

PRESIDENTS' MESSAGES

Robotics and Automation Society



George A. Bekey

It seems hard to believe that a whole year has elapsed since I wrote the message to our readers in the 1996 Special Issue. I suspect that this is additional evidence for the hypothesis that there is not a linear mapping between subjective time and the time we usually designate by "t" in control system problems. On the other hand, it could just indicate that presidents of IEEE societies are so busy, that their sense of time can't be trusted.

Be that as it may, I would like to welcome you to the tenth jointly sponsored issue of the *IEEE Control Systems Magazine*. For the Robotics and Automation Society, it has been a busy year, with a number of new initiatives which may be of interest to you.

Early in the year we signed a Memorandum of Understanding with the Robotic Industries Association (RIA), the major group representing robot manufacturers with sales in the U.S. The purpose of this agreement is to increase ties between the academic community and the manufacturers of robots and other "intelligent machines" used in industrial automation. The first concrete outcome of this cooperation was co-sponsorship of a workshop on "Needs for Robotics and Intelligent Machines in Emerging Industries," which was held in October in Albuquerque, NM. The goal of the workshop was to explore possible applications of robots and other automation equipment in

industries which are not yet highly automated, such as food handling, meat cutting, construction, or entertainment. From workshops such as this we expect to develop important new applications for our field, as well as to identify research issues which need to be addressed to make such applications possible. The workshop was partially supported by the U.S. National Science Foundation (NSF). A report to NSF outlining a proposed research agenda will be issued in the near future.

While this particular workshop was concerned primarily with applications of robots in U.S. industry, we anticipate similar meetings in other parts of the world. The agreement with the U.S. Robotic Industries Association serves as a model for similar agreements currently being negotiated with Japan and Australia; we also expect to negotiate agreements with several European countries during the coming year.

You may also be interested in two planned joint conferences between the Robotics and Automation Society and other IEEE groups. Of course, one of these is the Control Systems Society. We have recently formed a joint committee to plan for a conference on "Control Problems in Robotics and Automation," to be held in late 1997, probably adjacent to the CDC. A joint conference with the IEEE Neural Network Council, to be called "Computational Intelligence in Robotics and Automation" (CIRA '97), which will be held in spring 1997 in Monterey, CA. Both of these conferences recognize the increasing overlap of technical disciplines and, hence, of interests among IEEE entities.

The article in this issue of *Control Systems Magazine* are drawn from those presented at the International Conference on Robotics and Automation, held in April 1996 in Minneapolis. With more than 700 attendees, this was one of our most successful conferences, due to the outstanding work of General Chairman Norman Caplan and Technical Program Chairman George Lee.

The 1997 ICRA will be held in Albuquerque and the 1998 in Leuven, Belgium. The venues for these meetings were selected by the society's Conference Board in keeping with the tradition that there should be two meetings in the U.S. and one outside the U.S. each three years. However, we are becoming

an increasingly international society, and this tradition should not be viewed as a rigid requirement. Hence, the Conference Board will recommend that the "two out three in the U.S." rule be dropped, thus allowing more flexibility in the location of future meetings. With approximately 50% of our members residing outside of the U.S., we anticipate that beginning in the year 2000 approximately half of the meetings will be outside the U.S. as well.

Finally, I would like to take this opportunity to congratulate the President-Elect of the Robotics and Automation Society, Prof. Toshio Fukuda from Nagoya University in Japan. Prof. Fukuda will become president in 1998, and he will have the pleasure of writing this message for the next joint issue of the *Magazine*.

George A. Bekey
President

IEEE Robotics and Automation Society

IEEE Control Systems Society



Panos J. Antsaklis

It is a great honor to address all the members of the Control Systems Society through the pages of the *Control Systems Magazine* for the first time as the 1997 CSS President. It is also with great pleasure that I address at the same time the members of the Robotics and Automation Society, a society of which I am also a member. This year marks the tenth anniversary of the CSM issues published jointly

by both societies, and this event highlights the special relationship enjoyed by these groups. Another event that will help mark the 10 years of fruitful collaboration is a special workshop planned for just before this year's CDC in San Diego. The workshop is sponsored by both societies and it is on future control directions in robotics and automation. Here, the societies are taking the lead in identifying the control problems that must be addressed to meet future needs, together with promising approaches to address these problems. Please watch for the workshop announcement in the pages of the magazines of the societies and on the Web.

