomas Lozano-Perez, MIT
Vladimir Lumelsky, U Wisc.
Bud Mishra, NYU
Mike Peshkin, Northwestern
Robin Popplestone, UMass
Anil Rao, USC
Elon Rimon, Caltech
Art Sanderson, RPI
David Strip, Sandia
Tilove, Bob, GM
Chee Yap, NYU

Observations and Recommendations

This section briefly summarizes the observations and recommendations made during the workshop. Following is a detailed summary of individual presentations and a list of relevant references.

While sensing has traditionally been used to reduce geometric uncertainty, mechanical compliance (intentionally sliding parts against each other) is a useful alternative. Although compliance is widely used in manufacturing, for example in vibratory bowl feeders, computational algorithms for applying these techniques are only beginning to emerge. One fundamental question is how to discretize the infinite set of robot commands into a manageable set of equivalence classes. Another question is how to incorporate sensor queries with robot commands to decide when parts have been successfully arranged.

Planning for repetitive assembly occurs off-line. The LMT paper and subsequent publications provide a useful computational framework based on backchaining from a goal configuration. In its most general form, motion planning with uncertainty is computationally intractable. However in non-pathological cases, existing algorithms find robust plans in a few minutes. Further speedups may be gained with randomized or approximate algorithms.

It is easier to plan with less information. This follows from the fact that there are fewer alternatives to consider during planning. Thus automated planning may be most efficient for robot systems with few degrees of freedom and simple sensors. Also, detailed geometric analysis can be avoided during the non-contact phases of assembly.

Planning should not be restricted to robot commands. In a structured environment such as a factory, the environ-

A Ph.D. should not be required to reprogram robots on the factory floor

ment itself can be viewed as a variable, i.e., the design of sensors, feeders, and fixtures can be specified based on part geometry. Furthermore, we can in principle modify part geometry and tolerances to facilitate manufacture. Although humans have designed workcells for decades, automated planning algorithms could greatly reduce set-up times and increase performance efficiency for competitive manufacturing.

Industrial users require reliable systems. Although the primary motivation behind autonomous planning is to increase robot reliability, the algorithms must be rigorously tested with physical experiments. New planning software should be made accessible to the manufacturing community. This requires code that is compatible with existing CAD systems and well-designed user interfaces. A Ph.D. should not be required to reprogram robots on the factory floor.

Measures of progress are needed in this area. Latombe's text is a good start. To develop the scientific base for automated manufacture, it will be important to identify and solve well-formed research problems that explicitly address geometric uncertainty.

A Brief History of the IEEE Robotics and Automation Society: *Page Two*

Rosalyn Snyder

Nothing is ever simple. I think I said that before. Thanks to R.P.C. (Lou) Paul and Antal (Tony) Bejczy for filling in some gaps in the historical notes we presented in the summer issue, in particular the omission of three R&A Council Presidents: John Jarvis of Bell Labs, R.P.C. Paul of the University of Pennsylvania, and Antal (Tony) Bejcsy of Cal Tech. The complete list of R&A Council and Society Presidents is:

1984 George Saridis, Rensselaer Polytechnic Institute
1985 John Jarvis, AT&T Bell Labs
1986 R.P.C. Paul, University of Pennsylvania
1987 Antal Bejczy, California Institute of Technology/JPL
1988 Y.C. Ho, Harvard University
1989 A.C. Sanderson, Rensselaer Polytechnic Institute
1990 A.C. Sanderson
1991 Norman Caplan, National Science Foundation
1992 T.J. Tarn, Washington Univ.

During Jarvis's term as president the President Elect, King-Sun Fu regrettably died. Richard Paul was elected as Vice President and took over as President when Jarvis's term of office ended. During Paul's term of presidency the question of establishing student chapters came up, an activity that councils cannot engage in. It was then decided to take the step of becoming a society.

Most of the work of the transition fell on Tony Bejczy's shoulders.

This included the organization of a membership interest survey which was distributed to all the subscribers to the IEEE Robotics and Automation Journal and then analyzing the 1000+ responses which were received. The survey indicated the existence of a solid core of potential active members, an absolute necessity for a new society.

Bejczy, with the assistance of other council members, undertook the arduous political task of persuading the Presidents of all the other IEEE societies that Robotics and Automation was a separate discipline deserving of a separate society and that the proposed new society would complement rather than compete with the existing societies. After more than a year of meetings and negotiations, their efforts were successful.

Larry Ho, who succeeded Bejczy, was president when final approval of the new society was obtained.

Detailed Summary of Presentations

To get and print a copy of the (19-page) report:

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Name palenque.usc.edu: saavedra): anonymous
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230 Guest login ok, access restrictions apply.
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Los Angeles, CA 90089-0273
Phone: (213) 740-6428.
(FAX: -7877)

Products on the Market

Real-Time Control of Robotic Systems with DSP

Hermann Henrichfreise
*dSPACE GmbH**

EDITOR'S NOTE: Manufacturers and users of robotics and automation hardware are invited to share their experience with products on the market. Comparisons of product performance and evaluation criteria can help wipe out "wheel reinvention". Publication of articles in the Newsletter does not imply endorsement by the IEEE or the Robotics and Automation Society.

Digital signal processor (DSP) technology is becoming increasingly important in robot control applications. This is due to the fact that DSPs provide a computational power which is about ten times over their microprocessor counterparts. In robotics, this power can be exploited to improve the control system performance by increasing the controller sampling rates and at the same time implementing more sophisticated control algorithms.

Integrated development systems - featuring flexibly configurable hardware based on the Texas Instruments TMS320 DSP family, code generators, optimizing compilers, real-time signal capture and display tools - are offered by dSPACE. These systems are tailored to rapid prototyping of high-speed, multi-sensor/actuator robot controls.

To illustrate the computational performance that can be achieved, the following algorithms for a sixjoint elbow type robot were implemented in C language as benchmarks: (1) Computed torques, (2) transformation of distance measurement in end effector coordinate frame to absolute position in inertial frame (including forward kinematics) and (3) transformation from inertial to joint coordinates (backward kinematics). Table 1 lists the execution times on a dSPACE DS 1002 hardware system with a TMS320C30 DSP.

The TMS320C40 "Parallel-Processing-DSP" built in the DS 1003 system will increase the single chip performance by as much as 50%. Its six byte-wide data links, each having a transmission rate of 20MByte/sec, support parallel computing applications. Several DSPs connected by the links can provide a peak performance of hundreds of Mflops (Million floating-point operations per second).

