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President's Message

Tzyh-Jong Tarn
Washington University

October 12, 1993

It has been an honor serving as the President of the Robotics and Automation Society in 1992 and 1993. It has been an exciting time! In fact, the most rewarding part of serving as president was the pleasure of working with so many people who work together to support the Society. I would like to thank all the volunteers for serving the Robotics and Automation Society well during the last two years.

This will be my last message as the President of the Society. As I look back on my two year tenure in this position, I find that the Society has continued to provide a forum for some of the very best research that goes on in the field of Robotics and Automation and to provide outstanding services to its members and to the general public in a smooth and efficient manner.

We had two very successful events this year: the 1993 IEEE Workshop on Micro Electro Mechanical Systems which was held in Fort Lauderdale, Florida in February and the 1993 IEEE International Conference on Robotics and Automation which was held in Atlanta, Georgia in May.

Following those two events, the 1993 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS'93), co-sponsored by the Society, was held in Yokohama, Japan in July. More than 400 people worldwide attended. Many attendees were members of our Society. From my perspective, the papers were of high quality, the sessions were crowded, the receptions, banquet, and other social events were delightful. Congratulations are due to Professors Hirofumi Miura and Kuniji Asano, the General Co-Chairmen and Dr. M. Kidode and Professor T. Sato, the Program Co-Chairmen, as well as to their various committees.

The Industry, University, Government Cooperative Committee, chaired by Dr. Pat Eicker, held a very productive and successful day and a half meeting in Atlanta in September. The Committee is drafting a report which will be submitted to the AdCom in December.

Despite slightly declining overall membership, R&A Society Chapter activity is on the upswing. Recently, new Chapters were organized in Denmark, Turkey, and Taiwan, and soon will be organized in Australia, China, and Spain.

The Robotics and Automation Society is becoming more "international." As individual members, we interact with each other on an international basis quite regularly. In recognition of this fact and to facilitate even more interaction, the Society held its principle annual meeting, the 1992 International Conference on Robotics and Automation (ICRA), in Nice and will do so again in Nagoya in 1995.

Future directions and initiatives of the Society originate with it's members, a third of whom reside outside the U.S., and formal responsibility for implementing specific actions rests with the Administrative Committee (AdCom) and the Executive Committee. The AdCom is the final authority so far as to all Society activities are concerned. Its membership is thus one of the obvious and important places to start the process of increasing our Society's international representation. For the past several years, only one of the eighteen AdCom members has been from outside the U.S. Many IEEE Societies have appointed AdCom members. By supporting the IEEE globalization initiatives, the Robotics and Automation Society ought to introduce the appointed memberships for its AdCom.

The Robotics and Automation Society can be proud of its accomplishments during the past 10 years. We have made the transition from a Council to a Society. I am grateful to be part of the profession that provides major leadership in the Information Age.

From the Editor's Desk

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

Welcome to the final issue of the Newsletter. With this publication the staff can turn it's full energies toward producing the first issue of the new IEEE Robotics and Automation Magazine. The editorial board (see page 13 for a listing of Magazine associate editors), has already been busy reviewing technical paper submissions. The first results of that review process will be back to the authors shortly. We are willing and able to tackle the next batch so keep those extended abstracts and papers coming. With all the recent activity to meet the annual conference deadline, I know there are numerous excellent Magazine papers spinning in your computer systems. Publication at the conference and in the Magazine are not mutually exclusive. If your conference paper is within the scope of the Magazine, consider reaching a broader audience. Now is also the time to get serious about all the other important pieces of information; letters, research news, conference synopses, etc. if you want to include them in the inagural issue.

While this issue is certainly a "collector" item, please don't just preserve it without risking damage to the pages by reading the contents. Along with the introduction of the Magazine technical associate editors there is also a profile on our new Society president, Richard Klafter and interesting articles on teleoperation, robot navigation, and holonic manufacturing. Your fellow members were also generous enough to submit conference reports on IROS'93 and the WWW on Multiple/Distributed Systems.

Of course you will find a plethora of the usual calls for papers and conference information. As a current resident of San Antonio I want to extend my personal welcome to all of our membership planning to attend the Conference on Decision and Control. San Antonio is one of the most outstanding conference sites in the USA, the riverwalk is home to a major mall along with over 40 resturants and bars and the Alamo is only two blocks away. As the program chair I am partial to the call for papers for next year's International Symposium on Intelligent Control (ISIC). With a paper deadline of March and presentation in August, the ISIC offers a convient place to update the research presented at our annual conference. Of particular interest are papers describing real applications of intelligent systems, which not suprisingly are within the scope of the new Magazine. The right type of submission could be a two for one deal.

Previous columns have mentioned my efforts to champion telerobotics for remanufacturing applications. To keep you up to date, the final draft report from the JPL generic architecture study has been completed and is available upon request. In the coming year we will be expanding that effort to flesh out the architecture interfaces to the level of detail sufficient to begin a prototype effort in FY 95. The overall objective is to develop a unified telerobotics architecture/framework that supports low life cycle cost insertion of telerobotic systems into a wide variety of military and civilian applications.

Finally, I would just like to thank everyone for their support over last year and extend my best wishes for a joyful holiday season. See you in the Magazine!

JPL Teleoperations System Debuts in Cross-Country Test

Karre Marino

A laboratory technology demonstration of remote-control robotic space servicing, with hookups between Goddard Space Flight Center and JPL, showed NASA Select TV audiences May 21 how simulated satellite repair work may one day be done.

According to Dr. Antal K. Bejczy of JPL, new technologies created by JPL in the last several years make possible remote satellite servicing from ground-based NASA control centers.

In the demonstration, JPL acted as the operator site, which simulated the ground station, while Goddard lab-simulated an on-orbit Hubble Space Telescope robotic servicing site.

The JPL operator, Dr. Won Soo Kim, was able to control the robot at Goddard in real time aided by a novel computer graphics technique, carrying out an Orbital Replacement Unit (ORU) exchange. The command sequences from JPL to Goddard were transferred through the Internet computer communications network. The actual robot motion images generated by three TV cameras at Goddard were sent back to the JPL control station through the NASA Select Satellite TV channel.

Dr. Paul S. Schenker, supervisor of the group which implements the project, emphasized the importance of operating in real time: "One of the biggest challenges to robotic servicing in space from earth is time delay—the physical time required to communicate information," he explained. "The operator sends forward his physical commands. He generates the motion that the robot is to replicate. He, in turn, must immediately see and feel the results of that action.

"Consider, for instance, control of a telerobot in the space shuttle from the ground, where it may take about eight seconds to send commands forward at the speed of light and through a space satellite communications network, and then receive information back to the ground control station through the same network. That kind of time delay perceptually disconnects and slows the operator, who at most can deal with a delay of a quarter to a half second in real-time control situations."

Imagine, Schenker offered, driving your car, turning the wheel and braking all with a four-second time delay—as experienced in the May 21 JPL-Goddard experiment. "We've had to develop techniques to help the operator with this delay."

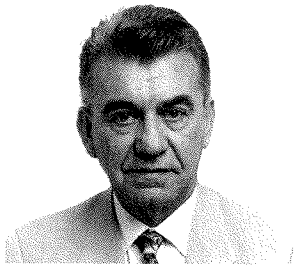
That's where the advanced computer technology has made the difference. The team used virtual reality to give the operator a high fidelity, real-time graphics model of his worksite, said Schenker.

"We developed a way to calibrate physically a graphics model of the worksite to actual camera views. We've matched the virtual reality in size, orientation, location and viewing perspective to the real world. When the operator looks at the graphics model, he is seeing an accurate rendition of the worksite, a physical truth and one that he can verify. Further, he can visualize situations often not directly viewable by the camera, due to viewing perspective or obstructions."

Using a 3-D graphics overlay on

Dr. Won Soo Kim was the operator for the JPL May 21 demonstration of space shuttle servicing via remote control robotic hardware. Dr. Soo controlled the robot, which was located at Goddard in real time, aided by the Advanced Teleoperation technology computer graphics technique. (Photo by Duane Patterson, courtesy of JPL photo lab.)

This article originally appeared June 4, 1993, in *The Universe*, which is published by the Public Affairs Office of the Jet Propulsion Laboratory, California Institute of Technology.



Antal Bejczy

video, scientists can literally place the model over the incoming video data—in real time. "We can use a shaded solid model, which is like a real object, or we can use a wire frame that the operator sees through," Schenker said.

Viewers of the JPL/Goddard demo saw the robot reach out to the spacecraft, grab the ORU, remove it, and replace it.

"The entire mission, which takes about 45 minutes, was operated remotely, and the experiment worked perfectly," commented Bejczy, who also noted that "novel proximity sensors added to the robot arm at Goddard really helped the actual tool and module insertion operations."

The JPL-developed advanced 3D predictive graphics display can generate high-fidelity synthetic camera views in real time, thus rendering critical motion events visible to the operator.

"This work is being done for NASA and is funded by the Office of Advanced Concepts and Technology," explained Schenker. "Our current project is research and development; the results have yet to be applied in space. This demonstration illustrated what we hope to achieve, showcasing technology for potential future robotics-assisted space servicing and applications and hopefully gaining confidence of mission users."

Schenker noted that the team realistically simulated long-distance remote robotics operation by a human operator, who physically controlled the remote robot at a simulated worksite.

"The actual experiment itself is a model of a planned real space application, a second astronautic servicing of the Hubble Space Telescope," expected to take place in late 1997.

Plans call for astronauts in extravehicular activity (EVA) to perform servicing and maintenance of the Hubble, retrieved to the space shuttle bay as part of scheduled maintenance operations. Schenker said the hope is that NASA, after seeing the May 21 demonstration, will view the technology as adding important capability and flexibility to the Hubble mission

He noted that "there aren't many robots used in space, the only other one currently being used is the space shuttle manipulator system."

Schenker added that the idea behind the advanced technology is to have robotic aides assist astronauts. "Robots can potentially perform key worksite preparation and closeout functions under the control of a ground-based operator," he said.

"With appropriate safety measures, a robot may work cooperatively alongside EVA astronauts."

The advantages of such technology, he noted, are increased operational safety and reductions in overall mission costs and difficulty

Schenker said the important thing about this technology is the combination of human and computer skills.

"We're using computers to enhance and amplify traditional human performance. Without the use of an advanced graphic-based control technology, this telerobotic capability wouldn't be possible.

"While teleoperations has been used for almost 50 years in simple master-slave pick-and-place tasks in the nuclear industry, it is this computer-enhanced Advanced Teleoperation technology that can be used to expand space capability across time and distance barriers and allow operators to perform tasks otherwise not possible through direct human means.

"In summary," Schenker said, "Advanced Teleoperations provides an enrichment of operation remote-control dexterity, 3-D viewing and remote information display."

Finally, Bejczy and Schenker noted that based on industry interest, commercialization of elements of the teleoperation technology used in the demonstration have already been initiated: The computer graphics-based remote-control capability, together with planned product improvements to commercial 3-D graphics packages, will be new features added to commercially available, commercially maintained computer-graphics software packages.

These enhanced commercial 3D graphics and robotics products will be applicable to a wide range of industry needs, including nuclear and other toxic waste site robotic operations, decommissioning of hazardous facilities under remote control, special emergency-type medical operations performed remotely and remotely operated highway maintenance.

NASA to Commercialize Remote-Control Technology

The remote control technology used in the May 21 NASA experiment is being licensed to a private firm for commercial development, according to Dr. Antal Bejczy, the experiment's technical manager. The firm's identity is being withheld while negotiations are in progress.

