of Prof. Islam Hussein. At WPI we have an interactive learning atmosphere, where students from different departments (including some undergraduate students) study together in a diverse engineering environment. I think the small size of WPI gives the education there a great advantage. During the past year, I've taken courses in control theory, computational methods, and advanced dynamics, among other topics. Projects and presentations are required in most courses, which I think is excellent practice for scientific learning and communication.

Q. What are your research objectives in pursuing the Ph.D.?

Yue: My major research interest is cooperative control of multiple autonomous vehicle systems. In our research group we seek to develop control strategies that will enable teams of autonomous vehicles to cooperatively carry out operations such as search, rescue and retrieval, wildfire control, and surveillance. In our laboratory, we are currently constructing a testbed composed of four cooperative autonomous submarines to test control strategies.

Q. The ACC in New York City is your first major conference. Are you enjoying it?

Yue: Yes, very much so. I find it useful to be able to discuss ideas with my peers. What I find most interesting is the breadth of control theory and its applications. Moreover, it is also my first visit New York City. New York is busy and amazing. No wonder it is one of the most wonderful cities in the world!

Q. Do you have any advice for undergraduate students who think they might be interested in pursuing systems and control studies in graduate school?

Yue: I think that first they must be interested in mathematics, because the study of systems and control needs a good mathematical background. Moreover, as a mechanical engineering student, I think that to implement the control theories in the real world, engineers must also understand the operation of robots and machines, including the mechanical dynamics, electronics, and software. I think my mechatronics background helped a lot in my case. Last but not least, students must have good training in computer coding since we need to first test the control laws on the computer before real implementation. As a female student, I also encourage more female students to come into the world of systems and control.

Q. Have you thought about what you might do after you have your Ph.D.?

Yue: Not quite. I might apply for a faculty position and continue to do research.

Q. Thank you for speaking with *CSM*!

Yue: You are most welcome. Nice to speak with *CSM*!

Daniel Liberzon

Q. Congratulations on being awarded the Eckman award of the AACC!

Daniel: Thank you very much.

Q. What are switching systems and the motivations for studying them?

Daniel: I think of switching systems as dynamical systems that evolve in continuous time and are described by a combination of differential equations and switching events. A widely used and closely related term is "hybrid systems." Switching systems, however, are different in that they take an abstract view of the discrete behavior and thus permit a more direct application of techniques from systems and control theory. These systems are interesting from a theoretical point of view, and they can model many real-life scenarios more accurately than purely continuous (or purely discrete) systems. Just think, for example, of biological cells growing and dividing, or of an aircraft entering, crossing, and leaving an air traffic control region. Also, by incorporating logic-based switching into control design, one obtains controllers that are more flexible, have better performance, and can solve more problems.

Q. What are some of the challenges in this area? Is there a "key" unsolved problem that would really advance the field?

Daniel: I don't know if there is one key unsolved problem, but rather a whole host of them. There are many things we understand fairly well about systems described by differential equations. Once we add switching events to the model, the behavior gets more complicated. So the challenges are to see what we can do with the tools that we have developed for continuous systems, how we can extend these tools to handle switching, and what new tools must be invented or borrowed from other

Daniel Liberzon of the Electrical and Computer Engineering Department of the University of Illinois at Urbana-Champaign. Daniel's specialty is switching systems and nonlinear control with applications to control with limited information. This picture was taken in Buenos Aires.

fields dealing with discrete phenomena, such as automata theory. I'm especially interested in switching control design and in developing analysis tools. Personally, I tend to be more solution-driven than problem-driven. I get excited when I see a nice solution, and this motivates me to continue in that direction. On the other hand, I find it difficult to judge which problems are more important than others, especially without the benefit of hindsight. But I do think that elegant solutions tend to have more impact on the field.

Q. What are some of your other research interests?

Daniel: I've been working toward developing a comprehensive theory of nonlinear control with limited information. The type of scenario I have in mind is where the plant and the controller are exchanging information with each other and, due to communication or security constraints, this information is very restricted—coarsely quantized, infrequently updated, delayed, and so on. The main questions are how much information is really necessary for control, and what should the control law be, in particular, what robustness properties should it have? Traditional control theory that assumes perfect and instantaneous signal transmission is inadequate. However, there are relevant tools in modern nonlinear systems theory that specifically address robustness to errors such as those arising from incomplete information. So there is a nice connection between some fundamental theoretical questions and application-motivated control design problems.

Q. What led you to the controls field?

Daniel: I did my undergraduate studies in mathematics at Moscow State University. By the end of the third year, all students had to select their area of specialization, and the professors were making presentations about their research to help us decide. Control theory in Russia is typically viewed as a branch of mathematics and not engineering as it is in the United States. One of the presentations was given by Andrei Agrachev. I don't remember the details now, and I'm sure I didn't fully understand them then, but it was something about a geometric approach to nonlinear controllability. I found it really beautiful, and this area became the topic of my undergraduate research. Soon afterward, I arrived in the United States to pursue my graduate studies in mathematics at Brandeis University. The university didn't teach applied math or engineering, but the great thing about Boston is the many universities in which students can explore research opportunities. I was fortunate to eventually get in touch with Roger Brockett at Harvard who agreed to be my Ph.D. advisor, and I've been working in controls ever since. Another thing I should mention is that my father is a controls professor in Russia; this might have had something to do with it too, I'm not sure.

Daniel, daughter Ada, and wife Olga. This picture was taken during a trip to Chicago.