Contact the author at: dSpace Gmbh, An der Schonen Aussicht 2, 4790 Paderborn, Germany, Tel:49 5251 1638-0, Fax:49 525166529

Algorithm	Exec.Time	Remarks
Computed torques for first four joints	<55 µsec	190 mults and adds 15 sine and cosine
Coordinate transformation forward kinematics	30 µsec	96 mults and adds incl. 12 sine and cosine
Backward kinematics	<90 µsecs	56 mults and adds 4 sine and cosine 6 atan2, 1 sq. root

Table 1. Execution times for six-joint elbow type robot

AdCom Notes

David Orin
Ohio State University
Secretary, Robotics and Automation Society

The Administrative Committee met during the annual conference in Nice, France and conducted business of importance to the Society.

Professor Richard Klafter, who has served as Vice President for Finance for a number of years, was elected President of the Society and will take office beginning January 1, 1994. With the change of the term of the President, his term will be for two years through 1995.

Congratulations go to Dr. Giuseppe Menga and Dr. Georges Giralt and their organizing committee for an excellent conference in Nice. The conference was truly international, meeting for the first time outside of North America, and having representatives from many different countries.

Plans are underway for the 1993 Conference which will be held in Atlanta on May 2-7. The conference goes back to its first location, having first been convened in Atlanta in 1984. The General Chairman is Professor Wayne Book and Program Chairman is John Luh. The AdCom voted to increase the prize amount for two of the awards to be given at the conference. A prize of $1000 will be given for the Anton Philips Award for Best Student Paper as well as for the Best Conference Paper Award and the Best Video Award.

The organization for the 1994 and 1995 Conferences is set. The 1994 Conference will be held from May 8-13 at the San Diego Princess Resort in Mission Bay under the leadership of Professor William Gruver as General Chairman and Professor Harry Stephanou as Program Chairman. The 1995 Conference will be held in Nagoya, Japan in the Nagoya Congress Center on May 21-27. The General Chairman is Professor Toshio Fukuda and the Program Chairman is Professor Suguru Arimoto.

The Technical Affairs Board (TAB) of the Society has been active under the direction of Professor George Lee, the Vice President for Technical Affairs. A Distinguished Lectures Program was formed and funds allocated for this purpose. Seventeen Technical Committees have been organized. Dr. Michael Leahy, the Editor of the Newsletter, will form a subcommittee to search for writers for the IEEE Spectrum for "Technology 93" and beyond.

Five individuals who were recommended by the Robotics & Automation Society were recently elected Fellows of the IEEE. Congratulations go to Professors Antti J. Koivo, Takeo Kanade, Aristides A. G. Requicha, Raymond A. Jarvis, and Ruzena Bajcsy.

Nominations are being received by Dr. Norman Caplan, the Chairman of the Nominations Committee. Six vacant positions in the AdCom are filled each year for a three-year term. The election was moved to the Autumn from the Winter to allow for an earlier return on the election results.

Four amendments to the Consti-

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The ORS-1 optical rangefinder is an alternative to costly computer vision and unreliable acoustic sensor systems.

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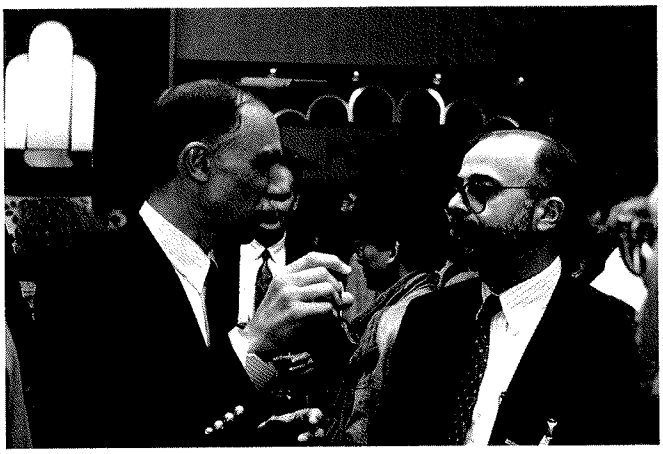
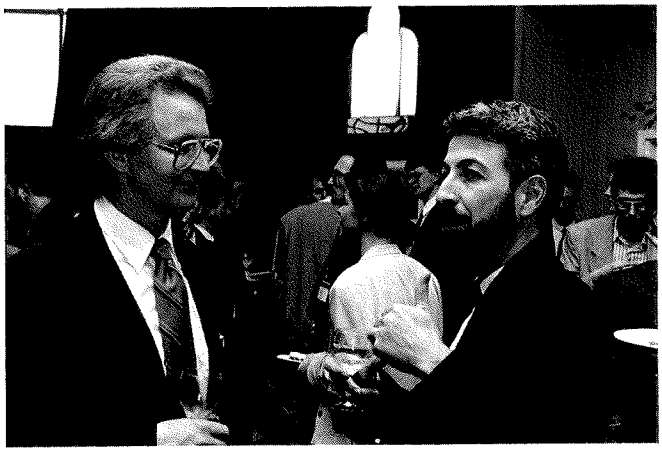


1992 IEEE International Conference
on Robotics and Automation
Nice France
People, Places and Robots



tution of the Society were approved by the AdCom. With final approval, the term of the President and other officers will be for two years, with election from the membership of the Society at large. The last two amendments make changes to the voting membership on the AdCom. (These amendments were printed in their entirety in the spring 1992 issue of the newsletter.)

Reports from Technical Committees

Assembly and Task Planning

The Assembly and Task Planning Technical Committee got off the ground in January of this year. We have started a number of activities.

A computer newsletter is distributed every two months or so. It contains the latest information on our ongoing activities, suggestions for new activities, and items of general interest for the field.

We have established a workshops and tutorials subcommittee. Our initial objective is to organize a tutorial in our area at next year's ICRA. We plan also to get involved with appropriate workshops.

We have an ongoing discussion on the construction of a taxonomy for the area.

If you are interested in becoming involved with the TC and/or if you have ideas for activities the TC should be involved in, please contact the chairman:

Dr. D.M. Lyons
Philips Laboratories
345 Scarborough Rd.
Briarcliff Manor NY 10510
(914)945-6444
dml@philabs.philips.com

Computer Integrated Manufacturing (CIM)

The CIM Technical Committee has been working to establish a charter for its activities. Our goals are to be able to provide information on CIM to the Robotics and Automation Society members through sessions at the annual meeting. More details of how this will be accomplished will be discussed at the meeting of the committee, which will be held during the next annual RAS meeting. For further information, please contact the chairman:

W. J. Trybula
Ivy Systems, Incorporated
PO Box 258
Ivy, Virginia 22945
(804) 295-1230
e-mail wjt5h@virginia.edu

Computer and Robot Vision

The Robotics and Automation Society has formed a new Technical Committee on Computer and Robot Vision. The scope of this committee includes all topics related to computer and robot vision, including:

- Image segmentation and feature extraction
- Perceptual organization
- Model based vision, including:
  - ~ Object modeling for visual recognition
  - ~ Organizing large object modelbases
  - ~ CAD based vision systems
  - ~ Functional modeling
- Visual inspection and precise mensuration
- Control of or by visual sensing, including:
  - ~ Vision guided manipulation
  - ~ Active or purposive vision
  - ~ Navigation
  - ~ Visual sensor planning

Those interested in becoming involved in the activities of this TC should contact one of the committee chairpersons, either:

Kim Boyer
Signal Analysis
& Machine Perception Lab
Dept. of Electrical Engineering
The Ohio State University
2015 Neil Avenue
Columbus, OH 43210-1272
kim@ee.eng.ohio-state.edu

or

Seth Hutchinson
The Beckman Institute
405 North Mathews Avenue
Urbana, IL 61801
seth@cs.uiuc.edu

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FOR MEMBERSHIP INFORMATION CALL 1-800-678-IEEE

RA AdCom Meeting

The Fall AdCom meeting will be held in Tucson, Arizona on Monday, December 14, 1992 from 12:00 noon - 8:00 p.m. at the Westin La Paloma. This is the location for the 1993 IEEE Conference on Decision and Control (CDC).