The teloperaton technique is designed for free-flying robots that would service orbiting satellites , and also has many potential uses on Earth, according to Bejczy.

Possible terrestrial applications for teleoperations include nuclear or toxic waste cleanup, decommissioning of hazardous facilities, special emergency medical operations, construction and building planning, and remotely operated highway maintenance.

"The module exchange tsk was originally designed to be performed by astronauts working in the shuttle bay," said Bejczy. "The success of the experiment shows that the same work can be done by robotic hardware controlled from Earth.

Bejczy also said that the graphics-based remote control technique will form the basis for new features added to commercially available computer graphics software packages.

Robot Navigation and Computer Vision Research: UT-Austin

Dinesh Nair, Xavier Lebegue and J. K. Aggarwahl

1 Introduction

Research at the Computer and Vision Research Center focuses on the role of machine vision for autonomous intelligent machines. The current research addresses the issues of map making, path planning, and the automatic creation of architectural CAD descriptions for the navigation of autonomous mobile machines in structured environments where *a priori* knowledge of the environment is not fully known. The overall goals of the research are to develop autonomous intelligent machines that can (l) sense the environment, (2) estimate their position in the environment by relating sensed information to *a priori* knowledge, and (3) effectively chart out plans and execute them for a specified task. Though our primary interest is in the role of vision for autonomous mobile robots, we also research the appropriateness of other sensing methods, such as radar and thermal sensors for mobile robot applications. Most experiments are conducted on an indigenously fabricated autonomous mobile robot (RoboTex). The ultimate role of RoboTex is to navigate autonomously in indoor environments, avoiding obstacles in its path and obtaining information to build an accurate CAD model of the environment. Already, significant progress has been made in this direction. At present, RoboTex can accurately generate CAD models of indoor environments without *a priori* knowledge of the environment.

2 Hardware

2.1 Overview

RoboTex, which serves as the platform for the experiments done here, is a 1.5 meter tall, tetherless mobile robot, weighing about 150 kg (see Figure 1). The robot subsystems are described in detail below. They are comprised of: (l) a TRC Labmate base and rigid metal frame to support the equipment; (2) a fast, on-board UNIX workstation to digitize video images and control the robot; (3) a camera and digitizer; (4) inclinometers; (5) an I/O system; (6) power supplies, which enable completely autonomous operation; and (7) an off-board computing option, remaining from an earlier version of RoboTex. A schematic description is presented in Figure 2.

2.2 Robot Base and Frame

The Transition Research Corporation's Labmate mobile robot base is a battery-powered vehicle with a control system. Motion commands and odometric readings are exchanged through a 9600 bps RS-232 port. The Labmate can carry 90 kg of equipment at speeds of up to 1 meter per second, and accelerations of 10 cm/ s^2. We use it at 40 cm/s and 5 cm/s^2 to avoid wheel slippage. The right and left driving wheels are mounted on a suspension for a good floor contact. Passive casters in each corner ensure stability. The Labmate controller processes measurements from the right and left odometers to update the 2-D position and heading of the robot. We found that, provided the accelerations were reasonable, the odometric readings were reliable. Two 12 V, 60 AH sealed batteries provide enough energy for several hours of operation. The front and rear bumpers of the Labmate are touch sensitive and stop the motion of the robot upon contact.

We bolted a rigid metal frame to the Labmate base to carry all the equipment. Rigidity is very important since the transformation between the coordinate systems of the robot and the camera must be calibrated precisely. Antennas for remote control are supported by an aluminum "roof" that serves as a ground plane. The perforated metal lumber used for the frame allows easy modifications.

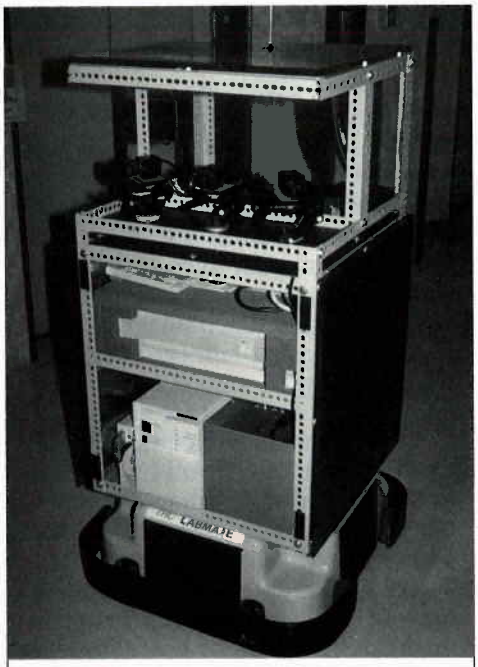


Figure 1 The mobile robot RoboTex

2.3 Computing Resources

The main computer on the robot is an HP-735 UNIX workstation with 32 MB of RAM and 840 MB of hard disk space. When the robot is not navigating, the workstation is connected to a console and to Ethernet, so that it can be used like any other workstation. The HP-735 is rated at 124 MIPS and 40 MFlops. The hard disk space is useful for storing long sequences of images registered with odometric measurements. The workstation is connected through two serial ports and a programmable serial switch box to a number of peripherals: the Labmate base, a cellular modem, an I/O rack, the uninterruptible power

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supply, and even an HP-95 palmtop computer (serving as a mobile VT-100 console).

2.4 Video and Digitizer

We have used monochrome and color video cameras on RoboTex. For practical indoor surveying applications, we found it was necessary to equip the camera (a Panasonic WV-CD 50) with a wide-angle lens (6 mm Computar TV lens, for a 2/3 inch CCD camera). This allows objects to remain visible as the robot drives past them. Unfortunately, the wide-angle lens introduces a strong barrel distortion. In order to correct it, we measure this distortion using a large calibration grid. Each image is then undistorted using bilinear interpolation. Here again, a good calibration procedure is essential for accuracy.

The robot is also equipped with two Panasonic CCD solid-state cameras equipped with fish-eye lenses (super-wide-angle lenses). The fish-eye lens used is manufactured by Tokyo Optics and has a horizontal view of 138° (approximately) and a diagonal field view of 178° (approximately). These lenses have been added to help the robot to navigate in cluttered environments or through narrow corridors. The lenses are particularly useful in viewing whole objects when there is little clearance between the lens and the object. We intend to use these lenses to help the robot navigate through doorways and tight spaces. These lenses are also useful for viewing objects which unexpectedly appear from unpredictable directions. Like the wide angle lens, the problem of distortion is inherent in the fish-eye lens and correction techniques are needed to render the accurate image of a scene.

The monochrome or RGB video signal from the camera is digitized by a Chorus PC-EYE frame grabber, providing either 8 bits for monochrome or 15 bits for color. The image size is 512 by 484. The frame grabber is installed in the single E/ISA slot of the HP- 735 workstation, and a custom UNIX device driver is used to control it.

2. 5 Calibration

Calibration is an important issue in computer vision. A very careful calibration is needed to obtain highly precise measurements. The calibration procedure determines the projection parameters of the camera, as well as the transformation between the coordinate systems of the camera and the robot (see [5] for details). To calibrate the camera, we determine the optical center, the focal length expressed in horizontal and vertical pixels, and a 2-D to 2-D function to correct the barrel distortion introduced by the wide-angle lens. The transformation between the coordinate systems of the camera and of the robot (rotation and translation) is also completely measured.

Fish eye lenses suffer from excessive barrel distortion. A simple calibration procedure, similar to the one used for the wide angle lens, has been used to calibrate the fish eye lens. The method uses a polynomial transformation between the angle in the world and the corresponding angle in the image plane to correct the barrel distortion (see [4] for details). The polynomial coefficients are obtained using the least squares estimation method.

2.6 Input/Output

An Alpha Products A-BUS rack contains several cards for I/O: a 12-bit analog to digital converter card, a reed relays card to select ADC inputs, a power relays card, and a voice synthesizer. The ADC is used primarily to measure the roll and pitch of the camera. The power relays save energy by switching off parts of the equipment when they are not needed. They control the camera, cellular phone, video transmitter, voice synthesizer, inclinometers, and cooling fans. The voice synthesizer announces warnings and occasional error messages when the robot navigates. Details on the error can then be read on the HP Palmtop console.

The power for most of the equipment is drawn from the Labmate batteries through a 24 V DC to 110 V AC power inverter (Dimensions Unlimited DUI- 24/750EH). The output is a quasi-sine wave, and the power rating is 750 Watts. A 10 A regulated power supply provides 13.8 V to the DC powered devices. Although this may be an inefficient use of energy, it makes experimentation easy: new devices can be connected by simply plugging them in.

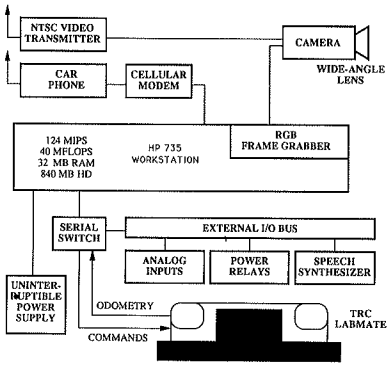

Figure 2. Schematic description of RoboTex

The batteries provide power for several hours of continuous operation. The HP workstation draws its power from an American Power Conversion 1200 VX uninterruptible power supply (UPS), which delivers a true sine wave 110 V AC for about an hour. The UPS is simply unplugged from the lab's AC line before the robot navigates, and switches to internal batteries automatically. The workstation does not need to be rebooted when power is switched. An RS-232 line informs the workstation of the UPS status.

3 Software Systems

3.1 Software for Hardware Control

The hardware is controlled by several layers of custom libraries. Almost all of the software is written in C++ using the HP SoftBench CASE tool. The controlling software is divided into two groups: the first block acquires images, reads odometers, and moves the robot, and the second group processes images and decides on the motion.

3.2 Simulator

For verification of the robot's behavior with new algorithms as well as for debugging, computer simulations are very useful. For this purpose we have built a simulator in C++ which can simulate the motion of the robot from a series of previously obtained images. This has been done by replacing the first block of the controlling software with a simulator, which reads images from a previously acquired sequence.

4 Ongoing research

At present, RoboTex can navigate through man-made structured environments using the boundaries, or edges, of the walls and doorways it identifies using a single camera. To do this, RoboTex relies on the geometrical properties of vanishing points to estimate the most likely orientation of the edges in each 2-D image. For example, vertical edges in a 3-D scene appear to converge to one point in the image, the vanishing point of vertical lines. See [5] for details. This approach reduces the number of unwanted features, increases the sensitivity to useful features, and drastically speeds the computation.

With the accurate estimation of the edges and boundaries in an 2-D image, RoboTex is visually able to measure distances between edges with a precision comparable to that available from an architect's plan. This information is now being used to generate complete CAD models of the corridors in the building.

We are also studying the use of parameter estimation and signal detection theories to recover 3-D structure for mobile robot applications. The proposed vision system recovers 3-D information from two images of the 3-D world through feature extraction, feature matching, and 3-D structure computation. The feature matching stage is implemented using an algorithm based on perceptual grouping and relaxation labeling.

Recently, we have initiated a project which will assist the robot to avoid stationary and moving obstacles. We plan to do use one camera (with a wide angle lens) and a priori knowledge of the environment. Most of the obstacle avoidance algorithms in use today employ other sensors, such as radar, to supplement the visual information. Our goal is to enable the robot to perceive moving and stationary obstacles using only visual information.