Q. What concerns do you have about the field of automatic control?

Daniel: I think we publish way too much. Every year, at least five control conferences release their proceedings, and we have about a dozen control journals, ranging from very prestigious to somewhat obscure. Everyone is always busy trying to meet a paper submission deadline or reviewing other people's papers. I wish we had more time to think about our ideas, discuss them with colleagues, and select and develop the best ones. This process would make our output less voluminous but more manageable and arguably more useful for future work both in our field and in other disciplines that use our results. To accomplish this, we could start by resisting "bean counting" when it comes to hiring and promotions and by better focusing ourselves and our students on depth and quality.

Q. What courses do you enjoy teaching at UIUC? Do you have a personal teaching philosophy?

Daniel: One of the great things about UIUC is that our controls curriculum is quite extensive, especially at the graduate level, and we have the opportunity to teach many courses in our field as well as develop new ones. I enjoy teaching all of them. I believe that my role as an instructor is not to cover a prescribed set of topics by the end of the semester but rather to teach the students how to think about the subject. This is because no matter what specific results I present in class, later on the students will probably encounter slightly different scenarios, which they should be able to approach in a creative way. The keywords I associate with teaching are not to "lecture" but to "engage," not "deliver" but "discuss." I try to have as much

interaction with students as possible. In fact, for me a good lecture is not too polished, it may even be (intentionally or not) a little puzzling, at least toward the end. I'm happy when I see the students argue about the fine points of the lecture as they leave the classroom.

Q. Do you have any teaching advice for novice instructors?

Daniel: Well, no matter what you do, teaching any course for the first time is a lot of work. When I prepare a course in advance, I first try to spend as much time as possible thinking about the "big picture," what my goals are for this course, which concepts and techniques are central to it, what connections between them I want to emphasize. After I'm able to "see" what the whole course should look like, details usually fall into place easily (and those that don't can be made into homework exercises). By the way, I find the same general approach helpful when writing papers and preparing talks.

Q. What are some of your interests outside of teaching and research?

Daniel: I already mentioned that my father is a controls professor; on the other side, my mother is an opera pianist and singing coach. I have always been, and sometimes still am, torn between technical subjects and music. I play guitar and sing a little, and I listen to a lot of music, from rock to jazz to classical. I like playing soccer and tennis. I enjoy exploring life and culture in large cities around the world. The picture of myself was taken in downtown Buenos Aires. But since June 2006, my wife Olga and I have had plenty of fun at home with our daughter Ada.

Q. Thank you for speaking with *CSM*!

Daniel: It was my pleasure.

David Castañón

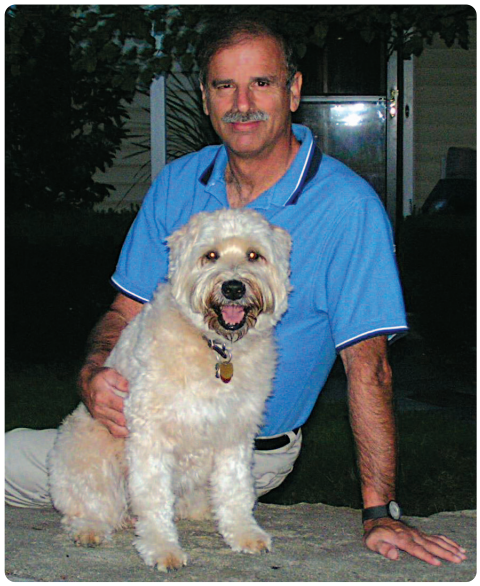
Q. Congratulations on being elected CSS president for 2008!

David: Thank you. It is an honor and a privilege to serve CSS in this capacity. Many distinguished colleagues and friends have held this position previously and helped grow our field and our society to its current successful state. I hope to continue the example set by my distinguished predecessors and help CSS continue its leadership in promoting the fields of systems and control throughout the world.

Q. Before we talk about CSS, I'd like to ask about your educational background.

David: I studied electrical engineering at Tulane University. The department had a strong applications focus on electric power systems, with high power laboratories where most components weighed significantly more than I did. I found I enjoyed analysis more than dangerous lab work, so I added a second major in mathematics to the electrical engineering curriculum. At Tulane, I took my first course in feedback control, using analog computers for implementation of controllers for electric machinery. This was the only course that presented an analytical foundation for design, a topic that combined both of my majors.

After Tulane, I went to MIT for graduate studies, switching to the Mathematics Department. I was surprised to find the variety of rich analytical courses offered in electrical engineering. At MIT, I was attracted to courses in dynamical systems and control taught by Jan Willems, Michael Athans, and Sanjoy Mitter, which sparked my interest in the field. This eventually led to my dissertation work on stochastic games and large scale systems.



David Castañón of the Electrical and Computer Engineering Department of Boston University. David is CSS president for 2008. He is also general chair of the 2007 CDC held in New Orleans in December.

Q. What did you do after you received your Ph.D.?

David: After completing my Ph.D. in mathematics, I chose to become a postdoctoral research scientist at MIT's Electronic Systems Laboratory (later to become the current Laboratory for Information and Decision Systems). I was involved in interesting projects associated with adaptive control of aircraft and stability of large scale stochastic systems. During this period, my Ph.D. adviser Nils Sandell left MIT to form a startup company, Alphatech, Inc. Subsequently, he convinced me to join the company. Alphatech's business was to develop technology for automated systems with applications primarily for government and industry interests.

At Alphatech, I discovered the difference between writing a paper and solving a customer's problem. I became much more familiar with computation techniques and optimization, building an interest in combinatorial optimization and distributed computation. I was also