The Executive Committee is scheduled to meet on Sunday evening. Detailed information on this meeting will be mailed to the appropriate persons in the next few weeks

Newsletter Deadline

Deadline for the Winter 1992 Newsletter is December 1!!

R&A Bulletin Boards???

We have received enquiries about R&A electronic bulletin boards. If you have information regarding any, please share it with us Thank.s.Dire

Notes from Industry

U.S. Robot Orders & Shipments Rise In First Half

Despite the recession, U.S.-based companies posted a 12.5% gain in new orders in the first half of 1992, according to new statistics released by Robotic Industries Association, the industry's trade group.

Through June, 2,600 robots were ordered, the highest first-half total since 1986. RIA now estimates that some 44,000 robots are installed in U.S. factories.

"The increase in robot orders is certainly a step in the right direction,: said Donald A. Vincent, Executive Vice President of RIA. "However, we've still got a very long way to go before robots are sold in the kind of numbers that they should be in North America. Only in Japan, where some 50,000 robots are installed each year, are companies taking full advantage of the productive power of robotics. It's no accident that Japan is such a strong competitor in so many manufacturing industries -- their companies are willing to make long-term commitment to robotics and advanced automation," Vincent asserted.

The largest application areas for the new robot orders are spot welding, materials handling, arc welding, and assembly.

"The high number of robots ordered for welding indicates that the automotive industry and other heavy manufacturing industries are still the primary customers. However solid orders for materials handling and assembly robots indicate that customers in food, pharmaceuticals, electronics, and other non-automotive industries are helping stimulate the increased demand," said Vincent.

Robot shipments remained strong in the first half, with over 2,000 robots delivered to customers. This represents the highest first-half mark since 1987.

"These positive numbers for new orders and shipments are especially impressive in light of the continued economic problems in the U.S. and abroad," Vincent said.

Market Profile: United Kingdom

(NOTE: this brief profile is excerpted from the 1990 International Robot Statistics book produced by the International Federation of Robotics. The book. which provides data on robot use in some 20 countries, can be ordered from RIA for $105.)

Through 1990 the United Kingdom had an installed base of 6,418 industrial robots. The leading application area is welding, which is not surprising since the automotive industry accounts for 35% of the total robot population. Material handling is the second largest application area.

IEEE Robotics and Automation Society Email Directory

Name	Affiliation	Email	FAX
Changes			
William F. Gruver	**Simon Fraser University**	**gruver@sfu.ca**	**604 291 4951**
Kemal Ciliz		**ciliz@trboun.bitnet**	
Ren C. Luo	**Univ. of Tokyo (1993 acad. year)**	**luo@ics.iis.u-tokyo.ac.jp**	**33 401 8144**
Robert Elliott Smith	**University of Alabama**	**rob@comec4.mh.ua.edu**	**(205) 348-6419**
Additions			
David Stanton	**University of Surrey (England)**	**d.stanton@surrey.ac.uk**	**44 483 306039**
E.E. Jaquenod	**Univ. of La Plata Argentina**	**guille@pir.edu.ar**	**54 21 25 40 24**
John Craig	**SILMA, Inc.**	**jjc@silma.com**	**408 725 8955**
Chris Goad	**SILMA, Inc.**	**cg@silma.com**	"
Paul James	**SILMA Inc.**	**paj@silma.com**	"
Dick Guptill	**SILM A Inc.**	**rg@silma.com**	"

Send Email Directory and Calendar items to Rosalyn Snyder, Managing Editor, roz@relito.medeng.wfu.edu, 6721 Penland Dr., Clemmons NC 27012, 919-766-6210 (Note new address)

Significantly, assembly accounts for just 8% of the total supply of installed robots, and just 2% of the 1990 installations. This is much lower than the figures for assembly robots in France and Germany.

About 46% of the robots sold in the United Kingdom in 1990 were supplied by Japanese companies. Some 31% were of domestic origin. while 23% came from European suppliers. The United States, once the dominant supplier in the United Kingdom, only accounted for 1% of the market.

Nine New Members Elected To RIA Board

The RIA membership recently elected nine new Board members. The new directors are:

- Chuck Clarkson, President, Dolan- Jenner Industries
- Michael Cozza, Vice President. Staubli Unimation
- Charles Duncheon, Vice President Sales & Marketing, Adept Technology
- Pat Eicker, Manager, Sandia National Laboratories
- John Hinrichs, Director, Engineering Resources, A.O. Smith Automotive Products Co.
- David Heikkinen, Vice President, San kyo Seiki (America), Inc.
- Jeff Mainville, Product Marketing Manager, Robotics, Miller Electric
- Chester Woodman, General Manager Robotics, Lincoln Electric Co
- William Yoder, Facilities Supervisor. R&B Manufacturing Company,

Each new director will serve a two year term. Brian Carlisle, CEO, Adept Technology, Inc. is the 1992-3 Chairman of RIA.

GAIN: Global Automation Information Network

RIA has created a new individual membership organization called the Global Automation Information Network (GAIN).

GAIN is for people at companies using robots and/or machine vision, prospective users, researchers, consultants, students, and educators. It is designed to provide vitally important information about who makes robot and vision products, successful applications, how to find systems integrators, new industry standards, leading books and videotapes...all the knowledge needed to succeed in implementing robotics and vision.

Among the benefits GAIN members will received for their $60 annual membership fee are the following:

- Free copy of Robot and Machine Vision Application Profiles
- Free directory of robot and machine vision suppliers
- Free robotics and machine vision glossaries
- Free quarterly newsletters on industrial robotics, machine vision, and service robotics
- Discounts on books, videotapes and conference proceedings.
- Discounts on all trade shows and conferences sponsored by RIA and AIA
- Priority access to GAIN's staff, who can help answer automation questions.

For details on GAIN, contact Stacy Oberleiter at 313/994/6088.