Another project involving the robot focuses on navigation through narrow corridors, doorways and tight spaces. We intend to use stereo information from two cameras with super-wide-angle lenses for this purpose. In related projects, we have developed several position estimation techniques for robots navigating in outdoor environments. For mountainous terrains with no recognizable landmarks, we use digital elevation maps of the area, information from the camera geometry and the position and shape of the observed horizontal line in four directions to determine the robot's position. See [8] for details. For navigation in a structured urban environment, the position estimation technique establishes correspondences between sensor images and a stored model of the roof-top edges of the buildings in the environment ([7]-[9]).

In other past research efforts, our group developed a methodology to recognize large man-made objects in outdoor scenes from color images by identifying geometric structures in the image and combining them with color information to guide the segmentation and interpretation of the scene [3]. We have also explored the use of perceptual organizational principles to locate man-made objects in non-urban environments [6]. We have also addressed the problem of CAD-based object recognition. A model-based vision system, which establishes correspondences between dense range images and a database of CAD models, is used to automatically recognize objects in a scene containing several overlapping objects ([1], [2]).

5 Conclusions

Research at the Computer and Vision Research Center is aimed at developing autonomous intelligent mobile machines that can self-navigate in unknown environments. Our primary focus has been on the role of machine vision for such an application. In the future, we also plan to incorporate other sensors such as thermal and range sensors to supplement visual information. Fusion of information from different sensors can be used to get better information about an unknown environment. Such research is needed to build the basic foundation of knowledge required to achieve the level of autonomy that will allow intelligent machines to be used in environments that are hazardous for humans, such as fires, and nuclear power and waste facilities

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Society News

Adcom Notes

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

T. J. Tarn is in the second year of his two-year term as President. Professor Richard Klafter, who had served as Vice President for Finance for a number of years, will take office as President beginning January 1, 1994.

Congratulations go to Wayne Book and Professor John Luh and their organizing committee for an excellent conference in Atlanta. We returned back to the location of our first conference to engage in a most stimulating program. Several new items were introduced at this conference including the Best Conference Paper Award and electronic version of the paper titles, abstracts, and bibliographies of the Proceedings.

Plans continue for the next two Conferences in 1994 and 1995. 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 Chair and Professor Harry Stephanou as Program Chair. The 1995 Conference will be held in Nagoya, Japan in the Nagoya Congress Center on May 22-26. The General Chair is Professor Toshio Fukuda and the Program Chair is Professor Suguru Arimoto.

The leadership for the 1996 and 1997 Conferences is also now set. The 1996 Conference will be held in Minneapolis with Norman Caplan as the General Chair and George Lee as the Program Chair. The 1997 Conference will be held in Albuquerque, New Mexico from May 11-16. The General Chair is Ray Harrigan and the Program Chair is Mohammed Jamshidi.

A Conference Board was activated at the AdCom meeting. Dr. Norman Caplan, the Past President of the Society, will serve as its Chair. The formulation of policies and procedures for continuity in management and long-range planning of our conferences will be the main tasks of the Board.

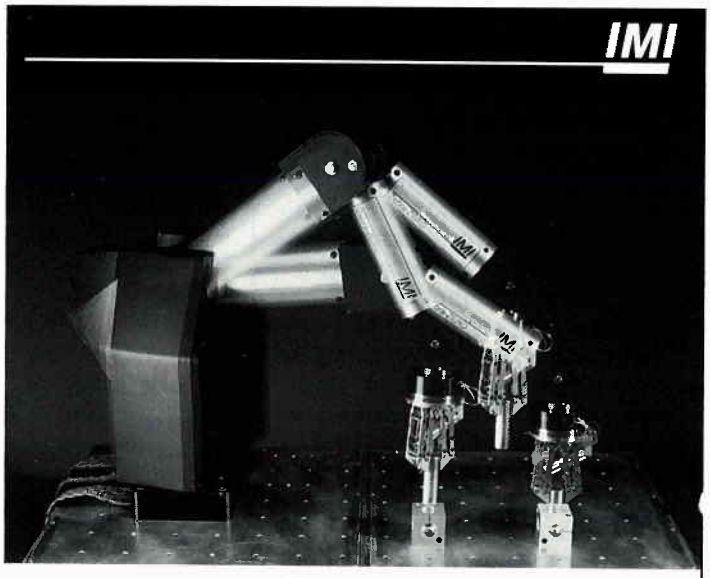
Richard Volz will succeed Dr. Russell Taylor as Editor of the Transactions. The appointment will take effect in 1994. Our appreciation goes to Dr. Taylor who has very capably served as Editor over the past five years. The AdCom also moved to grant The K.S. Fu Award of the Robotics and Automation Society for the best Transactions paper.

All approvals have been received for the Society's *Robotics and Automation Magazine*. Michael Leahy will serve as the first Editor of the Magazine for a four-year term. Thanks go to Robert Kelley, Michael Leahy, and Rosalyn Snyder for the time that they have spent in preparing the successful proposal for the Magazine.

The Distinguished Lectures Program is underway under the direction of George Lee, the Vice President for Technical Affairs. The travel expenses of an approved visit by a distinguished lecturer will be covered by the Society while local expenses are the responsibility of the chapter/section.

The Industry, University, and Government Cooperative Committee has been organized to facilitate a growing relationship among these private and public institutions. Dr. Patrick Eicker of the Sandia National Laboratories is serving as the Chair of the Committee.

David E. Orin
The Ohio State University
R & A Society Secretary



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IEEE Pub Committee Seeks Member Input

Is there a book you would like to see on your bookshelf that hasn't been published? Let us know so that we can find somebody to write it!

The IEEE Press is looking for feedback from members of the Robotics and Automation Society on topics for new books that they should publish.

Types of books published by the IEEE Press include:

- originally authored books on specific topics;
- tutorial material not available elsewhere;
- reprint books—annotated collections of hard-to-find classic papers originally printed in journals or conference proceedings;
- previously published books that you want on your bookshelf but are no longer being marketed.

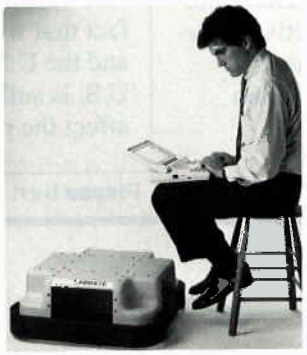
The Robotics and Automation Society would like to encourage authors to submit their book proposals to the IEEE Press. We are also looking for members, both technical experts and potential readers, to review submitted manuscripts.

Advantages to publishing with the IEEE Press include:

- Royalty arrangements which compare favorably with other publishers
- IEEE marketing offices in the USA, Brussels, and Singapore mean that IEEE Press representives are at most major conferences, including those sponsored by other organizations
- Society sponsorship—when the Robotics and Automation Society sponsors a book, it provides reviewers, assists in marketing, and in some cases the book is available to Society members for a discount price.

Your comments are needed! Send them to me via email: r.kelley@ieee.org.

Robert B. Kelley
Chair, RA Publications Committee



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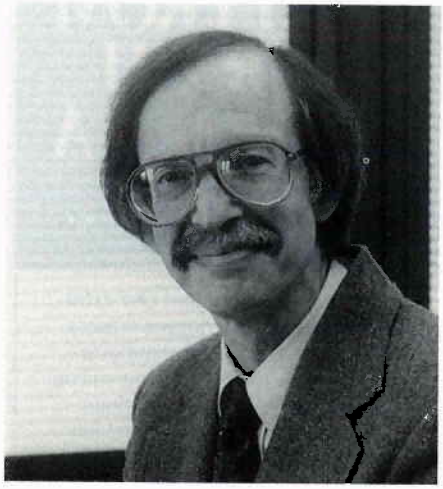
...introducing Richard Klafter— 1994-5 Society President

Rosalyn Snyder



Dick Klafter's first comment when asked to discuss the state of the Society was "the Society is in good shape financially."

He ought to know.

When Norman Caplan announced his nomination as 1992 President Elect, the immediate outcry from the AdCom members was "But if we elect Dick President, who's going to be Treasurer?"

Norm's retort was "Just because the man's done a great job doesn't mean he has to do it forever! He deserves to be President."

Certainly no argument there.

For eight years Klafter has kept track of the Society's general finances and worked with ICRA Treasurer Harry Hayman on the conference finances. In the process he has become one of the few IEEE volunteers who even approaches an understanding of IEEE bookkeeping practices.

In 1992, as ICRA-Nice treasurer, he took on the daunting task of successfully juggling accounts when the bills and payments were coming in dollars, francs and lira, at varying exchange rates.

As he prepares to take on the new role of RA President, Dick sees the society as "taking an activist role in pushing research funding, and communication and cooperation between industry, university researchers, and government."

"We're beginning to do these kinds of things," he said, citing the workshops held at ICRA-Nice and ICRA-Atlanta.

He suggested that the society might organize a workshop with the top people in the field of emerging technology, hold it in conjunction with a major conference— not necessarily ours and "send the results to Bill Clinton."

However, Klafter emphasized that it is important that RA keep its activities "non-political and non-parochial."

"What concerns me is that we try to be more globally oriented. One third of our members are not from North America and we have to concern ourselves with the needs of this membership."

"However, we can't ignore the fact that we have a world economy and the U.S. is a major player. If the U.S. is suffering bad times, it will affect the rest of the world."

Please turn to back cover

Tarn to Edit IEEE Design and Applications Series

T.J. Tarn has been named editor of the new IEEE Press/TAB Series on Design and Applications. Books in this series will be focussed on a particular or related topics such as "Control Systems Design for Robots" and "Welding Process Design. The books will come out of workshops conducted at IEEE conference or sponsored or co-sponsored by the IEEE. Examples of possible book topics are

According to Robert Kelley, Chairman of the RA Publications Committee and representative to the IEEE Publications Board, IEEE President-Elect Troy Nagle has proposed that potential contributors to a book in the series will bring their completed drafts to the workshop where they will be presented and critqued. Surviving manuscripts will be rewritten, new manuscripts added for completeness, and the editor will provide introductory and transitional material.

The rationale for the procedure is to ensure the timely production of well-reviewed publications in this extremely volatile field. Nagle has proposed that the entire cycle, from workshop announcement to appearance of the book, be completed in 12 months.

Questions or proposals may be addressed to Dr. Tarn via email (tarn@wurobot.wustl.edu) or FAX (314 935-6121).

IEEE Robotics &Automation Magazine Editorial Board

We are proud to introduce the eight associate editors who will assist Editor-in-Chief Michael Leahy in coordinating the review of the technical articles and tutorials submitted for publication in the IEEE Robotics and Automation Magazine. To ensure that articles published in the Magazine will be consistent with the high standards of IEEE magazines and journals, submissions will be subject to peer review. Many of you will be occasionally asked to review articles, and the Board asks that you give the articles you are sent the same expeditious and thorough review you you would like your own work to receive.

PAUL G. BACKES is a technical group leader in the Robotic Systems and Advanced Computer Technology section, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA where he has been since 1987.

JILL D. CRISMAN is an Assistant Professor and Director of the Robotic and Vision Systems Laboratory in the Department of Electrical and Computer Engineering at Northeastern University, Boston.

RONALD LUMIA is the Group Leader of the Intelligent Controls Group in the Robot Systems Division of the National Institute of Standards and Technology.

KAZUHIRO KOSUGE is currently an Associate Professor, Department of Mechano-informatics and Systems, Nagoya University, Nagoya, Japan.

YILONG CHEN is a Staff Research Scientist with General Motors Research Laboratories where he has been since 1984..

KOK-MENG LEE is an Associate Professor at the George W. Woodruff School of Mechanical Engineering at the Georgia Institute of Technology, where he has been since 1985.

