I am deeply honored and grateful to receive this award. Let me say a few words, in the tradition of reflecting on research and thanking those who influenced me professionally. I came to the United States to study with Rudolf Kalman, attracted by his application of rigorous mathematical thinking to problems of practical significance. Prof. Kalman was a challenging mentor, who inspired his students to strive in research excellence, deep thinking, and clear exposition. As graduate students, we shared many long discussions with Yutaka Yamamoto, who taught me much, from infinite-dimensional systems to the proper way to handle chopsticks.

The 1970s were a decade of maturation for systems theory, which witnessed an explosion of new and exciting ideas, involving the algebraic theory of linear systems, geometric approaches to feedback design, Lie-theoretic control, nonlinear filtering, adaptive control, and so forth. Kalman’s Center for Mathematical System Theory attracted the best and brightest visitors, including Yves Roucheleau, Ed Kamen, David Elliott, Steve Morse, Roger Brockett, Sanjoy Mitter, and Jan Willems. I remember, especially, because of their deep influence on my thesis work, Michel Flies, and Alberto Isidori, who is one of the most modest and brilliant people that I know. I was extremely lucky to have the opportunity to learn from all of them. After Florida, I accepted a job at Rutgers mainly because of my interest in working with Hector Sussmann. Hector had the strongest impact on my subsequent research. I learned differential-geometric control theory from his amazingly clear and deep papers, courses, seminars, and discussions.

There are many other people, too many to credit here, who had a significant influence on my work. Among the most senior ones, let me single out Pramod Khargonekar, Jack Rugh, Laurent Praly, Zvi Artstein, Jan-Michel Coron, Andy Teel, and of course Petar Kokotovic, whose enthusiasm for science and life is an example for us all. I have been also fortunate to be able to work with bright junior collaborators, including my amazing student Yuan Wang, the brilliant out-of-the-box thinker David Angeli, as well as Murat Arcak, Daniel Liberzon, Patrick de Leenheer, and many, many others.

These kinds of speeches are expected to include reflections on one’s field and about science in general. So, at the risk of sounding presumptuous, let me make put forth some personal opinions about research in systems and control theory.

First, it is important to pick questions that are mathematically natural, general, and elegant. Paradoxically, general facts are often far easier to prove than special ones, because they are stripped of irrelevant details.

Second, I never cease to be amazed at the inverse relationship between how much technical detail a publication has and its impact and citations.
Inevitably, it is the simplest ideas, those that look obvious in retrospect, that are the most influential. For me, this is a motivation to spend a major effort simplifying arguments to their most elementary form. That said, the development of any theoretical field involves the study of technically detailed and special cases, which provide the inspiration for the eventual conceptual synthesis. In turn, once a concept has been discovered, working out particular cases and proving abstract theorems serves to confirm the strength and depth of the concept. For example, the interest in converse Lyapunov theorems is not because such theorems are useful in practice but because they show the richness of Lyapunov’s ideas. Theorems are rarely applied. Concepts are.

Third, one should be cautiously open to new ideas, even those that are orthogonal to the current fashion. But of course, not all new ideas are good: novelty by itself is not a criterion. After all, a paper that lists the first 1000 integers has surely never been published before, but I would not recommend it for an IEEE journal.

Fourth, we should not be discouraged by rejections and should keep improving and trying until we succeed. This applies not only to papers and grant proposals. In the early 1980s I applied for IEEE membership, but was initially declined, presumably because I was in a math department. It was good that I persisted!

Finally, we should not lose sight of the fact that, while what we do might be fun, and intellectually challenging, and helps feed our families, the ultimate objective of our endeavors should be to make the world a better place through scientific understanding and engineering advances.

It is important to always keep in mind ultimate challenges, whether understanding human brain function, or the large structure of the universe, or designing safe and efficient energy systems. In my case, until fairly recently, my father would periodically ask me “What would you like to do when you grow up?” Well, I finally made up my mind and decided that when I grow up, I will work on systems biology. There is little doubt in my mind that the mechanistic understanding of cell and organism behavior will lead to the complete control over diseases and possibly life spans. In addition, the associated engineering field of synthetic biology will lead to new therapeutic approaches as well as scientific understanding, and new mathematics and control problems suggest themselves all the time.

However, I want to stress that I do not believe that the main value of systems and control to molecular biology is in applying deep theoretical results. Details of input to state stability, control-Lyapunov functions, realization theory, computational complexity, and so forth, are quite irrelevant to what biologists want to know. It is instead the conceptual ideas of input/output versus state representations, controls, measurements, robustness, design tradeoffs, signal processing, optimization, and estimation that are, in my opinion, where the main impact of our field will be felt.

To close, I should of course thank the person that made it all possible, my wife Fran, and our fantastic children Laura and David.

Thank you all for your attention and for this great honor.

Eduardo Sontag