

## A Healthy Identity Crisis

I have wondered how many people actually read the “President’s Message”... It is tempting to write something utterly provocative so as to stir reactions. If that works and reactions come pouring in, I would then feel very motivated for the next such message. If nothing happens, I know I would be disappointed, although there is always a chance that what I thought was controversial was in fact not so.

My topic here is not necessarily controversial, but it certainly has caused considerable debate: defining “control.” My predecessor, Rick Middleton, dealt with this issue in his first “President’s Message” a year ago. He even mentioned how the Asian Control Conference, held in Melbourne in 2004, was viewed by some in Australia as a gathering of those promoting the control of Asia (political or military) rather than a meeting of Asian researchers and practitioners on the technical field of control engineering. Jokes aside, however, it has been brought to the forefront this year, as the IEEE Technical Activities Board has asked all Societies to reexamine and update, where needed, their field of interest statements. The IEEE Control Systems Society (CSS) Executive Committee, with the help of the Board of Governors and anyone else willing to offer some input, has been trying to come up with a revised statement as it applies to our Society—a statement that captures our activities as they have evolved over the past few decades and as they are shaping up

for the future. The prevailing feeling among many, including myself, is that the activities of the “control” community have become substantially broader and that our future indeed lies in such a broader view. It is a healthy instance of an “identity crisis” in the sense that we are trying to redefine ourselves based on how we have naturally evolved over the past couple of decades.

The current field of interest statement for the CSS starts with the sentence “This society focuses on the theory, design, and application of control systems.” While this is not inaccurate, it seems to imply that the scope of this field is limited to “systems” exclusively functioning as “controllers.” In other words, when a large technological system is designed and built, someone might think that our work comes down to simply contributing a few “modules” that control this system. This leaves out major

responsibilities such as the overall architectural design, the analysis of the system’s performance objectives that drive the control tasks, or the incorporation of communication functions among system components—all functions that include feedback and commands often transmitted through network structures, wired or wireless. This perception also seems to imply that our role comes *after* the system is built, just to ensure it works well, rather than being part of its initial inception and conceptual design.

Yet, as we all know, nothing can be further from the truth. Our expertise allows us to analyze systems, design new and better ones, and manage their operation in innovative ways that only the understanding of fundamental concepts such as dynamics and feedback can enable. A typical attendee of our conferences today is in fact a system scientist or system engineer as much as a control expert.



Christos Cassandras with daughter Monica and wife Carol at an Aegean island in July 2011.



Christos Cassandras with some of his students in the Control of Discrete Event Systems (CODES) Laboratory at Boston University.

In short, our field is much broader than many consider it to be, and its scope is best characterized as systems and control where the systems we focus on are mostly dynamic in nature. This element of dynamics in what we study is precisely what makes the field so interesting: it means that we must be prepared to adapt to changing operating conditions, evolving system objectives, and confronting random events.

Another part of the current field of interest statement for the CSS states that "The word 'systems' as used herein shall be interpreted to include physical, biological, organizational and other entities, and combinations

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[*Editor's note:* The Boeing 7J7 development program was cancelled in the late 1980s when the price of oil dropped.]



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thereof, which can be represented through a mathematical symbolism." The restriction to systems that can be represented through a mathematical symbolism invokes the perception that if a system has no neat mathematical representation, then we do not deal with it. Again, as we all know, nothing can be further from the truth. In fact, I can recall a recent special issue of *IEEE Transactions on Automatic Control* precisely on symbolic methods for complex systems, not to mention numerous technical sessions and papers that address the fact that many of the sys-

tems we are interested in today cannot be represented by traditional mathematical means. Perhaps this is because the focus of our attention has shifted from servomechanisms, aircraft, and industrial machining processes to new systems involving computers, commercial electronic devices, and wireless networks—pretty much anything with an on-off switch. New models have emerged for these systems, and they often go beyond the traditional mathematical symbolism of differential and dif-

ference equations to include purely symbolic representations, graphical ones, and quite frequently combinations of these.

This identity crisis in CSS is very healthy in my opinion. Our mind-set remains that of controlling a system, but the methodological advances of our field combined with new technologies at our disposal have enlarged the sphere of our technical

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interests and activities. There have been, for example, groups from the CSS community that are now working on better ways to control computer operations through scheduling or power management algorithms using ideas and techniques having little to do with what is found in our favorite control textbooks from the 1970s or 1980s. Others have gotten involved with the analysis of the Transmission Control Protocol (TCP) for the Internet and have suggested new approaches to congestion con-

trol in networks or, for that matter, in transportation systems. On the other hand, those who are venturing into the emerging field of systems biology are not (yet) trying to control biological systems but rather trying to accurately model these systems and explore their inherent feedback mechanisms.

This is the broader perspective I am referring to when it comes to the activities of the CSS community these days. And this is what I am hoping our evolving identity can capture and project to the outside world that may still think of us as just a small cog in

the process of designing and building new systems, large or small. At the time these lines were written, a revised field of interest statement for the CSS was still being developed. At the time this "President's Message" is published, I expect that the statement will be finalized and made official, which hopefully better reflects our identity in 2012 and for the foreseeable future.

**Christos G. Cassandras**