KIMON P. VALAVANIS an Associate Professor and Associate Director for research in Robotics and Automation at the Apparel-CIM Center, Center for Advanced Computer Studies at the University of Southwestern Louisiana.

STEVE MURPHY is with FANUC Robotics North America, in Auburn Hills, Michigan.

IEEE ROBOTICS AND AUTOMATION SOCIETY MAGAZINE

INFORMATION FOR AUTHORS

The *IEEE Robotics and Automation Society Magazine* publishes high quality technical articles in the areas of: prototyping, demonstration and evaluation, and on site implementation of robotics and automation systems. Submissions should emphasize creative approaches, implementation details, and lessons learned from applying mature theories to complex real world problems. The *RAS Magazine* is published quarterly. Four types of technical contributions are regularly considered:

1. ***Papers*** - Presentations of significant prototyping, demonstration and evaluation, or implementations of robotics and automation systems
2. ***Tutorials*** - Clear explanations of the technical and historical background required to appreciate how theory evolves into applications, and insights into new theoretical developments
3. ***Letters*** - Significant remarks of interest to robotics and automation systems engineers, perspectives on current technology trends, and comments on regularly published papers
4. ***State of the Shelf*** - Objective evaluations of what's new in the market

Papers and tutorials go through the same peer review process. Letters and State of the Shelf contributions go through a shorter review process to facilitate rapid publication.

A. Submission process

Prospective authors are encouraged to send an extended abstract of proposed papers and tutorials to the editor. The extended abstract should contain the following sections: background, problem statement, objective, contribution, and outline. Length should not exceed three single-spaced pages. Email or fax is preferred to facilitate quick review. After editorial board review the author will be encouraged to submit the full article for peer review or be advised that the proposal is not consistent with the scope of the *RAS Magazine*.

Five copies of the complete manuscript with a cover letter stating the type of contribution (paper, tutorial, letter, state of the shelf) and the name and address of the corresponding author should be sent to the Editor:

Major Michael B. Leahy Jr.
IEEE Robotics and Automation Society Magazine
SA-ALC/TIEST
450 Quentin Roosevelt Rd.
Kelly AFB, TX 78241-6416
email: m.leahy@ieee.org
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B. Copyright

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C. Style for Manuscript

Submitted manuscripts must be typewritten in English. Specific guidelines are as follows.

1. The contribution of the paper should be presented in a manner that makes it accessible to the interested robotics and automation engineering professional. Descriptions and intuitive insight and interpretation are preferred to formal mathematical development (lemmas, theorems, and proofs). Detailed mathematical derivations (over 20 equations) are not appropriate. Theoretical developments should be sent to the *Transactions*.
2. Full length submissions must be double spaced 12pt type with adequate margins and a maximum length of 32 pages including references, tables, and figures. Papers longer than 32 pages will not be reviewed without prior editor approval.
3. References must be typed double-spaced in a separate section at the end of the paper, with items referred to by numerals in square brackets. References must be completed in IEEE style. The total number of references should not exceed 12.
4. The cover page should contain the title; name, affiliation, and complete mailing address of all authors; and a single paragraph abstract which briefly and clearly describes the contribution of the paper.
5. If accepted for publication, the text of the paper must be available electronically as a standard computer-readable ASCII text file. Instructions for electronic submission will be provided when the paper is accepted for publication.

Manuscripts exceeding the specified page limits, or clearly outside the scope of the Magazine will be returned without a review.

D. Style for Illustrations

1. It is in the author's interest to submit profession quality illustrations. Drafting or art service cannot be provided by the IEEE.

2. Original drawings should be in black ink on white background. Maximum size is restricted to 21.6 by 27.9 cm. Glossy prints of illustrations are also acceptable.

3. All lettering should be large enough to permit legible reduction of the figure to column width, sometimes as small as one quarter of the original size. Typed lettering is usually not acceptable on figures.

4. Lightly pencil each figure number on the back of each original illustration. Captions should not appear on figures.

5. Provide a separate sheet listing all figure captions, in proper style for the typesetter, e.g., "Fig. 5. The error variance for the optimal filter.

6. Contributors' photographs should measure between 1.6 cm and 9.5 cm across the widest part of the head. The overall size of the photographic paper used can be anything from passport size to 21.6 by 27.9 cm.

E. Page Charges

After a manuscript has been accepted for publication, the author's company or institution will be approached with a request to pay a charge of $110 per page to cover part of the cost of publication. As with IEEE Transactions and publications of most other professional societies, payment of page charges for this Magazineis not a necessary prerequisite for publication. The author will receive 100 free reprints (without covers) only if the page charge is honored. Detailed instructions will accompany the proofs.

F. Special Issues

The R&A Magazine will run up to two special issues each calendar year. A special issue consists of an introduction from the guest editor, and three to five technical articles. A tutorial article is highly encouraged. Individuals wishing to sponsor special issues should submit a concise package which includes the following: motivation, listing of specific topics, potential authors, proposed call for papers, and proposed editors. Special issues must also be coordinated through the appropriate society technical committee chairperson. The editorial board will review the package and make recommendations on scope and content. If the issue is tentatively approved, full papers will be solicited and then put through the normal peer review process.

G. Society News Submissions

The *RAS Magazine* also actively solicits the types of information found in the former society Newsletter. Information about conferences, workshops, new publications, research and industry, and other professional activities of the IEEE Robotics and Automation Society are invited. Newsworthy information should be sent directly to the Managing Editor with a courtesy copy to the editor (electronic format is preferred.)

Ms. Rosalyn Snyder
7621 Penland Drive
Clemmons NC 27012
(910)766-6210
(call to send fax)
email: r.g.snyder@ieee.org

News from Industry

The Society of Manufacturing Engineers (SME) has announced its 1994 event schedule of major expositions and conferences in the area of advanced productivity. The events examine all facets of manufacturing from basic engineering through factory automation, to evolving processes and materials.

These conferences present the "state of the shelf" in the area of manufacturing and can provide the research engineer an opportunity to learn first-hand about problems and opportunities which emerge when new technology hits the factory floor.

The SME is a world-wide 75,000 member organization of professionals in the field of manufacturing engineering and management. In addition to the events listed below, the SME sponsors 250-plus conferences, courses and clinics.

For information about any of the meetings listed below, contact SME's Customer Service Center 1/800/733/4763 (U.S. only) or 313/271-1500, ext 763; or FAX 313/217-2861.

1994 SME Calendar

- **January 18-20 Composites Manufacturing & Tooling Conference and Exhibits, Anaheim CA.**
- **February 1-3. HOUSTEX Houston Texas. Advanced Productivity Exposition and Conference.** —*Regional metalworking and manufacturing event features machine tools and accessories.*
- **March 8-10 Charlotte Advanced Productivity Exposition and Conference Charlotte NC.**
- **March 21-24 WESTEC Advanced Productivity Exposition and Conference Los Angeles CA.**
- **March 21-24 AUTOFACT WEST Exposition and Conference. Los Angeles CA.** —*Computer-integrated manufacturing technologies.*
- **March 21-24 FABTECH East Exposition and Conference. Baltimore MD.**—*Metalforming and fabrication.*
- **April 26-28 Rapid Prototyping Conference. Dearborn MI**
- **May 9-11 International Cold Forging Conference Columbus OH.**
- **May 24-26. EASTEC Advanced Productivity Exposition. W. Springfield MA.**
- **June 7-9 Applied Machine Vision Conference. Minneapolis MN**
- **June 21-23 Made in America For the World Trade Fair and Conference. Detroit MI.**
- **September 7-14 Manufacturing '94/IMTS Conference. Chicago IL.** *In conjunction with the Association for Manufacturing Technology's International Manufacturing Technology Show (IMTS) The conference will feature over 70 sessions and 300 speakers in the following areas: machining and tooling, automation for manufacturing systems, forming and fabricating, quality management and parts cleaning.*
- **September 13-15 Can Manufacturing Conference. Chicago IL**
- **September 19-21 Appliance Manufacturing Conference. Indianapolis IN.**
- **September 20-22 Adhesives Manufacturing Conference. Chicago IL.**.*Technical advances in adhesives, sealants, and equipment; adhesive selection for a specific application and designing for or with adhesives.*

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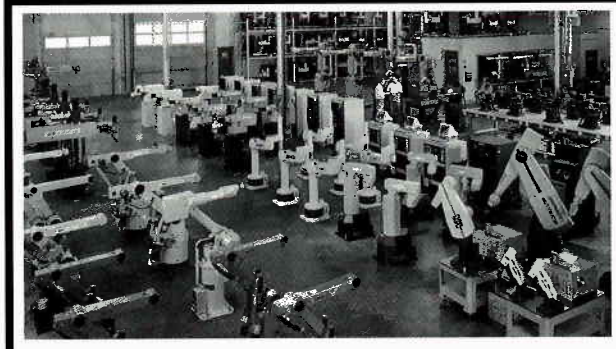

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- **October 3-5 International Sheet Metal Forming Conference. Columbus OH.**
- **October 11-13 FABTECH West Exposition and Conference. San Jose CA.**
- **October 24-27 GageTech Conference and Tabletop Exhibits. Chicago IL**—*Focus on building quality into the manufacturing process. State of the art information on gaging technology and equipment.*
- **November 2-6 International Exposition for Food Processing and Conference. Los Angeles CA.**
- **November 15-17 AUTOFACT Exposition and Conference. Detroit MI**— *CAD/CAM, CAE, CIM.*

Holonic Manufacturing Systems Consortium

Teams of industry experts, scientists, and engineers from the world's leading industrial nations are working together to build and test a framework for international collaboration in Intelligent Manufacturing Systems (IMS).

The experience of these teams, coming together from Australia, Canada, Europe, Japan and the USA to work for one year on collaborative "test case" projects, will form part of a two-year feasibility study which began in February 1992. The feasibility study aims to prove whether collaboration of this nature and on such a scale can be achieved and, more importantly, whether the benefits of such collaboration can be shared fairly. If the results prove positive, then a full-scale international research and development program could follow.

Three IMS international committees of high-level industrial, academic and government experts will advise on the management of the feasibility study. In the first stage, the International Steering Committee (ISC), aided by the International Technical and Intellectual Property Rights Committees, defined an experimental framework for collaboration. In January 1993, the ISC approved the initiation of six industry-led test case projects. Projects typically involve cooperation from four to five regions, with a total of 140 organizations participating in the six test cases.

The "Holonic Manufacturing Systems" (HMS) project addresses research, pre-competitive development, systemization and standardization of architectures and technology for open distributed systems comprised of intelligent, autonomous, cooperating elements ("holons") for application in IMS, encompassing discrete, continuous and/or batch processing. Its principal goal is to prove whether a common technological and organizational base for a possible future full-scale program can be established. The HMS project began on 4 March 1993; a successful start-up meeting of the HMS Consortium was held 17 March at the Catholic University of Leuven, Belgium, with subsequent meetings in Kingston, Canada and Melbourne, Australia.

The HMS project will explore mechanisms for cooperation among leading industrial companies, universities, and research institutes to promote research in and adoption of "holonic" technologies for manufacturing systems. Work to be performed includes the identification of user requirements and critical technology needs; definition of application test beds and benchmark studies; and formulation of strategies for future implementation and standardization of holonic manufacturing systems. Widespread diffusion of the results of this work within the international manufacturing community is planned.

The HMS Consortium consists of 32 Partners from all regions in the IMS program, comprising 15 industrial companies, 11 universities and 6 research institutes. The consortium is managed by Regional Project Management Committees headed by BHP Co Ltd. in Australia, Queen's University in Canada, Softing GmbH in Europe, Hitachi Ltd. in Japan, and Allen-Bradley Industrial Automation (a Rockwell International Company) in the USA. These "Coordinating Partners" also serve as the Consortium Management Committee, with Allen-Bradley serving as "Principal Coordinating Partner" for communication with the international IMS Committees. Coordination of the Consortium's technical work is performed by a Technical Steering Committee reporting to the Management Committee.

