

In this issue of *IEEE Control Systems Magazine*, we speak with Maria Elena Valcher, who is the incoming president of the IEEE Control Systems Society (CSS). Elena describes her experiences, research and professional activities, and priorities for the Society and its membership. We also speak with IEEE Fellows Er-Wei Bai, Alexander Fradkov, Innocent Kamwa, Giorgio Rizzoni, and Jing Sun.

Er-Wei Bai is professor and chair of electrical and computer engineering and professor of radiology at the University of Iowa and the World Class Research Chair Professor (in system identification) of the School of Electronics, Electrical Engineering, and Computer Science at the Queen's University, Belfast, United Kingdom. He received his B.S., M.S., and Ph.D. degrees from Fudan University, Shanghai Jiaotong University, and the University of California at Berkeley, respectively. He has served as an associate editor for several journals, including *IEEE Transactions on Automatic Control* and *Automatica*. He is the cochair of the 17th IFAC Symposium on System Identification, to be held in 2015 in Beijing, China. He has consulted with several companies and is an author of more than 160 journal papers. He received the Iowa Regents Award for Faculty Excellence and the University of Iowa President's Award for Teaching Excellence. He has broad research interests in control, identification, modeling, and their applications to engineering and life science problems. He is an IEEE Fellow.

Alexander Fradkov is head of the Control of Complex Systems Laboratory of the Institute of Problems in Mechanical Engineering at the Russian Academy of Sciences in Saint Petersburg, Russia, and a part-time professor at Saint Petersburg State University and Saint Petersburg National Research University of Information Technologies, Mechanics and Optics (ITMO University). He received a diploma in mathematics from St. Petersburg State University in 1971 under the supervision of V.A. Yakubovich, a candidate of sciences (Ph.D.) degree from Leningrad Mechanical Institute in 1975, and a doctor of sciences from Leningrad Electrotechnical Institute in 1986. He is the coauthor of about 600 journal and conference papers and 16 books, holds ten patents, and gave invited lectures at more than 70 universities and research centers of 25 countries during 1991–2014. His research interests include nonlinear and

adaptive control, control of oscillatory and chaotic systems, and dynamics and control of physical systems and networks. He has been an IEEE Fellow since 2004. He is the founder and was the president of the International Physics and Control Society in 2005–2013 and has been a member of the Russian National Committee of Automatic Control since 1998. He is a member of the IEEE CSS Conference Editorial Board (1998–2014), chair of the IFAC Technical Committee on Adaptive and Learning Systems (2008–2014), and editor-in-chief of the international journal *Cybernetics and Physics*, which launched in 2012. He organized and chaired more than a dozen international conferences in Saint Petersburg in 1997–2014, including the IFAC Symposium on Nonlinear Control Systems in 2001, the IFAC International Workshop on Adaptation and Learning in Control and Signal Processing/IFAC International Workshop on Periodic Control Systems in 2007, and the IEEE Multiconference on Systems and Control in 2009.

Innocent Kamwa is the chief of power systems and mathematics at the Hydro-Quebec Research Institute, Quebec, Canada. He received his B.S. and Ph.D. degrees from Laval University in 1984 and 1988. He then joined Hydro-Quebec as a research scientist and became chief scientist for smart grids in 2009. He is an associate adjunct professor at Laval University (1991) and McGill University, and he has mentored more than 30 graduate students. He has served as an associate editor of *IEEE Transactions on Power Systems* for the last seven years and currently serves as the editor-in-chief of *IET Generation, Transmission and Distribution*. He is the chair of the stability subcommittee, treasurer and standard coordinator of the Electric Machinery Committee, and a past member (2009–2013) of the Fellow Evaluation Committee of the IEEE Power Engineering Society. He has partnered with ABB and Alstom to develop advanced power grid control devices and systems implemented in Quebec, China, and Turkey. He is also collaborating with RTE (French System Operator) and CEPRI (State Grid of China) in the development of hardware-in-the-loop digital simulators of power system controls sold worldwide by OPAL-RT. He is the author of over 170 publications, including 102 peer-reviewed journal papers, 132 articles listed on IEEE *Xplore*, and 177 on Google Scholar. Honors include three IEEE Power Engineering Society

best paper awards, three IEEE Power Engineering Society outstanding working group awards, a 2013 IEEE Power Engineering Society Distinguished Service Award, and Fellow of IEEE. His research interests are in control theory and its application to power grid control. A member of the NERC Task Force on Smart Grid, he was also recognized as a worldwide leader in power grid control by the MIT Technology Review in February 2004.