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Puma	760	IBM	7545
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GMF	A-200	IBM	7535
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SMALL		Niko	600
Kawasaki	260	**SERVICES**	
Puma	560	Installation	
Puma	260	Rebuilding	
WELDING/PROCESS		Small systems	
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PSE&G's ART Facility
A New Partnership For The Mobile Robotics Community

Harry T. Roman
Public Service-Electric & Gas Company

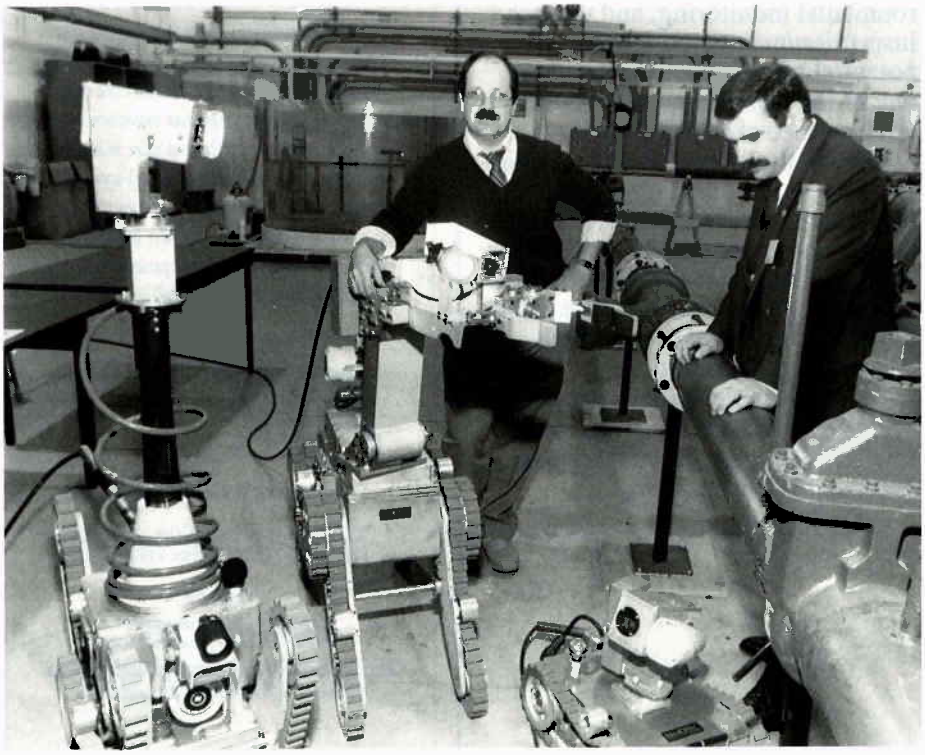
Since the mid-1980s, 44 U.S. utilities have become involved in the application of mobile robotic devices to perform potentially hazardous tasks in nuclear and fossil-fired power plants. According to a recent survey conducted by the Utility/ Manufacturers Robot Users Group, robots have been used in 192 utility specific applications. Much of this technology has grown out of the use of robots for the clean-up of the Three Mile Island nuclear power pant.

Estimates concerning the potential size and extent of this rapidly growing area of robots are scarce. Early estimates from the mid-1980s projected that the nuclear service industry alone could account for over $4 billion annually in sales, with as many as 100,000 robots in service by the mid-199Os. Japan has estimated that 10,000 robots could be in service in Japan in the mid-1990s, with Japanese sales of $140 million. Certainly more effort to quantify the potential size of this new industry is warranted-especially since the United States is quickly becoming a world contender in this technology -- challenging the leadership role of the Japanese and French.

A primary reason for the successful application of robots in the utility sector has been a close working relationship between utility engineers and robot vendors/developers. Many of these relationships have resulted in significant advances to the state of the art as well as new robotic devices coming into the marketplace. Another motivating force was the 1986 establishment of the Utility Manufacturers Robot Users Group (U/M RUG), which is dedicated to fostering a working relationship between robot users in the utility industry and robot manufacturers/ developers. From a modest beginning with 40 members in 1986, U/M RUG now has over 200 members worldwide. It is the only organization of its kind which caters to the specific robotic needs of the utility industry.

Public Service Electric & Gas (PSE&G) Company has been a pioneer in the application of robotic devices. It was also instrumental in the founding of U/M RUG, and has chaired this group since its inception. PSE&G has shown that for every $1 spent on robot hardware, the company realizes a $2 savings in operation and maintenance costs. The company has also generated royalty revenue streams and business arrangements through robot development partnerships with selected vendors/developers. PSE&G's success is largely attributed to a close working relationship with robot vendors, developers, researchers, and members of the academic communities. By working with these groups, PSE&G has helped influence the future course of robotics as well as develop hardware specific to its needs.

To continue this fruitful working relationship with the many members of the robotics community, PSE&G has established an Applied Robotics Test (ART) Facility at a company location in Hillsborough, New Jersey. ART functions as an



Harry Roman demonstrates a robot arm in tlhe PSE&G ART Facility

applied R&D laboratory where new robot designs and prototypical equipment can be tested and evaluated. vendors and developers are invited to bring their hardware to ART and demonstrate it to PSE&G's engineers, who will in turn provide a critique of its performance as well as make recommendations for further improvements. ART is equipped with various test tracks, pipe crawling mazes, underwater test tanks, and obstacle courses to challenge many of the different types of robots now emerging in the utility area.

ART also functions as a development facility where PS&G and selected vendors/developers can jointly work on the design and development of new types of robots. PSE&G is ready and capable of entering into a whole range of working agreements and contractual opportunities with the vendor/developer. The overall mission of the ART Facility is to: "provide an industry focus for influencing the development of utility specific robotic systems, and to serve as a nationally recognized robotic training and demonstration center."

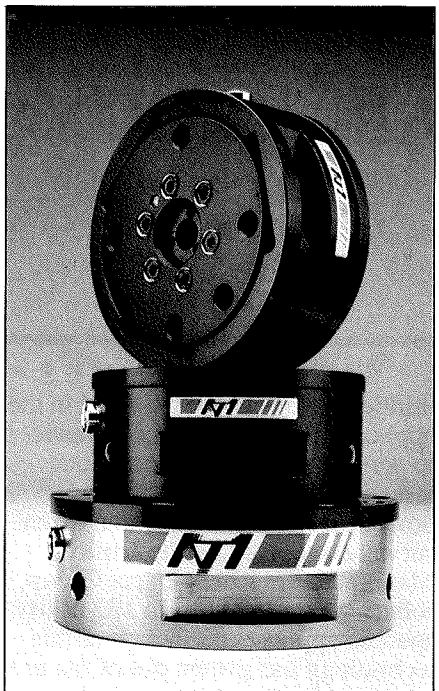
Specifically, the goals of the ART Facility are described below:

- Provide a training, mock-up, and test/demonstration area for the PSE&G application of robotic devices;
- Perform a robotic service for PSE&G departments that may be in need of assistance, and provide robot /training to PSE&G personnel;
- Stimulate improved utility mobile robot designs by working closely with vendors to develop and test commercial prototypical devices;
- Transform PSE&G mobile robotics technology and expertise into a royalty/revenue stream through joint PSE&G/vendor development of needed robotic devices;
- Act as a utility industry clearinghouse for mobile robotics information, applications, and training;
- Serve as a conduit for the application of mobile robotics research into other areas of interest to the company, and its industrial and commercial customers;
- Provide a learning environment for local college/university engineering students who can work on selected PSE&G robotics research projects.