Members of the HMS Consortium in North America include:

USA

Allen-Bradley/Rockwell International (U.S. Coordinating Partner)
Center for Manufacturing Competitiveness (NCMS/MCC/SEMATECH)
United Technologies
University of Connecticut
University of Illinois

CANADA

Queen's University (Canadian Coordinating Partner)
Alberta Research Council
Basic Technologies
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For more information, contact
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Storrs, CT 06268
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email: hoitomt@brc.uconn.edu

Oops!

A photograph of Dr. Jill Crisman which appeared in the last newsletter was erroneously identified as Dr. Debra Hoitomt. Profiles and correctly labeled photographs of both will appear in the first issue of the Robotics and Automation Magazine.

Recent Ph.D. Theses in Robotics and Automation

Mechanical Computation for Passive Force Control

Ambarish Goswami, Advisor: Michael A. Peshkin, Northwestern University, Evanston IL 60208 USA

Robot force control implemented by a passive mechanical device (perhaps a wrist) has inherent advantages over active implementations in regards to stability and speed. A passive mechanical device can regain some of the versatility of its active counterpart if it incorporates mechanical elements with programmable parameters, e.g., damping coefficients or spring stiffnesses. In this thesis we characterize the range of accommodation (inverse damping) matrices that a passive device may be programmed to possess.

A passive device of fixed geometric design can adopt only a subset of all accommodation matrices even with fully adjustable damping constants. With the help of network theory we describe the set of attainable accommodation matrices and show how the tunable damping constants can be chosen to achieve a desired accommodation matrix. Each such accommodation matrix can be composed of a positive linear combination of a fixed set of basis matrices. We compare the space of attainable matrices to the space of all matrices, and suggest a method of visualizing it in low-dimensional examples.

A kinematic Jacobian relates the task-space damping matrix to a similar matrix in the hydraulic space of the tunable dampers (joint-space). For wrists with redundant joints the transformation of damping matrices between task-space and joint-space is not straightforward. In this thesis we identify the causal directions along which the transformations are linear. We show that the joint-space matrices which are obtained as linear transformations of desired task-space matrices are all singular. Many realizable joint-space matrices (corresponding to a desired task-space damping matrix) are shown to exist which are not discovered by linear transformations.

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Reliability and Maintainability of Modular Robot Systems: a Roadmap for Design

Dean Leroy Schneider, Supervisor: Delbert Tesar, The University of Texas at Austin, Austin Texas 78712 USA, August 1993

As robotic technology is considered for use in extreme environments, such as on-orbit and planetary exploration missions, the availability of the robotic systems become of paramount concern. Availability has two components: Reliability and Maintainability (R&M). Modular robotic systems address the maintainability portion of availability by minimizing repair time and allowing for the optimal reconfiguration of the robotic system for different tasks. The remaining portion of availability is the reliability of the modular robotic system. This dissertation presents a review of robotic system reliability technology and develops a technology roadmap outlining future directions for research and technology application that will improve the reliability of modular robotic systems.

Also developed and tested is a design index based upon a modular robotic system's hardware and software reliability and the precision of the system.

The results of the R&M technology review indicate a need to improve modular robotic system reliability by insuring simple, quick, precise, and standard module interfaces; reducing the need for geared actuation, moving toward direct-drive technologies (based on the present state-of-the-art); and the use of high reliability drive technologies such as a/c servo motors. Additional research recommendations include the development of methodologies to identify and quantify the modular system component life dependency structures; a suggested method using H-function integral transform theory is discussed. The establishment of a national or international robotic parts reliability data-base is imperative to allow the types of reliability advancement in robotics as was seen in the electronics industry.

The Reliability Performance Index (RPI) is developed to allow the quantification of the modular robotic system reliability during module design and configuration determination. It includes the top level performance measure of accuracy as well as the operational measure of hardware and software reliability. By assuming a serial reliability structure, the system state-of-the-art); and the use of high reliability drive technologies such as a/c servo motors, the system hardware reliability is combined with the system kinematic reliability (which is the probability of the manipulator achieving a certain pose) to provide an overall probability of system success. The RPI was tested on a three degree-of-freedom planar example. While not suited for deterministic optimization, the RPI was used to test for statistical significance of the module configurations, allowing the designer to reduce the joint module design space by 70% and to select a statistically best link module combination. Future research recommendations for the RPI are also made.

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**Abstracts of approved Ph.D theses in the area of robotics and automation should be submitted by the advisors to the editor for publication in the Newsletter.*

Conference Reports

IEEE/Nagoya University WWW on Multiple/ Distributed Robotic Systems

The IEEE/Nagoya University WWW* on Multiple/Distributed Robotic Systems was held at Nagoya University Symposion, Nagoya, Japan on July 30 and 31, 1993. This workshop was the first one cosponsored by the Nagoya University and the IEEE (Robotics and Automation Society, Industrial Electronics Society and Neural Network Council).

The aim of the workshop was to create opportunities to exchange information and ideas on various aspects of the Multiple/Distributed Intelligent Robotic Systems and to stimulate and inspire pioneering works in this area. The area has not been well established as a discipline yet, in spite of a great deal of demand for the multiple/distributed robotic systems, including their industrial applications such as the IMS (Intelligent Manufacturing System).

In this workshop, we limited the number of attendees to forty and tried to keep the size small because a small workshop is very good for intensive discussions in a specific area.

The workshop started with opening addresses from Professor Nobuo Kato, the Chancellor of the Nagoya University, Professor T.J.Tarn, the President of the Robotics and Automation Society and Professor Toshio Fukuda, the Vice President of the Industrial Electronics Society. Nineteen technical presentations, covered many issues relating to the architecture and control of multiple/distributed robotic systems in the following areas:

(i) Coordinated Motion Control of Robot Manipulators
(ii) Coordinated Motion Control of Mobile Manipulators
(iii) Hyper Redundant Robots
(iv) Cellular/Modular Robotic Systems
(v) Multiple/Distributed Autonomous Robot

Multiple robotic systems and distributed robotic systems are usually discussed independently, although both have a similar basis from a robotics point of view. This workshop was the first one in which both topics were discussed together so as to bridge the gap between them.

The success of this workshop would not have been possible without each participant's contributions and continuous encouragement by Prof. T.J.Tarn and Prof. T. Fukuda.

Kazuhiro Kosuge
Nagoya University
General Chairman

* WWW is an abbreviation of the World Wisemen Workshop and a direct translation of "Sekai Kenjin Kaigi" in Japanese; "Sekai" means world, "Kenjin" means wisemen and "Kaigi" means a meeting or a workshop. "Sekai Kenjin Kaigi" has a good meaning in Japanese. The use of WWW was suggested by Professor Toshio Fukuda.

IROS'93

IROS'93 was held in Yokohama from 26th to 30th of July 1993. There were 411 participants from 20 nations, including Japan, U.S.A., Korea, Canada, France, Germany, Italy, P. R. China, UK, Australia, and Finland.

The main theme of the conference was "Yawarakana Robot" in Japanese or "Flexibility for Intelligence" in English. The Japanese word "Yawarakana" can have variety of meanings ranging from flexible to even dextrous, smart, versatile, robust.

The sessions were classified as follows taking account of "Yawarakana Robot"; dexterous manipulation, robust sensing, versatile intelligence, novel robotics, adaptive locomotion, multi-agent systems, application frontiers and intelligent motion control. There were 67 sessions including 26 organized sessions. More than 300 papers were presented under 8 parallel sessions. There were keen and fruitful discussions in each room. There were a remarkable number of papers concerning multi-robot and teleoperation robots. Dynamic robot vision also attracted keen attention.

Prof. Marvin Minsky of MIT presented the plenary address, "Autonomy and Emotion Machines." The keynote speaker was by Dr. Yasuo Nakajima of Nissan Motor Company who spoke on "Present status and future potential of human-friendly Robots in the Automotive Industry."

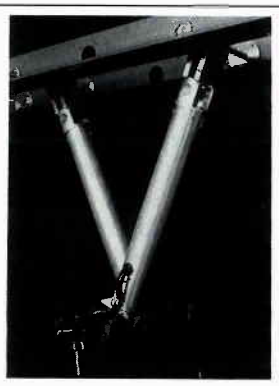
Since the conference site was located in the newly developed area of Yokohama harbor, participants could enjoy open space and open discussions of 30 minutes.

Finally as Program Committee Cochair of the conference, I would like to express my great thanks to all the people who made contribution to the conference as participants, speakers of sessions and tutorial sessions, key note speaker, members of program committee and organizing committee.

Tomomasa Saito
University of Tokyo
Program Committee Cochair

Correction

The photograph of the Saito/Fukuda "Brachiation Robot" in the summer issue of the newsletter was upside down.The picture shows a pending state holding parallel bars with both arms. The robot achieves locomotion by releasing one arm, rotating and approaching the next bar.



Call for Papers

Special Issue on Mobile Robots

IEEE Robotics and Automation Society Magazine

This special issue focuses on the recent progress of research and development of mobile robots. The emphasis will be on creative approaches to applying mature theories and technologies of mobile robots to manufacturing and service industries, defense, and space exploration. The goal is to provide current state-of-the-art mobile robot applications to the society members and to stimulate the research and development activities in this important area. A technology assessment of the field in terms of its feasibility in practical implementation and applications is an important motivation of this special issue. The special issue will place emphasis on but not be limited to the following topics:

a. Autonomous mobile robot navigation.
b. Collision-free path planning for mobile robots.
c. Multi-sensor integration for environment understanding.
d. Legged robots negotiating difficult terrain.
e. Mobile robot dynamics, kinematics and control.
f. Coordination of manipulability and mobility.
g. Neural network applications to mobile robots.

Submission of examples of innovative and successful implementation and experimentation of mobile robots are especially encouraged.

Important Dates

March 31, 1994:	Deadline for paper submission.
July 31, 1994:	Complete the first review cycle of all the papers and make the preliminary selection
October 31, 1994:	Complete the final review cycle of the selected papers and make the final selection.
November 30, 1994:	Final review and acceptance by Editorial Board.
December 31, 1994:	Publication of the Special Issue (the fourth issue of the magazine in 1994).

Special Issue Editors

Yuan F. Zheng
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Philadelphia, PA 19104
(215) 898-6783 (Phone)
(215) 898-0587 (FAX)
yun@central.cis.upenn.edu

Instructions for Manuscripts

Five copies of each manuscript should be submitted to the Editor of the IEEE Robotics and Automation Society Magazine (not to the Special Issue Editors). Both the manuscripts and transmittal letters should be clearly marked to indicate that they are being submitted for consideration for this special issue. They will be logged and sent to the Special Issue Editors for review. Both regular and short papers will be considered. Papers must not have been published previously or submitted for publication elsewhere. (Please review the *Information for Authors for the IEEE RAS Magazine* provided in this issue of the newsletter.)

