

IEEE Robotics and Automation Society announces a new Publication:

## **The IEEE Transactions on Automation Science and Engineering (*T-ASE*)**

February 2003: First Issue to appear in mid 2004.

### **Executive Summary**

Automation plays an increasingly important role in the global economy and in our daily lives. Engineers strive to combine automated devices with mathematical and organizational tools to create complex systems for a rapidly expanding range of applications and human activities. To meet these challenges, we will establish a major archival journal on *Automation Science and Engineering* to publish the abstractions, algorithms, theory, methodologies, models, systems, and case studies that can be applied across industries to significantly advance efficiency, quality, productivity, and reliability for society.

Automation is central to the IEEE Robotics and Automation Society (RAS) Field of Interest and are of keen interest to our members. Although Robotics and Automation are closely related, there are significant and important differences. Robotics research emphasizes intelligent machines and systems for unstructured environments where a significant portion of the environment is either not known or cannot be directly sensed, and often cannot be controlled. Research in Automation is directed toward scientific methods and technology that improve efficiency, productivity, quality, and reliability, specifically for machines and systems operating in structured environments over long periods, and the explicit structuring of environments.

Discussions with leading automation researchers (both within and outside of IEEE) and a detailed analysis of competing journals reveals that what is needed is a major archival journal devoted to Automation.

**In February 2003, the IEEE approved our proposal to expand the *IEEE Transactions on Robotics and Automation (T-RA)*, into two publications: the *IEEE Transactions on Robotics (T-RO)* and the *IEEE Transactions on Automation Science and Engineering (T-ASE)*. Our goal is to establish *T-ASE* as the top cited periodical devoted to Automation, building its reputation on our long-standing tradition of peer review of the highest caliber.**

Ongoing and fruitful cross-fertilization between these closely allied areas will motivate most of the current members of IEEE RAS to subscribe to both publications. A flagship journal devoted to Automation will also attract many non-IEEE researchers and subscribers from industry and academia. *T-ASE* will emphasize high-quality and significant results, publishing rigorous and visionary papers that explore a range of analytic methodologies relevant to a broad scope of applications. By inviting leading researchers in the field to submit exemplary work to the initial issues, we can rapidly build *T-ASE* into a major archival journal, galvanizing the field of Automation and establishing a research community that will integrate and share knowledge across disciplines and industries.

A *T-ASE* Steering Committee composed of eighteen established researchers in Automation, including the current and past Editors-in-Chief of the *T-RA*, has been created to carry out the work of starting the publication. This Steering Committee will evolve into the initial Editorial Board. In addition, a *T-ASE* Advisory Board has been created to promote the new publication and secure outstanding papers, with a highly prestigious list of non-IEEE Automation researchers on board. Two other IEEE Societies, Industrial Applications (IAS) and Systems Man and Cybernetics (SMC), will become technical co-sponsors.

Initiating a new journal is a major milestone for a research society. It requires years of planning, input from hundreds of members, and approval from the IEEE. The sponsoring Society of a new IEEE journal must confirm its commitment by providing the first three years of funding. After

years of grassroots effort, the RAS AdCom, Officers, Publications Activities Board, and *T-RA* Editorial Board voted unanimously in May 2002 to endorse this proposal. In February 2003, the IEEE approved the proposal. The consensus is that this is a timely and important investment in the future of both the RAS and the IEEE.

## **Background**

Under the leadership of its Editors and the dedication of its Editorial Boards, the *T-RA* has grown into a major archival journal. Its size and impact have grown steadily over its 18 years of publication. It covers two growing related areas, Robotics and Automation. *T-RA* is the top-cited periodical in Robotics – with impact factor regularly the highest of any journal in robotics and a half-life that is among the highest in the field. However, perhaps due to its historical emphasis on Robotics, *T-RA* is considered less authoritative in Automation, and has far less impact there. Currently only 25% of its roughly 100 annual papers address Automation, and Automation has a much lower visibility than Robotics in the RAS.

As technology advances, Automation Science and Engineering is coming of age with new abstractions, new algorithmic approaches, new hardware, and new integrated systems. Since Automation is central to the IEEE RAS, relevant to an increasing range of applications and human activities, and of keen interest to our members, it is important to elevate the status of Automation in our Society. To address this situation, we propose to establish a new publication devoted to the important and growing area of Automation.