The ART Facility is located in central New Jersey in Hillsborough, Township-about 12 miles north of Princeton University, and about 40 minutes by car from PSEG's Newark corporate offices and Newark Airport. ART is housed in PSE&G's Energy Technology Development Center in a modern industrial building. The facility occupies a high bay area of the Center, approximately 80 feet by 60 feet in floor area, with a 30 foot ceiling. The bay is equipped with a 2-ton overhead crane. ART has been in operation since early 1990, and has drawn on a capable staff of on-site technicians.

Many large PSE&G commercial and industrial customers can utilize mobile robots for use in their businesses, factories and processes. Over the next 1-3 years, in addition to testing utility specific robots, PSE&G plans to begin testing and evaluating security, fire fighting, service, hazardous spill clean-up, environmental monitoring, and various inspection/maintenance robots of potential use to PSE&G customers. any of the techniques and robotic devices used at PSE&G can be applied in the industrial and commercial sectors, thereby helping to make customers more competitive. The key emphasis for PSE&G in the long term will be robots for maintenance as distinguished from their use today for primarily inspection, surveillance, and monitoring.

Harry Roman is Principal Engineer-R&D PSE&G Robotics and AI Projects Manager, Public Service Electric & Gas Company



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Conference Report

IROS'92: Intelligent Robots and Systems

Ren C. Luo, General Chairman

The 1992 IEEE/RSJ International Conference on Intelligent Robots and System (IROS '92) was held in Raleigh, the capital city of the State of North Carolina. This is the 5th such technical conference. IROS meetings have evolved in Japan as International Workshops and, for the first time, this meeting was held in the United States as an International Conference under the sponsorship of the IEEE Robotics and Automation Society and the Robotics Society of Japan instead of a Workshop.

This year, we received a record number of papers for peer reviews, totaling 366 completed manuscripts rather than just abstracts. The Program Committee provided a great contribution in conducting paper reviews through the Technical Program Committee members and external reviewers whose backgrounds spanned the range of submitted papers. Each paper went through 3 reviews. We accepted 244 papers for inclusion in regular Conference sessions. There were 53 more papers included in special sessions which were organized by the special session chairmen. I was pleased by the quality of these papers and their presentations.

There were almost 400 participants from 25 different countries attending the IROS '92 conference. Social events offered for the enjoyment of conference participants included a Southern-American-style Pig Pickin' dinner with a bluegrass music band and clogger dancing; a formal banquet dinner with special guest speakers; a featured seminar on the Art of Chinese Placement (also known as Feng Shui); and a post-conference beach trip.

Mr. Sei-ichi Takayanagi, Sr. VP of Toshiba Corp. in Japan gave the keynote speech, "Industrial Robots in Japan: Today and the Future".

The theme of IROS '92 was Sensor-Based Robotics and Opportunities for Its Industrial Applications. This theme was intended to highlight the synergistic use of multiple sensors of different types and modalities to increase the capabilities of intelligent robots and systems. Typical applications that can benefit from the use of multiple sensors and intelligent robotic systems are industrial tasks like: assembly, material handling, inspection, multitarget tracking, and so on. Common to all of these applications is the requirement that the system must intelligently interact with and must operate in an unstructured environment without the complete control of a human operator.

I strongly believe that robotics is a science of action and movement and requires strong ties between theory and practice. As you can find from the papers presented at this conference, there were a great number of implementation results presented from industrial practitioners, in addition to many theoretical papers. It is my hope that this conference provided a broadened and deepened technical interaction between the various research institutions and industrial private sectors in intelligent robotics and systems community and served as an important forum for cross-disciplinary interaction.

The success of IROS '92 would not have been possible without the dedication and hard work of all conference committee members and volunteers and my secretary, as well as each participant's unique contributions.

Johnson Endowed Chair in Machine Intelligence

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The College of Engineering at the University of California, Riverside is initiating a nationwide search to attract an outstanding scholar for the Johnson Endowed Chair in Machine Intelligence. Current research in the College is in intelligent systems, artificial intelligence, robotics, visualization, and environmentally- conscious manufacturing. We are searching for candidates with established international prominence and proven leadership qualifications to develop a strong research focus in the newly-emerging College. Both applications and nominations are solicited.

The candidate for the Chair should have qualifications commensurate with the academic rank of full professor at the University of California. In particular, the candidate should possess:

1) **Research Ability**, demonstrated by major and internationally recognized contributions in the area of Machine Intelligence, including Mechanisms, Sensory Perception and Artificial Intelligence;

2) **Leadership**, demonstrated by the ability to create and lead an active research group and to interact effectively with other groups and institutions;

3) **Professional Standing** at the level of Fellowship (or equivalent) in a major professional society

4) **Commitment toTeaching**, demonstrated by an interest and ability in providing high-quality instruction.

Please submit a resume, complete list of publications, a written statement on research and teaching objectives, and names of at least three individuals willing to write letters of reference by **December 1, 1992** to: Chair, Johnson Endowed Chair in Machine Intelligence, College of Engineering, University of California, Riverside, CA 92521-0425.

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Calendar

- **Oct 7 - Oct 10 RNNS/IEEE Symposium on Neuroinformatics and Neurocomputing.** Rostov-on-Don, USSR *Sponsors*: Russian Neural Networks Society and the IEEE Council on Neural Networks. Contact: Dr. Wesley E. Snyder, Dept. of Radiology, Bowman Gray School of Medicine, Wake Forest University, Winston-Salem NC 27157-1022. 919-748-3908, FAX 9 19-748-2870. email: wes@mrips.bgsm.wfu.edu.

- **October 13-16. VBC'92: Visualization in Biomedical Computing. Chapel Hill, NC.** *Sponsor:* Dept. Computer Science, UNC-CH in coop. w/ Alliance for Engineering in Medicine & Biology, IEEE EMBS, and SPIE. *Contact:* Dept. of Computer Science, CB #3175, Sitterson Hall, UNC, Chapel Hill, NC 27599-3175.

- **October 11-14 MILCOM '92: Communications: Fusing, Command, Control and Intelligence.** San Diego CA. Sponsors: IEEE, IEEE Communications Society, and the Armed Forces Communication and Electronics Association. *Contact*: John Peckham, (619) 592-5153.