IEEE

9th IEEE International Symposium on Intelligent Control

CSS

August 16-18, 1994
Holiday Inn, Crown Plaza
Columbus, Ohio, USA

Sponsored by the IEEE Control Systems Society

General Chair: Ümit Özgüner, The Ohio State University
Program Chairs: Michael B. Leahy, Jr., U.S. Air Force and Levent Acar, University of Missouri, Rolla

Papers are being solicited for presentation at the Symposium and for publication in the Symposium Proceedings. Topics of interest include, but are not limited to:

- Architectures for intelligent control
- Hierarchical intelligent control
- Distributed intelligent systems
- Modeling intelligent systems
- Mathematical analysis of intelligent systems
- Discrete event systems
- Hybrid systems
- Design techniques for intelligent controllers
- Knowledge-based and expert systems
- Planning systems
- Fuzzy systems / fuzzy control
- Machine learning / adaptive systems
- Neural networks / neural control
- Reconfigurable control
- Multisensor fusion / integration
- Failure detection and identification
- Applications / Implementations
  - Robotics
  - Manufacturing systems
  - Automotive systems / IVHS
  - Aircraft / spacecraft
  - Underwater / land vehicles
  - Process control
  - Consumer products

Submissions:

Papers: Five copies of the paper (including an abstract) should be sent by **March 1, 1994** to:

Major Michael B. Leahy, Jr.
SA-ALC/TIEST, Bldg. 183
450 Quentin Roosevelt Rd.
Kelly AFB, TX 78241-6416
Phone: (210) 925-3711
Fax: (210) 925-4916
Email: mleahy@sadis05.kelly.af.mil

or

Prof. Levent Acar
Robot Systems Division
Building 220, Room B124
National Institute of Standards and Technology
Gaithersburg, MD 20899

Clearly indicate who will serve as the corresponding author and include a telephone number, fax number, email address, and full mailing address. Authors will be notified of acceptance by **April 18, 1994**. Accepted papers, in final camera ready form (maximum of 6 pages in the proceedings), will be due **May 13, 1994**.

Invited Sessions: Proposals for invited sessions are being solicited and are due **March 1, 1994.** The session organizers should contact one of the Program Chairs by **February 18, 1994** to discuss their ideas and obtain information on the required invited session proposal format.

Workshops and Tutorials: Proposals for workshops and tutorials should be submitted by **March 15, 1994** to:

Ümit Özgüner, ISIC'93
Dept. Electrical Engineering
The Ohio State University
412 Drees Laboratory
2015 Neil Ave.
Columbus, OH 43210-1272, USA
Phone: (614) 292-5940
email: umit@ee.eng.ohio-state.edu

Please contact Ümit Özgüner by **March 1, 1994** to discuss the content and required format for the workshop or tutorial proposal.

Preliminary Call for Papers

IROS '94

IEEE/RSJ/GI International Conference

on

Intelligent Robots and Systems

- Advanced Robotic Systems and the Real World -

September 12-16, 1994 — München, Germany

Today our factories are equipped with standard robotic devices performing low-intelligence jobs, but the promise of 'intdligent robots' remains largdy unfulfilled. Even large robot manufacturers are fighting for survival and are reducing their research efforts. Also, some researchers are now realizing that their contributions have not always sufficiently addressed the problems of robots operating in the real world. Apparently, the highest-priority goal of the robotic community must now be to find a real break-through in autonomy, intelligence, and dexterity for the next generation robots. Therefore, the upcoming IROS '94 conference especially asks for those contributions that show advances in robot intelligence and deterity proven by experiments or applications in the real world.

Main Topics

- ntelligent Motion Control
- oordinated Control Architectures
- Learning Control, Fuzzy Control
- Neural Network Techniques
- Advanced Sensors and Actuators
- Active Sensing, Vision, Perception
- Multi-sensor Integration
- Sensor-based Task Planning / Execution
- Environmental Modeling
- Simulation and Virtual Reality
- Machine Learning
- Human Robot Interface and Interaction
- Telerobotics
- Shared Autonomy
- Dexterous Manipulation
- Adaptive Locomotion
- Autonomous Robotic Systems
- Multi Robot Systems
- Micro Systems and Robots
- Robots in the Factory
- Robotics in Unstructured Environments
- New Robotic Applications
  (Space, Under Water, Construction, Service Industry, Medicine etc.)

Sponsors

- IEEE Industrial Electronics Society
- IEEE Robotics and Automation Society
- Robotics Society of Japan
- Soc. of Instrumentation and Control Engineers
- New Technology Foundation
- Universität der Bundeswehr München
- Gesellschaft fur Informatik
- VDI/VDE-GMA

Deadlines

Submission of proposals for organized sessions:	Dec 01, 1993
Submission of papers	Jan 15, 1994
Acceptance notification	Mar 20, 1994
Submission of final camera-ready paper	Jun 01, 1994
Final acceptance notification	Jun 15, 1994

onference Organization

Advisory Council

Honorary Chair:Fumio Harashima	University of Tokyo
Chair:Toshio Fukuda	University of Nagoya
Vice Chair:Shinichi Yuta	University of Tsukuba
General Chair:Volker Graefe	Universitat der Bundeswehr München

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Gerhard Hirzinger	DLR Oberpfaffenhofen
Gunther Schmidt	Technische Universität München

Regional Program Co-Chairs:

America: Avi Kak (	Purdue University
Asia: Shinichi Yuta	University of Tsukuba

Autumn is an excellents reason for visiting Bavaria and Munchen. A program of sightseeing andof cultural events is planned, especially for accompanying persons. The conference will end on the day before the opening of the famous annual beer festival ***Octoberfest***

Addresses:

IROS '94 Secretariat
München
85577 Neubiberg
Germany
Fax: (+49 89) 6004 3074

Regional Prog. Chair, America
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Purdue University
Electrical Engineering
West Lafayette
IN 47907 USA
FAX: (+1 317)494-6440

Regional Prog. Chair, Asia
Prof. Shinichi Yuta
University of Tsukuba
Institute of Information Science and Electronics
Tsukuba 305 JAPAN
FAX (+81 298) 53 5206

Papers from America and from Asia should be sent to the respective Regional Program Co-Chairs; papers from all other areas as well as requesrts for additional information, should be sent to the IROS' 94 Secretariat.

MFI'94

IEEE

CALL FOR PAPERS

IEEE International Conference on

Multisensor Fusion and Integration for Intelligent Systems

October 2 – 5, 1994 Las Vegas, Nevada, USA

Sponsored by: IEEE Industrial Electronics Society
Society of Instrumentation and Control Engineers (SICE)
IEEE Robotics and Automation Society
Robotics Society of Japan
New Technology Foundation, Japan

MFI'94 is an IEEE sponsored conference devoted entirely to multisensor fusion and integration. The use of multiple sources of sensory information can increase the reliability and extend the capabilities of intelligent systems, and is currently an active area of both theoretical and applied research.

General Chair:	Ren C. Luo, North Carolina State University
Program Co-Chairs:	Masatoshi Ishikawa, University of Tokyo Michael G. Kay, North Carolina State University
Organizing Committee Co-Chairs:	H. Yamasaki, Yokogawa Electric Corp. Paul Schenker, Jet Propulsion Laboratory
Advisory Committee Chair:	Fumio Harashima, University of Tokyo
Local Arrangements Chair:	Jing Wang, University of California–Riverside

TOPICS Papers with new research results are encouraged for submission. Topics of interest include but are not limited to:

- Algorithms for Sensor Fusion and Integration
  - Algorithms for signal-, pixel-, feature-, symbol-, and decision-level fusion
  - Representation of uncertainty
  - World model representations
  - Signal processing and probabilistic methods
  - AI, neural networks, and fuzzy logic
  - Knowledge engineering and databases
- Sensing Architectures
  - Active, behavior-based, and task-directed sensing
  - Sensorimotor integration
  - Sensing system evaluation and performance modeling
  - Placement, registration, and selection of sensors
  - Hierarchical architectures
  - Control of multisensor systems
  - Fusion of active and passive sensors
- Implementation
  - Parallel and distributed processing
  - Network architectures
  - Real-time processing
  - Distributed multisensor systems
  - Microsensors and integrated sensors
  - Modularization and standardization
  - Software architectures
- Applications
  - Target detection, tracking, and recognition
  - Mobile robot navigation
  - Fusion-based manipulation
  - Inspection and automation
  - Virtual reality and human interfaces
  - Spatial understanding
- Other related multisensor fusion and integration topics

PAPER SUBMISSION Papers are limited to 25 double-spaced pages. Each paper should be complete with illustrations. Upon acceptance, authors will be requested to prepare a camera-ready manuscript in IEEE format (limited to 8 pages).

DEADLINES

Paper submission due: (**four copies** of each complete paper to Program Co-Chair for peer review)	**March 10, 1994**
Acceptance notification:	**May 20, 1994**
Final camera-ready manuscript due:	**July 15, 1994**

Submit papers to either of the following Program Co-Chairs:

Masatoshi Ishikawa, Program Co-Chair
Dept. of Mathematical Eng. and Information Physics
Faculty of Engineering
University of Tokyo
Bunkyo-ku, Tokyo 113, Japan
Phone: 81-3-3812-2111 ext. 6901
Fax: 81-3-5800-6969
E-mail: ishikawa@k2.t.u-tokyo.ac.jp

Michael G. Kay, Program Co-Chair
Department of Industrial Engineering
Box 7906
North Carolina State University
Raleigh, NC 27606, USA
Phone: 919-515-2008
Fax: 919-515–5281
E-mail: kay@eos.ncsu.edu

ETFA'94

Seiken/IEEE Symposium on Emerging Technologies & Factory Automation
-Novel Disciplines for the Next Century-

November 6 - 10, 1994, Tokyo, Japan

First Announcement and Call for Papers

Sponsored by:
Institute of Industrial Science (Seiken), The University of Tokyo
IEEE Industrial Electronics Society (tentative)

Co-operation requested with:
IEEE Neural Nets Council
The Society of Instrument & Control Engineers of Japan (SICE)

This is the third ETFA conference which focuses on applications of the newly emerging areas of technology to factory automation. This time the Symposium will be held at The University of Tokyo, sponsored by the Institute of Industrial Science (IIS). IIS, headed by Professor Fumio Harashima, is a research institute employing more then a hundred full and associate professors and scientists, who are involved in research conducted in more than 20 specialist laboratories. The work conducted by the Institute Staff is at the leading edge of the newly emerging areas of technology. This Symposium will allow participants to get acquainted with current technological developments and future trends. It will also provide an opportunity to visit laboratories of the Institute of Industrial Science, and to meet the Institute Staff.

Scope:
Prospective authors are invited to submit papers which address the technical issues, as well as the impact of new technologies on future developments in the areas of factory automation. Some of the technologies of special interest are:

- Micromachines: materials, fabrication, design & support tools, devices and systems
- Intelligent Manufacturing Systems (IMS)
- Autonomous Distributed Systems (ADS)
- Neural Networks and Fuzzy Systems
- Genetic Algorithms
- Knowledge Acquisition & Expert Systems
- Symbolic Reasoning
- Petri Nets & Other Modelling Techniques
- Chaos
- Factory Communication Systems & Protocols
- Sensor-Based intelligent Interfaces

Submission of papers:
Submitted papers should be printed, using 12 point font, in a single column format. Papers are limited to twenty A4, single-spaced, printed pages. Submissions should be formatted as follows: First page: title, authors, mailing address of each author, telephone and fax numbers, e-mail addresses. Second page: title authors, 100 word abstract. Third and succeeding pages: title, full paper. Submit four copies of each, in English, to:

Hiroyuki Fujita
Institute of Industrial Science, The University of Tokyo
7-22-1 Roppongi, Minato-ku, Tokyo 106, Japan
Phone +81 3 3408 1493, Fax +81 3 3402 5078
E-mail: fujita@fujita3.iis.u-tokyo.ac.jp

Author's schedule:

- Deadline for submission of full papers: June 1, 1994;
- Notification of Acceptance: August 1, 1994;
- Deadline for submission of final manuscripts: Sept. 5, 1994

Further Information:
Please contact either:

Hiroyuki Fujita
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The University of Tokyo
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Richard Zurawski
Laboratory for Robotics & Intelligent Systems
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Swinburne University of Technology
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Phone + 61 3 728 71 61; Fax + 61 3 728 71 83
E-mail: rzz@stan.xx.swin.oz.au

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M. Zhou
New Jersey Inst. of Tech.