Giorgio Rizzoni is the Ford Motor Company Chair in Electro-mechanical Systems at the Ohio State University (OSU). Giorgio received B.S., M.S., and Ph.D. degrees in electrical and computer engineering in 1980, 1982, and 1986, respectively, from the University of Michigan. Between 1986 and 1990, he was a postdoctoral fellow and then a lecturer and assistant research scientist in the Department of Electrical Engineering and Computer Science at the University of Michigan. In 1990 he joined the Department of Mechanical Engineering at the Ohio State University as an assistant professor and was promoted to associate professor of mechanical engineering in 1995 and to professor in 2000. In 1999 he was appointed director of the Center for Automotive Research, a position he has held continuously since that time. He has served as an associate editor of *IEEE Transactions of Vehicular Technology* and of the ASME publication, *Journal of Dynamic Systems, Measurement, and Control*. He was chair of the ASME Dynamic Systems and Control Division and of the IFAC Technical Committee on Automotive Control and chair of the International Program Committee for the 2nd IFAC Workshop on Advances in Automotive Control (1998) and the IFAC Workshop on Engine and Powertrain Control, Simulation, and Modeling (2012). His research has been funded by more than 30 companies, including Ford, General Motors, Chrysler, Honda, Daimler, and Fiat, and by many government agencies. He is

the author of three books and over 400 journal and proceedings papers. Honors include Fellow of the IEEE, Fellow of the Society of Automotive Engineers, the Stanley Harrison Award for Excellence in Engineering Education, the NSF Presidential Young Investigator Award, and numerous best paper and teaching awards. His research interests are in dynamic systems and control and system fault diagnosis and prognosis, with application to sustainable mobility and vehicle safety.

Jing Sun is a professor at the University of Michigan. She received the B.S. and M.S. degrees from the University of Science and Technology of China in 1982 and 1984, respectively, and the Ph.D. from the University of Southern California in 1989. From 1989 to 1993, she was an assistant professor in the Electrical and Computer Engineering Department at Wayne State University. She joined the Ford Research Laboratory in 1993, where she worked in the Powertrain Control Systems Department. After spending almost ten years in industry, she returned to academia and joined the faculty of the College of Engineering at the University of Michigan in 2003, where she is currently a professor in the Department of Naval Architecture and Marine Engineering and the Department of Electrical Engineering and Computer Science. Her research interests include system and control theory and its applications to marine and automotive propulsion systems. She holds 37 U.S. patents, has coauthored a textbook on robust adaptive control, and has published over 200 articles in archived journals and conference proceedings. She is an IEEE Fellow and one of the three recipients of the 2003 IEEE Control System Technology Award. She served as an associate editor for *IEEE Transactions on Automatic Control* from 1995 to 1997, and she is the general chair of the 2017 American Control Conference.

MARIA ELENA VALCHER

Q. Congratulations on your new role in the IEEE Control Systems Society (CSS). You have been extremely active in CSS over the years. Which of the numerous roles have you found the most rewarding thus far?

Elena: Thanks! I am both delighted and proud to be serving as IEEE CSS president. I regard this as an honor and an amazing reward that I have received for my volunteer activity.

I have to say that it is hard for me to choose one specific role, so I will mention two roles that really absorbed a lot of my time but also made me feel that each of us can really contribute and make a difference: vice president Conference Activities (VPCA) and program chair of the 51st IEEE Confer-

ence on Decision and Control (CDC, Maui, 2012).