- **November 3-6, 1992 IJCNN '92-Beijing: The International Joint Conference on Neural Networks Beijing, China.** *Sponsors:* The IEEE Council on Neural Networks, The International Neural Network Society, The China Neural Networks Council, The IEEE Beijing Section. Contact: Meeting Management, 5665 Oberlin Drive, Suite 110, San Diego CA 92121 Tel 619 453 6222; Fax 619 535 3880.

- **November 3-6. Madrid. 3rd European Conf on Software Quality.** *Contact*: Julio Gonzalez-Sanz AECC-CONGRHISA C/Velazquez 90, P-5 28006 Madrid Spain. 34 15 75 2580; FAX 34 15 77 3874.

- **November 9-13 ISRAM '92: International Symposium on Robotics and Manufacturing.** Santa Fe, New Mexico. *Contact*: Dr. Ron Lumia (Robotics), Intelligent Controls Group, Robot Systems Division, National Institute of Standards and Technology, Gaithersburg MD 20899 USA, Tel: 301-975-3452; FAX 301-990-9688, email: lumia@cme.nist.gov or Prof. Joe H. Mullins (Manufacturing), Manufacturing Engineering Program, Farris Engineering Center, College of Engineering, University of New Mexico, Albuquerque, NM 87131 USA. Tel: 505-277-0558; FAX: 505-277-0813.

- **November 15-20. Intelligent Robots and Visual Communications and Telemanipulator Technology.** Boston. *Sponsor*: SPIE. Part of OE/Technology '92; an applications symposium on optics, electro-optics and lasers in industry. *Contact:* SPIE; International Society for Optical Engineering; PO Box 10, Bellingham WA 98227-0010;Tel: 206 676 3290; Fax 206 647 1445

- **November 16-18 ISMCR'92: Second International Symposium on Measurement and Control in Robotics.**

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Tsukuba Science City, Japan. *Sponsor:* IMEKO. *Contact*: Prof. S. Tache, RACST, University of Tokyo, 4-6-1 Komaba, Meguro-ku, Tokyo 153 JAPAN. Tel: 81 3 3481 4467 FAX: 81 3481-4469.

•**December 2-4, 1992. 2nd Int. Workshop on Industrial Applications of Fuzzy Control and Intelligent Systems.** College Station, Texas. Spons.: Center for Fuzzy Logic & Intelligent Systems Research, Texas A&M Univ. and North American Fuzzy Information Processing Soc. Contact: Sherry Escalante, Dept. Computer Science, Texas A&M Univ., College Station, TX 77843 Phone (409)845-5466 Fax (409)847-8578 email: csdept@cs.tamu.edu

•**December 7-9 MVA'92. IAPR Workshop on Machine Vision Applications. Tokyo.** *Contact*: Mikio Takagi, Institute of Industrial Science, University of Tokyo, 7 22 1 Roppongi, Minato-ku, Tokyo 106 Japan.

• **December 16-18, 1992, 31st IEEE Conference on Decision and Control**, Tucson, AZ. *Contact:* Professor T. Basar, Coordinated Science Lab, Univ. of Illinois, 1101 West Springfield Ave., Urbana, IL 61801, (217) 333-3607, (217) 244-1764 (FAX) e-mail: tbasar@markov.csl.uiuc.edu.

•**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.wwu.edu; Compuserve: 71620,2177

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

•**March 10, 1993 12th APEC Micromouse 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, 5665Oberlin Drive, Suite 110, San Diego CA 92121 Tel 619 453 6222; Fax 619 535 3880

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•**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.

•**March 10, 1993 12th APEC Micromouse Contest.**

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

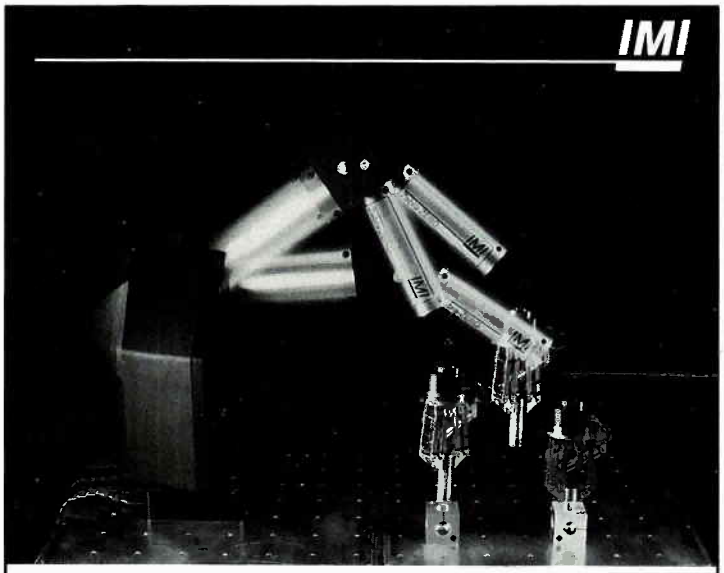
•**April 26-29 1993: 5th Topical "Meeting on Robotics and Remote Handling.** Sponsored by the American Nuclear Society and others and in coop. with the IEEE Robotics and Automation Society. Contact: Fifth Topical Meeting on Robotics and Remote Handling, PO Box 200001, Oak Ridge TN 37831.

•**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, Ph. 612.624-4116, email: sobelman@ee.umn.edu.

•**May 2-9, 1993. IEEE International Conference on Robotics and Automation. Atlanta Hilton and Towers, 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@gtme.courier.gatech.edu.**

•**May 9-14 1993. IS&T's 46th Annual Conference, Cambridge Mass.** (*See Calls for Papers*)

•**May 10-12, 1993. IMACS Symposium on Signal Processing and Neural Networks.** SPANN'93



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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.