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R.C. Luo
North Carolina State Univ.

Symbolic Reasoning
I. Bratko
University of Lubljana

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International Symposium on Evolutionary Computation

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Meeting Management
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For more information contact
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Steven Shafer to Head CMU PhD Program in Robotics

PITTSBURGH--Steven A. Shafer, associate professor of computer science at Carnegie Mellon University, has been named chairman of the university's doctoral program in robotics. He had been associate director since the program's inception in 1989, and was instrumental in formulating its curriculum.

The robotics doctoral program, believed to be the first of its kind in the world, is a four-to-five-year course of study intended to educate a new generation of leading robotic scientists and engineers familiar with all aspects of robotics and experienced in integrating them. The curriculum includes such basic technologies as perception, cognition and manipulation, as well as integrated robot systems for manufacturing automation, and autonomous mobile robots. Today, 60 students are enrolled in the program and six have graduated.

Shafer designed and built the Robotics Institute's Calibrated Imaging Laboratory, which has become one of the world's centers of controlled experimentation for machine vision research. In this laboratory, Shafer and his students analyze such visual phenomena as color, gloss, texture and shadows. They are developing methods to base computer vision on an understanding of physics rather than the current ad hoc statistical and pattern classification techniques. Shafer's research has played a key role in developing the vision capabilities of the Navlabs, Carnegie Mellon's vehicles that drive themselves autonomously.

Software Positions Available
Adept Technology, Inc.

Adept is seeking software professionals to work on design and development of industrial robotics systems. Will join small software group in S. California.

Jobs include developing task-level programming systems, computer languages, networks, user interfaces, kinematic models, and trajectory generators.

Must have M.S. or Ph.D. in Engineering or Computer Science. Experience or course work in robotics, real-time programming. Both hi-level and assembly language. Excellent programmers only.

Start immediately or no later than early 1994. Send resume or email to:

Clifford C. Geschke, Ph.D.
Adept Technology Inc.
17800 Castleton Street, Suite 175
City of Industry, CA 91748
(cliff@la.adept.com)
Or call Karen Iverson at
(408)434-5023

Missing Out?

If you are not receiving the Newsletter or Transactions, you may contact IEEE Membership Services by email: membership.services@ieee.org; by phone 1-800-678-IEEE (U.S. only); or FAX 908-463-3657l.

A few of you may have received copies of the August Newsletter with several blank pages. No, we didn't get lazy with the heat of summer in Texas and Carolina—a few of the prepress copies escaped from the printer to the mail room. If you will contact Roz Snyder, she will make sure you receive complete copy.

Calls for Papers

Note: Fax and email submissions of papers are usually (but not always) not acceptable. Please contact the Program Chair for specific details regarding paper preparation and deadlines before submitting papers.

- **Japan-USA Symposium on Flexible Automation.** July 11-13, 1994. Kobe, Japan. Submissions: Send 4 copies of complete paper w/ 150 word abstract (for long papers) or a 800 word summary (for short papers) by November 30, 1993 to Prof. Tsuneo Yoshikawa, c/o Institute of Systems, Control and Information Engineers, Kinki-chiho Hatsumei Center, Yoshida-Kawahara-Cho 14, Sakyo-ku, Kyoto 606, Japan (all countries except US and Canada) or Prof. David E. Hardt, Dept. of Mechanical Engineering, MIT, Room 35-234, Cambridge, MA 02139 USA (US and Canada).

- **1994 Int'l Conference on Data and Knowledge Systems for Manufacturing and Engineering.** May 2-4 1994. Shatin, Hong Kong. Submissions: 4 copies of full (<5000wds) papers by December 3 to: (Asia/Australia) Prof. Nelson Chen, Dept of Industrial & Manufacturing Systems Engineering, The University of Hong Kong, Pokfulam Road, Hong Kong. (America/Europe/Africa): Prof. Sudha Ram, Dept. of Management Information Systems, University of Arizona, Tucson AZ 85721 USA

- **"Intelligent Simulation for Robotics and Manufacturing Systems,"** Special issue of *The International Journal in Computer Simulation* (Ablex Publishing Corporation). Submit 5 copies of full manuscript by December 10, 1993 to Guest Editor: Dr. Albert Y. Zomaya, Department of Electrical and Electronic Engineering, University of Western Australia, Nedlands, Western Australia 6009, Tel. (+619) 380-3875, Fax. (+619) 380-1065, e.mail: zomaya@ee.uwa.edu.au.

- **ASCC: 1st Asian Control Conference. July 27-30, 1994.** Tokyo. Sponsors: ASCC, SICE, ISCIE. Submissions: Extended summary (1000 wds) by December 15, 1993 to Prof. Kenko Uchida, Dept. of Electrical Engineering, Waseda University, 3-4-1 Okubo, Shinjuku, 169 Tokyo, Japan. Tel (+81)3-3203-4141 ext 733153. Fax: (+81)3-5273-9507 email: kuchida@cfi.waseda.ac.jp.

- **CBMS'94: 7th IEEE Symposium on Computer-Based Medical Systems.** June 10-12, 1994. Winston-Salem, NC. Submissions: 4 copies of 2-page abstract by December 1, 1993 to Nassrin Tavakoli, Info Enterprises, 3260 N. Colorado St., Chandler AZ 85225-1123 or Paul Kiazkevich, Research Triangle Institute, PO Box 12194, Research Triangle Park NC 27709.

- **IEEE Int'l Conference on Systems, Man and Cybernetics.** October 2-5, 1994. San Antonio Texas. Submissions: 2-3 page abstracts by February 15, 1994 to: Prof. Charles Malmborg, Decision Sciences and Engineering Systems Dept., Rensselaer Polytechnic Institute, Troy NY 12180-3590; Tel: 518-276-2935; FAX: 518-276-8227;
email: usergp7v@mts.rpi.edu.
Send proposals for workshops and invited sessions to Prof Frank DiCesare, Dept. of ECSE, RPI, Tel: 518-276-6440; FAX: 518-276-6261; email: dicesare@ecse.rpi.edu.

- **WCCI: IEEE World Conference on Computational Intelligence.** June 26-July 2, 1994. Orlando FL. **See Announcement.**

- **DARS'94: Distributed Autonomous Robotics Systems.** July 18-19, 1994. Saitama, Japan. *Submissions:* Abstract by February 28, 1994 to Dr. Hajime Asama, Chemical Engineering Lab, Institute of Physical and Chemical Research (RIKEN), Hirosawa 2-1, Wako-shi, Saitama 351-01 Japan. Tel (+81)48-462-1111 ext. 3144 Fax (+81)48-46204658. email: asama@cel.riken.go.jp.

- **IROS '94: IEEE/RSJ/GI Int'l Conf. on Intelligent Robots and Systems. Theme: Advanced Robotics Systems and the Real World. SEE ANNOUNCEMENT**

- **SYROCO'94: 4th IFAC Symposium on Robot Control.** September 19-21, 1994. Capri ITALY. *Submissions:* 5 copies of full paper by *December 15, 1993* to Prof. Salvatore Nicosia, Dipartimento di Ingegneria Elettron-

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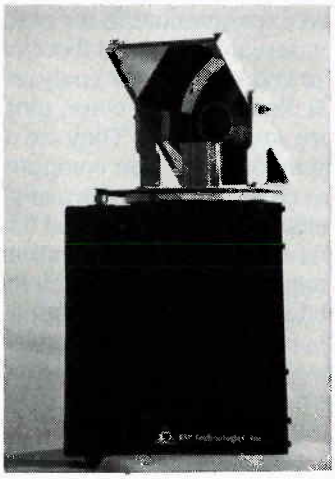

The **ORS-1** is an eyesafe, infrared optical rangefinder specifically designed for mobile robots.

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Now you can transform your workstation and an ordinary video camera into a 3-D imaging workstation for under $10,000. The K²T GRF-1 is a high-performance gray-code structured light rangefinder which uses a light source and an LCD shutter to project a sequence of gray-coded patterns onto a scene. An ordinary video camera captures the reflected images, which are processed to produce a dense 3-D image.

The range images can be captured and manipulated by using our X-window-based interface or used directly by a subroutine of your program by including our C application library.

The GRF-1 is modular, so that any video camera, digitizer, or workstation is compatible. This allows the GRF-1 to be directly integrated into your own real-time system.

Because of its modularity, the GRF-1 can be configured into a system with multiple sets of light sources and cameras to provide the 360° viewing angles necessary to measure objects in their entirety.

Measurement time: 3 seconds
Range calculation time: 3 seconds
Output: a dense 3-D range image, typically 512 x 512 pixels
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ica, Università degli Studi di Roma "Tor Vergata", Via della Ricerca Scientifca, 00133 Roma Italy. email: syroco94@disna.dis.unina.it. FAX 39 81 7683186.

- **ICARCV'94: 3rd Int'l Conference on Automation, Robotics and Computer Vision.** November 8-11, 1994. Singapore. *Submissions*: 3 copies by April 30, 1994, to N. Sundararajan, c/o ICARCV Conference Secretariat, Institution of Engineers, Singapore, 70 Bukit Tinggi Road, Singapore 1128, Republic of Singapore. Tel: (65) 469 5000; Fax: (65)467 1108. Telex: RS 22992 IESI.

- **FUZZ-IEEE/IFES '95: 4th IEEE Int'l Conf. on Fuzzy Systems and 2nd Fuzzy Engineering Symp. March 20-24, 1995.** Yokohama, Japan. Submissions: 4 copies of full (<10pp) papers by August 31, 1994 to Congress Secretariat, LIFE (Laboratory for Int'l Fuzzy System Research, Siber Hegner Bldg 4FL, 89-1 Yamashita-cho, Naka-ku, Yokkohama 231 Japan, Att: Ms. Mieko Hemmi.

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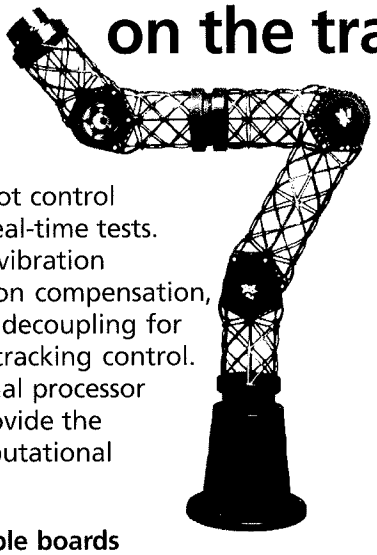

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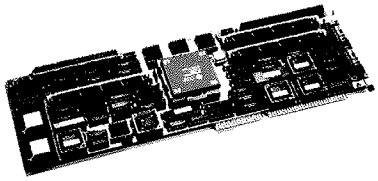

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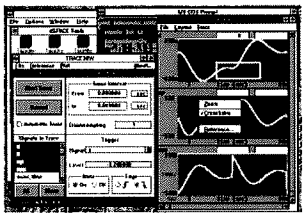

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Calendar

•**November 14-17, 1993. 1993 DND Workshop on Advanced Technologies in Knowledge Based Systems and Robotics.** Contact: Chief of Research and Development (CRAD), National Defence Headquarters, Constitution Bldg., 305 Rideau St., 7th Floor, Ottawa Ontario KIA 0K@ Canada. Att: Harold Merklinger. Tel: (613)996-0761. FAX (613)996-0038.