I served as VPCA of the CSS for three years (2008–2010), working with three very active presidents. The number of conference-related activities that the CSS has to deal with is incredible. There are, of course, the nontrivial routine tasks related to the organization of the two annual CSS conferences—the CDC and the Multiconference on Systems and Control. These tasks include appointing general chairs and supporting them in all the subsequent steps

(such as selecting the Operating Committee members, choosing the venue, preparing the budget, and signing the hotel contract), of course with the help of other experienced volunteers. Many goals need to be simultaneously achieved, with the principal goal being to preserve the high scientific standards of our conferences, while also ensuring the financial sustainability of these events. In addition, there are other more general issues related to conferences that a VPCA has to deal with, for instance, related to IEEE and CSS policies, outreach



Maria Elena Valcher.

activities, monitoring the technical quality, and also keeping up with technologies and innovations.

The role of program chair was absolutely exciting. Part of the excitement came from having involved a good number of colleagues who I regard not only as extremely skillful but also as dear friends, with whom interactions are always very pleasant. So, it was overall a very nice adventure, full of satisfaction, even if it was really demanding. To ensure the quality of a conference, the review process has to be supervised very carefully and every paper must receive a fair and accurate evaluation. This supervision may mean checking the reviews and reports of almost every paper and possibly asking for additional opinions. For me, this meant a good number of almost sleepless nights, but I do not regret it and I believe that my frequent interactions with Alessandro Astolfi as Conference Editorial Board chair and with Thomas Parisini as vice program chair for the invited sessions further strengthened our already strong friendships.

Q. How did your educational background bring you to the systems and control field?

Elena: As a bachelor's student at the University of Padova, I was fascinated by the prospect of doing research and working in academia. My father is a retired university professor, and I remember him talking enthusiastically about the beauty, the excitement, and the freedom of his job. This surely had an impact on me. However, it was only when I took the Linear Systems Theory class, which was taught by Ettore Fornasini, that I realized what I would really like to work on.

I developed my master's thesis, and later my Ph.D. thesis, under Ettore Fornasini's guidance, and I still work with him on an almost weekly basis. I am still fascinated by the research topics of our field and have never regretted my choice. In addition, I also became increasingly familiar over the years with the control community, and I realized it is a very nice and



(From left) Alessandro Astolfi, Jay Farrell, Elena Valcher, Franco Blanchini, Pradeep Misra, and Paolo Bolzern at the CDC 2012 Program Committee meeting in Padova.

healthy environment in which to work and exchange opinions.

In particular, I found the community of CSS volunteers full of amazing people: sharp, informed, well organized, and very entertaining. I really developed a sense of belonging to this community.

Q. What are your current research interests?

Elena: My present research interests are mostly focused on switched systems and Boolean control networks, even if I occasionally work also on multi-agent systems and consensus problems as well as on multidimensional systems and the behavioral approach, which were my very first interests. At the beginning of my career, I had the opportunity to work with Jan Willems, who pioneered the behavioral approach. He had a big influence on me, not only on my research interests, but his broad views, critical spirit, open mind-set, and passion really set important references for me. His recent passing has left a deep sense of loss in the entire control community.

Coming back to the subject of my current research interests, I started working on switched positive systems a few years ago, together with a former Ph.D. student of mine, Paolo Santesso. This research activity was first stimulated by purely theoretical interests but was later boosted by the possibility of applying results regarding stabilization

and optimization of positive switched systems to model therapies to mitigate HIV viral escape. Plus, it has given me the chance to collaborate with some dear friends like Franco Blanchini and Patrizio Colaneri. We are indeed planning to write an extended survey about this subject, and we believe that there are many challenging problems in this area that still await complete solution.

The algebraic approach to Boolean control networks is a really new research topic, not only for me but also within our community. I approached the subject by pure chance, thanks to some interactions with Michael Margaliot.

A lot of literature on genetic networks shows that Boolean state-space models provide a very effective means to model phenomena that essentially can be described in terms of activating or inhibiting actions. The algebraic approach makes it possible to fruitfully employ results and techniques traditionally adopted for standard state-space models, as well as graph-based techniques, Markov chain theory, and so on. I believe this is a very promising and open research topic. In some cases, even the problem formalization requires some really out-of-the-box thinking.