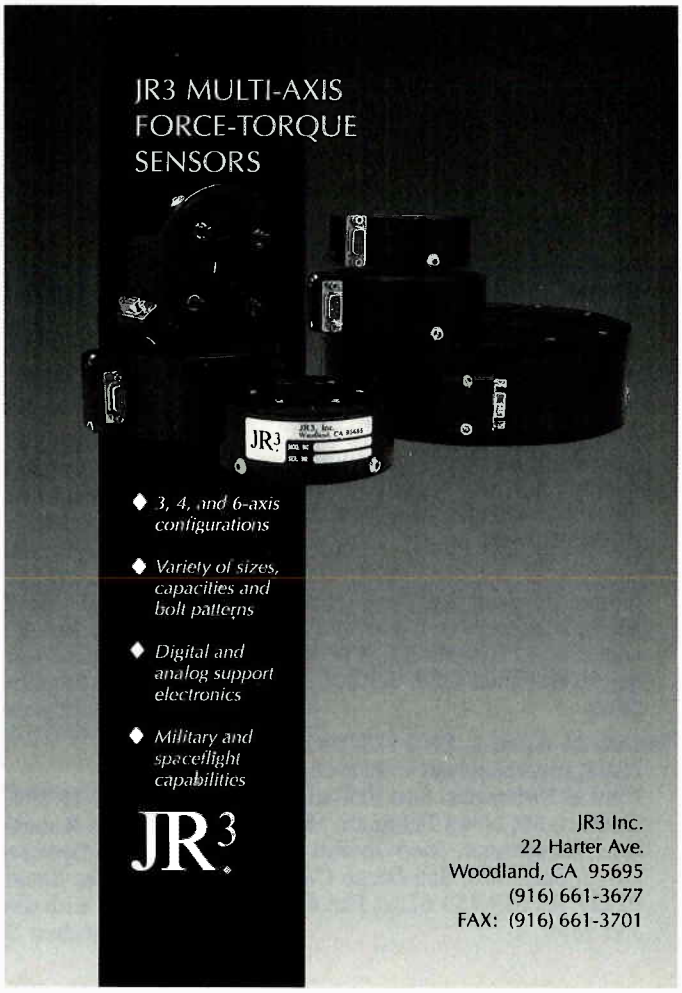
- **June 1-4, 1993. IEA93AIE: 6th Int'l Conf. on Industrial & Engineering Applications of Artificial Intelligence & Expert Systems.** *(See Calls for Papers)*
- **June 7-10, 1993. 7th Int'l Conf. on Solid State Sensors and Actuators. Yokohama Japan** *(See Calls for Papers)*
- **June 13-16, 1993. CBMS'93: IEEE Computer-Based Medical Systems Symposium. Ann Arbor, MI** *(See Calls for Papers)*
- **June 21-5, 1993. 14th Int. Conf. on Application and Theory of Petri Nets. Chicago.** *(See Calls for Papers)*
- **July 17-22, 1993. Fifth International Conference on Genetic Algorithms.** University of Illinois at Urbana-Champaign, *(See Calls for Papers)*
- **July 26-30, 1993 IROS 93: Int'l Conf. on Intelligent Robots and Systems. Yokohama JapanJuly 14-16 1993. Intelligent Vehicles '93.** Tokyo *(See Calls for Papers)*
- **July 30-31, 1993** ***IEEE/Nagoya University Workshop on Multiple/Distributed Robotic Systems: Architecture and Control for Coordination and Cooperation,*** **Nagoya Japan.** *(See Calls for Papers)*
- **August 2-4, '93 Yokahama, Japan. ICAM'93: Int'l Conf. on Advanced Mechatronics** *See Calls for Papers)*
- **(August 29-Sept.3, 1993. IJCAI'93: Int'l Joint Conf. on Artificial Intelligence.** Chambery 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.
- **September 13-16, 1993 2nd IEEE Conference on Control Applications.** Vancouver, BC Canada. *(See Calls for Papers)*
- **Sept. 18-22, 1993. VRAIS -'93:Virtual Reality Annual International Symposium.** Seattle Washington. *(See Calls for Papers)*

Presence

The first issue of *Presence,* a journal for the latest developments in teleoperation and virtual environments research and development is scheduled to appear in January 1992. PRESENCE is published by MIT Press and edited by Tom Sheridan of MIT and Tom Furness of the University of Washington.

In addition to refereed articles, the journal will include a section called "What's Happening" which will include short news items and announcements of conferences, books, new products, electronic lists, new companies, new laboratories, short courses, etc.

Send items of interest via e-mail to Blake Hannaford, Associate Editor, blake@uw-isdl.ee.washington.edu.



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.

- **IS&T's 46th Annual Conference, May 9-14 1993. Cambridge Mass.** *Sponsor*: Society for Imaging Science and Technology. Submit 150 word abstract to Michael R. Lee, Publications Chair, Polaroid Corp., 1265 Main St. W4-2G, Waltham MA 02154 1799. Tel 617 684 5391; Fax: 617 684 4396.
- **IEA93AIE: 6th Int'l Conf. on Industrial & Engineering Applications of Artificial Intelligence & Expert Systems. June 1-4, 1993.** *Submissions*: 4 copies of short (4pp.) or long (10pp) paper by November 1 1992 to the Program Chair: Dr. Paul Chung, Dept. of Chemical Engineering, Loughborough University of Technology, Loughborough, Leicestershire, England, UK, LE11 3TU, Email: p.w.h.chung@uk.ac.lut
- **Transducers'93: Solid State Sensors and Actuators June 7-10, 1993** Yokohama, Japan. *Sponsors*: Institute of Electrical Engineers of Japan and Japan Science Foundation. Submissions: 2 copies of a 2-page abstract before November 30, 1992 to the regional chairman. *Europe:* Prof. Jan-Ake Schweitz, Dept. of Technology, Uppsala University, Box 534, S-751 21 Uppsala, Sweden; *NA, SA, Africa & Australia:* Dr. Kurt Petersoen, Lucas NovaSensor, 105 Mission Court, Fremont CA 94539 USA; *Asia & all other regions:* Prof. Akio Sasaki; Secretariat TRANSDUCERS '93, c/o SANSEI International Inc., Fukide Bldg. No. 2, 1-21 Toranomon 4-chome, Minato-ku, Tokyo, 105 Japan.
- **IEEE Conference on Computer Vision & Pattern Recognition June 15-17, 1993,** New York City. The program will cover all aspects of computer vision and pattern recognition, including: Physics of image formation, Low-level processing, Pattern analysis, Texture analysis, Motion analysis and stereo, Integration of modules and cues, Segmentation and perceptual grouping, Shape and object representation, Object recognition, Active vision, Real-time vision and architectures, Systems and applications *Submissions:* Four copies of complete manuscripts should be received no later than November 9, 1992 by: Yiannis Aloimonos, Computer Vision Laboratory, Center for Automation Research, A. V. Williams Building, 115 Paint Branch Drive, University of Maryland, College Park, MD 20742-3411.
- **PetriNets'93: 14th Int. Conf. on Application and Theory of Petri Nets. June 21-25, 1993.** Chicago. *Submissions*: 8 copies of complete papers by November 16, 1992 to Marco Ajmone-Marsan, Dipartimento di Electronica, Politecnico di Torino, Corso Duca degli Abruzzi 24, I-10129 Torino Italy. Phone 39 11 5644032. Fax 39 11 5644099 email: ajmone@itopoli.bitnet.
- **CBMS 93: IEEE Computer Based Medical Systems Symposium. July 13-16 1993.** Ann Arbor Michigan. *Sponsors:* IEEE and Engineering in Medicine and Biology Society. *Submissions:* Timothy J. Kriewall. Ph.D., Sarns, 3M Health Care, 6200 Jackson Road, Ann Arbor MI 48106; 313 741 6276.
- **Intelligent Vehicles '93. July 14-16 '93,** Tokyo. *Sponsor:* IEEE and SAE. *Submissions*: 3 copies of 1 page abstract by December 15 '92 to 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
- **Fifth International Conference on Genetic Algorithms. July 17-22, 1993.** University of Illinois at