•**December 15-17, 1993 (CAMP'93) Computer Architectures for Machine Perception Workshop** Univ. of Maryland, College Park, MD 20742, USA. Contact Johanna Weinstein by email at: camp93@umiacs.emd.edu.

•**January 25-28, 1994 3rd Int'l Symposium on Automation, Robotics and Artificial Intelligence Applied to Analytical Chemistry and Laboratory Medicine.** San Diego. Contact: SCITEC, Suite 105, Barksdale Road, Newark DE 19711 USA. Tel: (302)737-3045; FAX: (619)239-4527.

•**January 25-28, 1994. 7th IEEE Int'l Workshop on Micro/Electro/Mechanical Systems. Tokyo.** *Sponsor:* IEEE Robotics and Automation Society. *Contact:* MESAGO Japan Corporation Palais Eternel 1004, 4-28-20 Yotsuya, Shinjuku-ku Tokyo 160 Japan. Tel: 03-3359-0894; FAX 03-3359-9328.

IEEE Robotics & Automation Magazine "Newsletter" Deadline December 1, 1993

The new IEEE Robotics & Automation Magazine will include the calendar announcements, news items, professional activities, conference reports and other information contained in the Newsletter. Please send newsletter items to the Managing Editor, Rosalyn Snyder, Technical articles should be submitted to the Editor, Dr. Michael Leahy, Jr. (Addresses on front cover)

Please refer to the "Information for Authors" on page 13 before submitting papers for review.

•**February 2-4, 1994 MATH MOD Vienna: Int'l IMACS Symposium on Mathematical Modelling.** Vienna, Austria. Contact: Prof. Dr. Inge Troch, Technische Universitaet Wien, Wiedner Hauptstrasse 8-10, A-1040 Wien, Austria.

•**February 7-10, 1994, Int'l Symposium on Defense Industrial Robotics and Automation.** Albuquerque NM. Sponsors: U.S. Dept. of Energy, NASA, U.S. Army, AFMC Robotics and Automation Center of Excellence and The Robotics Institute, CMU. Contact: American Defense Preparedness Association ATTN: Fred Raines, Robotics and Automation Symposium, 2101 Wilson Boulevard, Suite 400, Arlington, VA 22201-3061, (703) 522-1820

•**February 24-25, 1994 EP'94, The Third Annual Conference on Evolutionary Programming, San Diego, CA,** Sponsored by the Evolutionary Programming Society, in cooperation with the IEEE Neural Networks Council. Contact: Technical Program Chairman, Dr. Lawrence J. Fogel, ORINCON Corporation, 9363 Towne Centre Dr., San Diego, CA 92121.

•**March 20-23, 1994. 3rd Int'l Workshop on Advanced Motion Control.** Berkeley CA. Contact: Prof. H. Kazerooni, Dept Mechanical Engineering, Univ. of Cal., Berkeley CA. 94720 USA. Tel: (510) 642-2964. Fax: (510)643-5599. email: kazeroon@euler.berkeley.edu.

•**March 21-24, 1994. CIRFFSS'94: AIAA/NASA Conf. on Intelligent Robots in Field, Factory, Service and Space.** Houston TX. Contact: Dr. Jon D. Erickson, Lyndon B. Johnson Space Center (NASA), 2101 NASA Road 1, Houston TX 77058. Tel: (713)483-7580; Fax: (713)483-7480. email: erickson@aio.jsc.nasa.gov

•**April 25-26, 1994. Conference on Computer Integrated Manufacturing in the Process Industries (CIMPRO' 94).** New Brunswick, New Jersey. Sponsors: National Science Foundation and Defense Logistics Agency. Host Institution: Rutgers, the State University of New Jersey. *Contact:* T.O. Boucher, Industrial Engineering, Rutgers University, P.O. Box 909, Piscataway, NJ 08855, or Frank DiCesare, Electrical, Computer, and Systems Engineering Department, Rensselaer Polytechnic Institute, Troy, NY 12180 Department of Industrial Engineering at Rutgers University: Tel. (908) 932-3654, email: cimpro@princess.rutgers.edu.

•**May 2-4 1994. 1994 Int'l Conference on Data and Knowledge Systems for Manufacturing and Engineering.** Shatin, Hong Kong. *See Calls for Papers*

•**May 8-13, 1994. IEEE Int'l Conference on Robotics and Automation** San Diego. See Announcement

•**July 18-19, 1994. DARS'94: Distributed Autonomous Robotics Systems.** Riken, Saitama, Japan. *See Calls for Papers*

•**July 27-30, 1994. ASCC: 1st Asian Control Conference.** Tokyo. *See Calls for Papers*

•**September 7-14, 1994 Manufacturing '94 Conference. Chicago.** *Sponsor:* Society for Manufacturing Engineers in coop. w/ Association for Manufacturing Technology's IMTS'94 exposition. *Contact:* SME, PO Box 930, Dearborn, MI 48121. Tel (313) 271 1500. FAX (323) 271 2861.

•**September 12-16 1994. IROS '94: IEEE/RSJ/GI Int'l Conf. on Intelligent Robots and Systems.** Munich. *See Announcement*

•**September 19-21 1994 SYROCO'94: IFAC Symposium on Robot Control.** *See Calls for Papers*

•**November 8-11, 1994. ICAR'94: 3rd Int'l Conference on Automation, Robotics and Computer Vision.** *See Calls for Papers*

•**March 20-24, 1995. FUZZ-IEEE/IFES '95: 4th IEEE Int'l Conf. on Fuzzy Systems and 2nd Fuzzy Engineering Symp.** Yokohama, Japan. *See Calls for Papers.*

The IEEE *Robotics and Automation* Society Magazine

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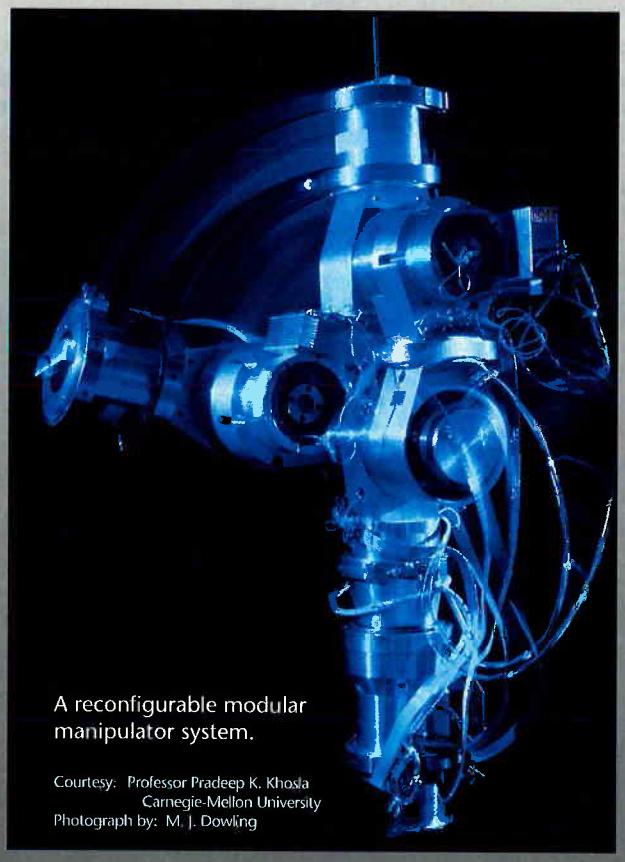

A reconfigurable modular manipulator system.

Courtesy: Professor Pradeep K. Khosla
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May 8-13, 1994
Princess Resort
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ADVANCE ANNOUNCEMENT

The theme of the 1994 Conference is **"Robotics and Automation in the Service of Humankind"**. This year, the Conference celebrates its 11th anniversary. Major scientific and engineering accomplishments have been reported over the last decade. As the field matures, the research community is now looking into the future with a renewed sense of purpose, entrepreneurship, and dedication to the enhancement of the quality of life. Intelligent robotic systems are being developed by the rapidly emerging service robotics industry. Applications of advanced automation technology are having an increasing impact on productivity and quality control in many manufacturing sectors, and have become a key competitive factor in the global economy. The 1994 Conference will bring together researchers and practitioners to present the latest accomplishments, and explore future directions. Special emphasis will be placed on **applications and industrial case studies** to help identify new "pulling forces" for research in the 21st century. Technical papers presented on Tuesday, Wednesday, and Thursday, May 10–12, will appear in the bound proceedings. Topics include but are not limited to:

- Robot sensing and sensor data fusion
- Reasoning and planning
- Multirobot coordination
- Dexterous and redundant manipulation
- Robot dynamics and control
- Telerobotics and shared control
- Autonomous systems
- Micro electromechanical and micro robotic systems
- Advanced actuators
- Mechatronic design issues
- Distributed intelligence and self-organizing systems
- Robot systems in unstructured and hazardous environments
- Virtual reality and environments
- Industrial inspection
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- Computer integrated manufacturing
- Scheduling and control of manufacturing systems
- Modeling and performance evaluation of discrete event systems
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TUTORIALS AND WORKSHOPS:
Half day and full day tutorials and workshops will be held on Sunday, May 8; Monday, May 9; and Friday, May 13, 1994.

EXHIBITS:
There will be exhibits of state-of-the-art hardware and software products at the conference. Reservations for space and further information may be obtained from:

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Richard Klafter

Continued from page 12

Another concern of Klafter's is the perception in industry, particularly in the U.S., that the Society is being "strictly theoretical and academic."

"There are interesting and important problems which industry can bring to researchers. But it is difficult to attract these so-called applications papers to our conferences. There seems to be in industry something of a distrust of the Society. They don't think our work is relevant to them, but this is not the case. Just look at the videotapes."

Like many others, Klafter sees that the review process is "predisposed not to accept" papers which rather than presenting new theory, focus on the interesting and important problems associated with implementing theory into working robots or systems in a real environment"

"To turn up your nose at anything practical is shortsighted," he emphasized.

Klafter would like to see the Society continue its efforts to bridge the gap between academia and industry. One way might be to coordinate ICRA with an exposition sponsored by RIA, the major U.S. industrial robotics trade organization.

At the same time, Klafter is proud that the RA Society is known for publishing the best of the theoretical research being done worldwide.

Richard Klafter obtained his Ph.D at the City University of New York in 1968. His original research was in the area of optimal control. He is currently professor of electrical engineering at Temple University, where he has been since 1984. Prior to coming to Temple he was at Drexel University for 17 years. He has also consulted for U.S. Robotics. His textbook, *Robotic Engineering: An Integrated Approach* was published in 1989.

He and his wife Marcia have two daughters and one granddaughter, of whom his wife says Dick has made approximately 9,000 photographs. Dick is also a singer, a baritone with the Choral Arts Society of Philadelphia, a professional choral group.

ICRA-San Diego Exhibits

Suppliers of robotics and automation equipment or software, book publishers, service companies,and other vendors are invited to participate in the 1994 IEEE International Conference on Robotics and Automation to be held at the Princess Resort in San Diego California.

Each booth is 8'x10' and the rental fee for the booth is only $750 (unchanged from previous years). This is a bargain for a major technical conference!

Over 800 attendees, including substantial representation from Europe, Asia, and the Pacific, are expected at ICRA94..

Dates for the exhibition portion of the conference are May 9-12, 1994. For more information or to reserve a booth, contact the exhibits chair:

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