Q. How do you see your role as president of the Society, and what are your priorities for the next year?

Elena: The state of our Society is extremely good from several points of



Elena Valcher, Roberto Naldi, Robert Mahony, Lorenzo Marconi, Giuseppe Notarste-fano, Paul Pounds, and Claudio Melchiorri (all in the front row), with a group of Ph.D. students at the Bertinoro SIDRA Ph.D. School.

view. Membership, technical activities, publications, and conferences all have positive trends. In particular, I would like to mention the recent creation of the Technical Committee on Smart Cities, the launch of *IEEE Transactions on Control of Network Systems*, the first Symposium on Control of Network Systems (SCONES, in October 2014), CSS active involvement in the IEEE Life Sciences project and, in particular, in *IEEE Life Sciences Letters*. These are signs of a very healthy community, whose interests are increasingly broad, and that is fruitfully interacting with other Societies and communities on topics of common interest.

The CSS is a very open community, and a lot of the research developed under the label of system theory and control is potentially useful in a very wide number of application areas, from the traditionally related fields of aerospace, chemical, and mechanical engineering, to more recent areas such as system biology and medicine, where control-theoretic analytical approaches have proven their effectiveness.

I believe the versatile nature of the research developed in our field needs to be further emphasized, and new successful collaborations with other Societies and communities, possibly in the form of joint journals and conferences, must be encouraged.

The Society finances need a reevaluation in view of the recent modifications of IEEE financial policies. In particular, the change in the mechanisms according to which IEEE *Xplore* revenues are distributed among Societies has significantly reduced our income. Addi-

tionally, we are severely constrained in using the Society reserves for new and continuing initiatives. In the past, we have tried to reinvest a good portion of our annual surplus in outreach initiatives and in initiatives aimed at supporting membership (for instance, a few years ago the CSS membership fee was reduced by 20%). In light of the current situation, we may need to propose different initiatives and possibly discuss our new targets and priorities.

As a matter of fact, as president elect in 2014, I promoted the discussion and design of a new strategic plan for the CSS to understand which aspects of the Society need to be improved and which goals should be focused on, both in the short and long term. I believe that the CSS needs to keep this strategic plan updated, and the role of the Long-Range Planning Committee in this respect is of fundamental importance. So my priorities next year will be, on the one hand, to keep promoting communications with the other communities, and, on the other hand, to stimulate ongoing discussions of our strategies, as well as short- and long-term objectives.

Q. What do you see as some of the priorities for ensuring the future success and impact of control-related technology?

Elena: It is quite hard to say something that my predecessors have not already said about this issue! I really believe, as does Jay Farrell, the 2014 CSS president, that dynamic systems, estimation, and feedback control have never been more relevant, and this is

a guarantee of the future success and impact of our field. The solid theoretical structure of system and control theory makes it potentially applicable to diverse areas. On the other hand, in a number of application areas, the complexity of the systems and the cost and risk related to experiments demand for a careful and accurate modeling of the processes so that the early testing of the process functioning is achieved via simulations. Identification and control techniques provide fundamental supporting tools that allow for obtaining accurate models as well as designing efficient and robust algorithms to ensure the correct functioning of complex physical systems.

Our community has an extremely solid and rich theoretical background. We are not equally good, however, at communicating to the industrial world the enormous potential of this theoretical background, and surely the future success of control-related technologies will be enhanced if we reduce the well-known gap between theory and applications. I know that I am not saying anything new, but despite a clearly positive trend in this direction I believe that significant effort is still needed. Surely, it is extremely important that the CSS plays a proactive role in this direction.

Q. The young members in our field—especially students—are the future of CSS. How can we expand their participation and role in CSS?