Before I describe more of this year's planned activities, I would like first to briefly recount some of the CSS 1996 events, starting with our conferences.

One of the highlights of 1996 was the very successful CCA/ISIC/CACSD conference that took place in Dearborn, MI, last September. This combined conference brought together our annual Conference on Control Applications (CCA), the annual International Symposium on Intelligent Control (ISIC), and the symposium on Computer-Aided Control Systems Design (CACSD). This meeting served as the Society's main meeting in the United States, as the 1996 CDC was in Japan and the ACC did not take place since the United States hosted the IFAC's World Congress. Stephen Yurkovich was the general chair of the combined conference; Kevin Passino and Grantham Pang were the organizing chairs for the ISIC and CACSD. The conference had over 450 registrants and included 410 papers, over four days, assembled by three program committees. The Henry Ford Museum served as the site of the conference banquet, made possible through a grant from the Ford Foundation.

The 35th Conference on Decision and Control (CDC) took place in Kobe, Japan, last December, and it was co-sponsored by the Society of Instrument and Control Engineers, Japan (SICE) and the Institute of Systems, Control and Information Engineers (ISCIE). Hidenori Kimura was the general chair. This was the third time the CDC took place outside the U.S., but its first time in the Pacific Rim; the two previous CDCs outside the U.S. were in Greece in 1986 and in England in 1991. A record number of papers, 1,658, were submitted, out of which 1,088 were presented in 173 sessions. Following the initiative that started with the 1995 CDC, the 1996 CDC had its Proceedings published on a

CD-ROM and made considerable use of electronic means to disseminate information. I would like to extend to our Japanese hosts the sincere thanks of the Society for a wonderfully exciting meeting.

The IFAC held its 13th Triennial World Congress last July in San Francisco. There were close to 2,000 attendees from 70 countries, and this was a new record: 1,500 papers were presented. The American Automatic Control Council (AACC), which represents the United States in the International Federation of Automatic Control (IFAC), sponsored this event. If you are wondering about the Society's role in this, you may want to know that the IEEE Control Systems Society is a major partner in AACC. I am sure that you also noticed that there was no American Control Conference (ACC) in 1996; this was because the AACC, which sponsors the annual ACC, sponsored instead the World Congress that took place in the US in 1996.

The Society had exhibits at both the IFAC's World Congress and the CDC describing the benefits of membership and several attendees decided to join as new members. I would like to thank our VP for Membership, Dan Repperger, and all the volunteers for making this possible.

In addition to these conferences the Control Systems Society was a technical cosponsor of a number of meetings around the world, in places such as Greece, Portugal, Italy, Singapore, Japan, and the United States. We should not forget, after all, that our members—and we have more than 11,000—come from more than 70 countries.

Our publications, both *Transactions* and the *Magazine*, continued their tradition of excellence, publishing high-quality papers and articles. The *Transactions on Control Systems Technology* increased its frequency of publication in 1996 and it is now bimonthly. It also has a new editor, Mark Spong, to whom I would like to extend a warm welcome. On behalf of the Society, I would like to thank Bruce Krogh, the retiring founding editor, who had a vision of a new *Transactions* that emphasized applications, and who worked diligently and very successfully to make it a reality.

In 1996 the Society had its 5-Year IEEE review and received high marks. Mike Masten did a masterful job in assembling the myriad of bits of information required to perform the review, and in presenting all this to IEEE Technical Activities Board. Mike Masten has served the Society for a great number of years in

many positions, more recently as the general chair of the 1994 CDC and as VP for Finance, and in 1996 as the CSS President. On behalf of the Society, I would like to thank him for his wonderful dedication and inspiring leadership. Mike was elected Division X Director and in that capacity will continue serving IEEE and Society members. He will also serve this year as the chair of the very important CSS Nominations Committee and of the CSS Advisory Board.