While there are many similarities between Robotics and Automation, there are also significant and important differences. The term “**Robot**,” from the Czech “*robota*” (worker), was coined in 1923. Although the term “*automata*” dates back to the 17<sup>th</sup> century (it was used by Descartes), the term “**Automation**” was first used by Ford Motor Co. in 1947. Both Robotics and Automation study interactions between computers and the physical world. Both subjects make use of techniques from computer science, electrical engineering, industrial engineering, mechanical engineering, operations research, and related fields such as computational geometry, mathematics, and biomechanics. Both subjects have large research communities, although the overlap between these communities is not as much as one might expect. Historically, “Robotics” often connotes anthropomorphic machines, while “Automation” often connotes manufacturing and system operations. Today, Robotics emphasizes intelligent machines and systems for *unstructured environments* where a significant portion of the environment is either unknown or cannot be directly sensed, and often cannot be controlled. In contrast, research in Automation is directed toward scientific methods and technology that improve efficiency, productivity, quality, and reliability for society, focusing on intelligent machines and systems operating in structured environments over long periods, and the explicit structuring of environments. Automation is concerned not only with automated devices, but also the mathematical, organizational, and systems integration tools that allow a complex system to function efficiently; and involves the creation, design, analysis, organization, and operation of entire systems and their environments.

Automation plays an increasingly important role in the global economy and in our daily lives. In addition to its roots in mass production, many new applications areas for Automation are emerging, such as Biotechnology and Health; Transportation, Security, and Maintenance; Service, Construction, and Retail; and Food Handling and Processing. Research in Automation also includes topics at the Enterprise/Operational level such as System Modeling, Analysis, Performance Evaluation; Production Planning, Scheduling, Coordination; Risk Management; and Supply Chain Management.

## **Rationale for Splitting Transactions on Robotics and Automation**

A separate publication focusing on Automation will clearly demonstrate the Robotics and Automation Society’s commitment to this vital and expanding research area. Why not just expand the existing *T-RA*? We have tried Special issues and Special sections on Automation,

and four such sections have either been published or are currently under review since 2001. But Automation experts view *T-RA* as a Robotics journal with a relatively minor readership among the Automation community, and it has been difficult to attract top quality original papers on Automation topics. The RAS has come to realize that what we need is not incremental steps. Rather, we need a major new initiative with full backing from RAS leadership and membership. Furthermore, leading automation researchers outside RAS also agree that expanding the existing *T-RA* will not solve the problem, and what is needed is a major archival journal devoted to Automation. *T-ASE*, with its new Editorial and Advisory Boards, will attract prestigious leaders and practitioners from the Automation community.

After an extensive review of the status quo and competing research publications (information can be found below), we confirmed that Automation lacks a flagship journal, and the need for an *IEEE Transactions on Automation Science and Engineering (T-ASE)* - devoted to high quality archival research in the fundamental theory and applications of Automation. We have an opportunity to establish the top cited periodical devoted to this area, emphasizing research of the highest quality and significance, following our long-standing tradition of peer review of the highest caliber. Aydan Erkman, Chair of our Membership Activities Board, noted: "We need to make people from the Automation community feel at home in RAS." A new journal will generate enthusiasm that will motivate leaders of the field to join IEEE, RAS, and our Editorial and Advisory Boards. This is a vital opportunity for the IEEE and the best way to accomplish the goals of our Society.

### **Responses from Leaders in Automation Research**

Most competing journals on Automation focus on manufacturing, often with a particular application (Electronics) or methodology (Controls). The new *T-ASE* will provide a central archive for high-quality research that applies multiple methodologies to a broad array of applications. Initial feedback suggests that the new Transactions would attract many researchers from outside IEEE and many new industrial members. Selected leaders in automation science and engineering were asked about the need for a flagship journal in automation. The responses were overwhelmingly positive. Sample excerpts:

*"As a long standing member of the Automation community (with a focus on manufacturing processes and systems, precision manufacturing, design-manufacturing automation, semiconductor manufacturing, etc.) I think you have hit upon a solid idea. The current journals do not really provide a suitable fit for a lot of innovative work in the Automation areas.... The result for a lot of us is a 'second choice' archival journal that is broad enough to publish the work but for which the readership is likely to be in other areas.... I also think that any IEEE journal that is successful only enhances the other field and close field journals."*