Elena: Actually, I was thinking about this issue just a few days ago! At the time that I am responding to this interview, I am just returning from the

SIDRA Ph.D. School in Automatica, held every year in Bertinoro, Italy. I am one of the two school coordinators, together with Claudio Melchiorri from the University of Bologna. Every year we have the task of organizing one week of classes split into two courses: one with a more theoretical flavor and one with a more application orientation. Just as an example, the topics covered this year were Analysis and Control of Nonlinear Systems and Unmanned Aerial Vehicles, with both courses coordinated by Lorenzo Marconi.

Looking at the enthusiasm of the Ph.D. students attending the school, their desire to learn more, as well as their amazing capability of socializing and making the school environment a place where they are all friends, I felt that the future of our community is very bright. Student participation is of fundamental importance to the health of our Society. But the fact that they will be willing to be actively involved and contribute to the CSS essentially depends on us, the leadership and senior membership of the Society. If we set a very positive role model, if we make them perceive how rewarding it can be, not only to attend the conferences but also to be involved in technical activities (as reviewers, as members of technical committees, or as associate editors) and in organizational activities (members of conference operating committees or of the Board of Governors and Executive Committee) later in their career, I am sure that new energy will flow into the Society, and the CSS will remain a healthy and vibrant Society.

In my view, a good number of young researchers already perceive volunteering as a valuable activity. Important roles, such as associate editor of the Conference Editorial Board or of the CSS-sponsored journals, are regarded by them as very prestigious and desirable, even if they come with a significant workload. When I was VPCA or program chair of the CDC 2012, I was contacted by several young people asking me how to become actively involved as a volun-



Elena and Pradeep at their wedding in Palazzo Moroni, in Padova.

teer. I think this is a very good sign. Admittedly, these people had already received their Ph.D. degrees a few years earlier, and normally we expect that people serving in such key roles will have some years of experience. However, I believe that such an interest does not come up instantaneously, which means that, in the early years of their career, the volunteers must have a very positive image of the Society.

The CSS has several initiatives in place to engage Ph.D. students and to promote their active participation in the Society, which include the newcomers/student receptions at the CDCs, the special rates offered to students to attend workshops, and

even, on some occasions, free Society membership, but I believe that none of these initiatives can compare with the positive example offered by someone whom they respect.

In addition, as I mentioned before, this is a very nice community of active, smart, and also very enjoyable people. Nobody would believe it, but I often had a lot of fun serving the Society.

Q. What are some of your interests and activities outside of your professional career? Please also tell us about your family.

Elena: After several lazy years, where my only physical activity was some biking during the nice season (but my colleagues could remark that I am unable to move inside the department without running along the corridors and flying up or down the stairs two steps at a time), I am now a very dutiful and methodical gym rat! Actually, I am taking many fun classes at the gym, and the environment is so pleasant that it is no sacrifice at all.

Apart from that, for several years I have had a yearly subscription to the Verdi Theater in Padova. I love watching plays by Shakespeare, Strindberg, Pirandello, Goldoni and also the classic Greek tragedies. The atmosphere of a theater is really unique and fascinating.

Profile of Maria Elena Valcher

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- *IEEE Control Systems Society experience highlights:* registration chair, 43rd IEEE Conference on Decision and Control, 2004; publicity chair for Europe, 1st Multiconference on Systems and Control, 2007; program chair, 51st IEEE Conference on Decision and Control, 2012; associate editor, *IEEE Transaction on Automatic Control*, 1999–2002; Board of Governors, 2003–2006, 2010–2012; vice president Member Activities 2006–2007; vice president Conference Activities 2008–2010.
- *Notable awards:* Socio Corrispondente of the Istituto Veneto di Scienze, Lettere ed Arti, in Venice (founded by Napoleon) since 2008; IEEE Control Systems Society Distinguished Member Award, 2011; IEEE Fellow, 2012.

I love spending time either reading novels and history books or cooking. But I must admit that my spare time is really limited. There is a chance that they are right when they tell me that I work too much!

The question about my family is very timely since I recently got married (at the time I am writing this, I have been married about three weeks). The funny thing is that my husband is surely more popular within the control community than I am! Every-

body who has submitted a paper to any of our conferences surely knows Pradeep Misra.