I would like to welcome a new member to the Executive Committee, Tamer Basar, who will serve as the VP for Publications replacing Stephen Yurkovich who has moved to become the VP for Finance. Harris McClamroch, the 1996 VP for Finance is now the CSS President-Elect.

What should we expect in 1997? First, we are looking forward to a number of successful conferences: the 1997 ACC will be in early June in Albuquerque, NM, the ISIC in July in Istanbul, Turkey, the CCA in September in Hartford, CT, and the CDC will be in December in San Diego, CA.

At this point, I would like to take this opportunity to talk about some important issues for the 1997 and beyond, which I think are shaping the directions of research in control and the future of the profession. I have touched upon some of these issues once before, in an interview as president-elect that appeared in the August 1996 issue of this magazine.

It is rather evident that if we are to successfully address the control needs of our society in the 21st century, we need to develop new methods to meet the new challenges, as the needs of our technological society are imposing ever-increasing demands for better, faster, cheaper, and more reliable control systems. There are challenging control needs all around us, in manufacturing and process industries, in transportation, and in communications, to mention but a few of the application areas. Advanced sensors, actuators, computers, and communication networks offer unprecedented opportunities to implement highly ambitious control and decision strategies. There are many interesting control problems out there which desperately need good solutions. These are exciting times for control, full of opportunities. It is up to us to rise to the challenge. We should identify these new problems and challenges and help the development and publication of fundamental results in new areas, areas that show early promise that will be able to help address the

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Kalman Estimator

Once the gain matrix K for the Kalman estimator has been found, the estimator can be constructed as a sub-system along with Kalman initialization. The block diagram of the design is shown in Figure 4, and K the estimator and its state equations are given in Figure 5. Notice that the estimator shares the controller for both output and state variables of the system, and therefore can be used as an observer as well.

Figure 4. Kalman estimator block diagram.

Figure 5. State space representation for the Kalman estimator showing that the first output of the system is the control signal and only the last output is the estimator. The result agrees with the block diagram in Figure 4.

State equations:

$$\dot{x} = Ax + Bu + K(y - Cx - Dv)$$

$$\dot{z} = (A - KC)z + (B - KD)v + Ky$$

Output equations:

$$y = Cx + Dv + Cz$$

Initial conditions:

$$x(0) = x_0, z(0) = z_0$$

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control needs of industry and society well into the next century. We need to enhance our traditional control methods, we need new ideas, new concepts, new methodologies and new results to address the new problems. The opportunities are there and it is up to us to identify them and convince the rest of society that we are the group who will solve these problems. Can we do this? This is the challenge and the opportunity. The CSS/RAS workshop mentioned above, on future control directions in robotics and automation, will help identify problems and promising solutions in that area. We should have similar workshops in other application areas to identify fundamental problems and promising research directions.

There are a number of other areas I plan to emphasize during my presidency. First, it is evident that electronic dissemination of information, particularly via the Internet and the World Wide Web, is becoming increasingly important to serving our members better, and it is going to be one of my priorities this year. Another way to serve our members better and attract new members is via our CSS Chapters, and I plan to encourage the establishment of new chapters, particularly outside the United States. The Control Systems Society is in excellent financial health; it is vibrant and dynamic. However, as a Society we must be continuously reviewing and critiquing our practices. Only in this way we can be the best. For this reason, I have established task forces to examine three important areas: our publications, our conferences and our administrative structure. These task forces will report their preliminary findings and recommendations to the Board of Governors by June 1997 and submit their final report soon after that.

It is a great honor and indeed a privilege for me to lead the IEEE Control Systems Society, the premier professional society for the world's control engineers and scientists. All indications are that control systems will be playing an increasingly important role in the technological systems of tomorrow, and so I am happy to report to you that the future of controls looks bright indeed. Of course, it is up to us to rise to the challenge. I look forward to hearing from you on ways we can make your Society serve you better.

Panos J. Antsaklis
President
IEEE Control Systems Society