- David Dornfeld  
Will C. Hall Family Professor of Engineering, ME, UC Berkeley  
Past Editor-in-Chief of ASME Journal of Manufacturing

*"To date, the field of automation research has been defined rather narrowly. By offering T-ASE, a new journal devoted to automation science and engineering, the IEEE has an opportunity to provide a forum for research on a much broader set of automation related topics and to engage new members from the groups currently working on these topics. Design, construction, and operation of automated systems are complex tasks, requiring integration of knowledge and experience from many domains. By assembling the best work from these many domains, the new journal will contribute significantly to the integration of knowledge and consequently will support a stronger research community."*

- Warren Seering  
Weber-Shaughness Professor of ME  
MIT

*"I have been involved in Automation for 30 years and am now GM's Chief Scientist for Manufacturing. I fully support the proposal to establish the new Transactions on Automation"*

*Science and Engineering (T-ASE). Expanding the scope to create two Transactions will better serve both fields, I think it will be a much needed addition. As a technology user, I am personally most interested in the visionary and application oriented papers but I also recognize the importance of basic research contributions as well."*

- Steve Holland, Chief Scientist for Manufacturing  
General Motors

*"The broader Automation community includes the control community, manufacturing, mechanical engineering... a journal on Automation (not automatic control) can attract people like myself who already belong to IEEE. For example, many papers from the Japan-USA Symposium on Flexible Automation will be highly relevant to T-ASE."*

- Masayoshi Tomizuka,  
Cheryl and John Neerhout, Jr., Distinguished Professor of ME  
UC Berkeley

*"It is my pleasure to endorse the creation of a new IEEE journal dedicated to Automation Science and Engineering. As a Senior Technical Fellow at Boeing, I have been leading company efforts in gaining the technical excellence and enabling technology. Currently, Boeing is focusing on several important issues such as lean manufacturing, enhanced quality with cost reduction initiatives. I believe that Automation research is extremely important for the success of the aerospace industry and industry as a whole."*

*I am pleased to learn that the IEEE Robotics and Automation Society is considering a new journal, which intends to capture the latest advancements in Automation. This journal will cover both theoretical mathematical modeling and practical applications. I strongly believe that such a journal will be tremendously beneficial to the industries in term of automation advancement. I am interested in applying Automation research to enhance our manufacturing processes. I believe that Automation has a great potential to be applied in the areas of material synthesis, parts assembly, Internet-based manufacturing, and supply chain management. I enthusiastically endorse the creation of IEEE T-ASE."*

- Peter Wu  
Senior Technical Fellow  
The Boeing Company

*"There is a need for more 'Automation' thinking in Operations Research. As it is, a majority of OR models assume a fixed structure for the system (including system parameters) and develop algorithms for optimizing its performance. In a realistic setting the system structure and parameters are continuously changing. We should focus on developing self checking models and adaptive algorithms for simultaneous parameter estimation and optimization (providing the possibility of Operations Research Automation)."*

-Prof. George Shanthikumar  
IEOR, UC Berkeley

*"I endorse most strongly the proposal of the IEEE Robotics and Automation Society vote to establish a new Transactions on Automation Science and Engineering (T-ASE). I have long felt the need for such a Journal and wish that the IEEE Governing Body approve it as soon as possible."*

*Modern Robotics had its origin in industrial automation but has moved far away from the initial focus as new scientific and engineering challenges in robotics have emerged, in robots for hazardous environments, in space robotics, in mobile and autonomous, in hyper-redundant robots in vector field robots etc. The new journal is aimed at emphasizing the Automation Sciences and will kindle activity in the science and engineering problems that proved so hard in the work done under the original emphasis."*