Pradeep has been, for several years, a very committed volunteer of the CSS and the AACC, as well as a sort of historical memory for both societies. And that is exactly how I met him: working together as volunteers. He is a very balanced person, and he has a very broad perspective over things, in particular those related to the CSS, so I often seek his advice.

Well, he may add that this does not mean that once I have heard his opinion I necessarily follow it, but life with some spice is more enjoyable!

Q. Thank you for your comments. We wish you success as 2015 CSS president, and we look forward to reading your editorials in the magazine.

Elena: You are very welcome. Thanks for your kind interest and the opportunity to share my thoughts through this nice interview!

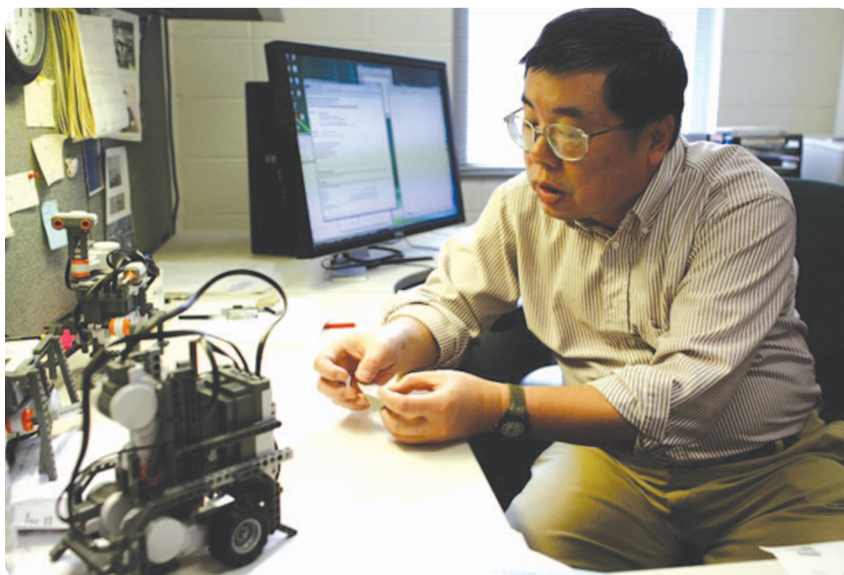
ER-WEI BAI

Q. How did your education and early career lead to your initial and continuing interest in the control field?

Bai: My path is quite unusual. I never went to high school and, in fact, did not have a high school education at all. During China's Cultural Revolution, all schools and universities were closed, and I spent over ten years in a factory making industrial boilers. Looking back, I had fun as a teenager, and it did not feel tough at the time—it was a way of life then. When the Cultural Revolution ended, I had the opportunity to go to university. During my college years, I had a few control-related classes that attracted me to the field.

Q. What are some of your research interests?

Bai: During the first half of my academic career, I was very interested in theoretical problems, especially in the areas of adaptive systems and identification. On the other hand, since my teenage years I have very much enjoyed building things, and so my later projects always involve theoretical developments as well as real-world applications, including the development of a bolus-chasing computed tomography machine, muscle modeling, optimal control of electric



Er-Wei Bai preparing LEGO robots for the Engineering Problem Solving I class.

arc furnaces in steel mills, radiological threat detection, and, recently, cyberphysical systems. The core of my research interests lies in high-dimensional nonlinear nonparametric system identification.

Q. What courses do you teach relating to control? Do you have a favorite course? How would you describe your teaching style?

Bai: I have taught all kinds of control courses at all levels, including basic undergraduate analog control and digital control and graduate-level nonlinear control. My teaching style is to foster critical thinking and an ability to solve open-ended problems.

We as instructors have to be creative to make dry material exciting and attractive so students want to learn. My favorite course is Engineering Problem Solving. Besides mathematical rigor, the course is unstructured so I can push students' creativity and imagination to the limit.

Q. What are some of the most promising opportunities you see in the control field?

Bai: I see many opportunities for control, such as in big data, cyberphysical systems, and medical applications. I am heavily involved in control in medicine and strongly believe that control will play an important role in the next