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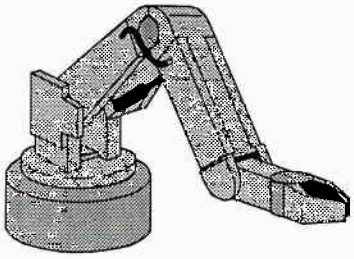

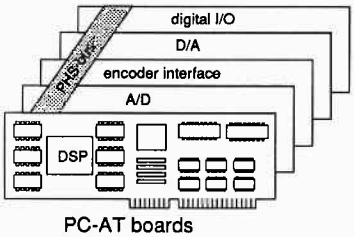

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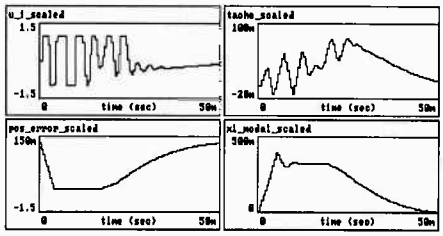

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Urbana-Champaign, *Sponsor:* The International Society for Genetic Algorithms, *Contact:* Prof. Stephanie Forrest, Dept. of Computer Science, University of New Mexico, Albuquerque, N.M. 87131-1386, phone: (505) 277-3112, fax: (505) 277-0813, email: 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

- **IROS 93: Int'l Conf. on Intelligent Robots and Systems. July 26-30 Yokohama Japan** Papers are sought on: Dexterous Manipulation, Robust Sensing, Versatile Intelligence, Novel Robotics, Locomotion, Multi Agent Systems, Application Frontiers, Intelligent Motion Control and other related topics. Submission: 4 copies of long (25pp max.) or short (10pp max.) by December 1, 1992 to either of the co-chairs: 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.
- **ICAM'93: Int'l Conf. on Advanced Mechatronics August 2-4, '93 Yokahama, Japan.** *Submissions:* 3 copies of 800 word abstract by December 1, 1992 to: Prof. 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.
- **IEEE/Nagoya University Workshop on Multiple/Distributed Robotic Systems: Architecture and Control for Coordination and Cooperation July 30-31, Nagoya Japan.** Travel expenses for the authors of the best papers will be supported by WWW. *Submissions:* Send abstract to Prof. 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.
- **2nd IEEE Conference on Control Applications. September 13-16, 1993. Vancouver, BC Canada.** *Sponsor*: IEEE Control Systems Society. *Submissions:* 5 copies of complete manuscripts for regular papers or 5 copies of extended summaries for brief papers by Jan. 15, 1993 to Dr. C. de Silva, Dept. of Mechanical Engineering, University of British Columbia, Vancouver, BC Canada, V6T 1Z4. For further information contact Dr. S. Atadan at the same address. FAX: (604)822 2403.
- **VRAIS'93: Virtual Reality Annual Symposium.** September 18-22, 1993, Seattle Washington. *Sponsor:* IEEE Neural Networks Council. Submissions: Papers: Send 5 copies of full papers (max. 10 pp.) by December 1, 1992 to Meeting Man-

Call for Participation
The Sixth International Symposium of Robotics Research

The Sixth International Symposium of Robotics Research will be held near Pittsburgh, Pennsylvania, USA, from October 2 to 5, 1993. The symposium, bringing together active leading robotics researchers from academia, government, and industry, has a tradition to be held in an informal setting with attendance limited to presenters and to invited participants in order to maximize interaction. During the four-day symposium, approximately fifty papers will be presented, in a single track.

Papers representing authoritative reviews of established research areas as well as papers reporting on new areas are sought for presentation at the symposium. While a number of leading researchers will be asked to submit an extended abstract, researchers who feel that they have made a significant new contribution to robotics are invited to submit an abstract. Extended abstracts are due by February 1, 1993, to either Program Chairman. Decisions of acceptance will be made by April 1, 1993, and the final papers are due by September 1, 1993.

Symposium Chairmen

Takeo Kanade	Richard Paul
Robotics Institute	Room 301C, 3401 Walnut Street
Carnegie Mellon University	University of Pennsylvania
Pittsburgh, PA 15213	Philadelphia, PA 19104-6228
tel: (412) 268-3016	tel: (215) 898-0372
fax: (412) 621-1970	fax: (215) 573-2048
e-mail: kanade@cs.cmu.edu	e-mail: lou@cis.upenn.edu

Robotics and Automation Society
EDITORIAL POLICIES

We publish news items, letters, and reports on work in progress. Normally, technical contributions will not be reviewed. However 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.

For-profit short courses and seminars may be advertised at our standard classified or display rates.

For more information about advertising in the newsletter please contact the Managing Editor, Rosalyn Snyder, 7621 Penland Drive, Clemmons, NC 27012, Tel:(919) 766- 62 10, email: roz@relito.medeng.wfu.-edu.

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3. I am not a member of the IEEE, but I am a member of the following other professional society _____. I am applying for affiliate membership in the Robotics & Automation Society. ~~$47.00~~ 48.00

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- **Software Engineering Standards Symposium. '93 September 1993** *Sponsor:* IEEE Computer Society. *Theme*: Internationalization of Industrially Useful Software Engineering Standards (SES) *Submissions*: 6 copies of abstract of paper, panel session proposal, position paper or tutorial proposals to one of the Program cochairs by December 18, 1992. *Europe:* Tim Denvir, Translimina Ltd., 37 Orpington Road, Winchmore Hill, London N21 3PD +44 81 681 4774; Fax ((Int) +44 81 681 6814.; *Japan:* Dr. Akira Kumagai, Fujitsu Ltd, Tel: +81 3 3730 3185 FAX 81 3 3734 4161.; *USA and other*: Sal Mamone, Nynex Corp., 500 Westchester Ave, White Plains NY USA. Tel +1 914 683 2237 FAX +1 914 683 2191

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Applications must be postmarked ***December 1, 1992*** for the Developing Countries Fellowships offered by the Robotics and Automation Society. The fellowships include travel assistance of $500 and waiver of registration fees will be granted to selected applicants from Africa, Asia, Eastern Europe, and Latin America (preference given to university students).

To apply, submit a one-page letter containing: name, address, telephone and FAX numbers (if available); (2) professional affiliation and nature of work (if student, describe current level in university, major field, etc.) (3) brief description of why attendance at the conference would be beneficial to your studies and/or professional career. The letter should be sent to:

Professor George Bekey
Computer Science Department
Univ. of Southern California
Los Angeles CA 90089-0782
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