*The emphasis on the robot itself was evident even in the early days. In the 1960's and 1970's, when I started and managed IBM's research effort in robotics, I noticed and used to comment on the fact that the robot in an automation application only contributed 20% of an application, the main expense was in understanding and solving the automation aspects. This observation was confirmed when the product was taken to market. It was further confirmed when I was Director of Hewlett-Packard Company's Manufacturing Research Center in HP Labs. These automation problems were deep problems in orienting, feeding and presenting parts to the robot, in scheduling jobs through multiple robot stations, through systems for recovering from errors while maintaining 6-Sigma production. There was no Journal where a practitioner could go for archived material, nor a place where solid scientific discoveries in the area could be published. Patenting was the only publishing option. This situation is not different today. There is significant need for a journal where the depth and breadth of Automation work can be published and archived.*

*For a time in the 1980's the National Science Foundation recognized the needs of Manufacturing and Automation. I am proud to have been Chairman of several NSF Advisory Committees on the Design Manufacturing and Computer Engineering during that time. There is no such focus today. It will come however when the field is more fully recognized for its excellence in published work. The good work in Automation Science today, if published at all, is spread over a wide variety of journals. The scientist and engineer are forced to publish in the closest discipline to the subject of the work. This though possible destroys the synergy possible in publishing in a peer Journal, and precludes building a community.*

*The proposed Transactions on Automation Science and Engineering first fulfills the need of the automation scientist and engineer for a specialist journal but second, it will also serve to show workers in other disciplines the applicability of their work in the domain. Such synergy will be good for both domains. I am happy to give my fullest endorsement to the proposed Transactions."*

- Peter Will

Research Professor in Industrial and Systems Engineering, USC  
Chair, National Academy Study on Information Technology in Manufacturing

### **Scope of the T-ASE**

**The IEEE Transactions on Automation Science and Engineering (T-ASE) publishes fundamental papers on Automation, emphasizing scientific results that advance efficiency, quality, productivity, and reliability. T-ASE encourages interdisciplinary approaches from computer science, control systems, electrical engineering, mathematics, mechanical engineering, operations research, and other fields. We welcome results relevant to industries such as agriculture, biotechnology, healthcare, home automation, maintenance, manufacturing, pharmaceuticals, retail, security, service, supply chains, and transportation. T-ASE addresses a research community willing to integrate knowledge across disciplines and industries. For this purpose, each paper shall include a Note to Practitioners that summarizes how its results can be applied or how they might be extended to apply in practice.**

### **Scope of the T-RO**

The name of the existing Transactions on Robotics and Automation will be changed to the "**Transactions on Robotics (T-RO)**" and its scope changed to:

**The IEEE Transactions on Robotics (T-RO) publishes fundamental papers on all aspects of Robotics, featuring interdisciplinary approaches from computer science, control systems, electrical engineering, mathematics, mechanical engineering, and other fields. Robots and intelligent machines and systems are critical in areas such as industrial applications;**

**service and personal assistants; surgical operations; space, underwater, and remote exploration; entertainment; safety, search, and rescue; military applications; agriculture applications; and intelligent vehicles. Special emphasis in the *T-RO* is placed on intelligent machines and systems for unstructured environments, where a significant portion of the environment is unknown and cannot be directly sensed or controlled.**

**Sample New Application Areas for the Proposed *T-ASE*:**

Biotechnology and Health

- Pharmaceutical High Throughput Screening
- DNA Chip Fabrication and Screening
- Medical and Health Monitoring
- Combinatorial Chemistry

Food Handling and Processing

- Agriculture
- Livestock and Fishing
- Inspection and Storage

Service Industries

- Construction
- Cleaning
- Data Storage and Cartridge Loading
- Retirement and Child Care
- Hospitality, Entertainment, and Theme Park Systems
- Retail: Labeling, Checkout, Stocking

Transportation, Security, and Maintenance

- Transportation and Traffic Automation
- Package and Baggage Handling and Inspection
- Automatic Identification
- Law Enforcement
- Home/Garden Automation
- Space and Underwater Systems

**Exemplary Table of Contents for the first issue of *T-ASE*:**

- Editorial - The Whole is More than the Sum of its Parts: Automation beyond Manufacturing
- The MIT OXYGEN Project - Human Beings in an Automated and Networked World
- Globalization and Supply Chain Management from an Engineering and Mathematical Viewpoint
- Control of Piezo Actuators for Nanoliter Precision Fluidics with Applications to High-Throughput Screening
- A Proposed Curriculum for an Undergraduate Program in Automation Science and Engineering

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