

Acceptance Speech  
IEEE Control Systems Award presentation to  
Pramod P. Khargonekar  
IEEE Conference on Decision and Control  
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Thank you, IEEE, IEEE Control Systems Society, Awards Committee, colleagues and friends. I am extremely happy , greatly honored, and deeply humbled to join the distinguished scholars and pioneers of our community who have received this award in previous years. And, I congratulate Anders Lindquist who will stand here in about 12 months to receive next year's award.

The famous Danish philosopher Soren Kierkegaard wrote, "It is quite true what philosophy says that life must be understood backward. But then one forgets the other principle, that it must be lived forward."

Let me start with the easier part of Kierkegaard's observation: understanding life looking backwards. My parents were high school teachers from quite poor backgrounds. My parents, especially my mother, had a very big influence on me. From my early childhood, she instilled the love of learning and encouraged me to aim for the highest goals,. Without their support, sacrifice and love, I would not be much of anything. If they were alive, they would be very happy for me. I am and will always be extremely grateful to them.

I was very lucky to secure admission to the Indian Institute of Technology, IIT, Bombay. The exceedingly stringent academic standards of IIT Bombay have shaped my mind and intellect. At IIT, I became very close friends with Kameshwar Poolla, someone many of you know. His father, a renowned experimental physicist, strongly advised me to go for graduate studies to the US. I was taking graduate level classes in control and estimation. By chance, I read some recent papers by Professor R. E. Kalman. I was deeply inspired by his pioneering spirit and persuasive writing. I wrote him a letter hoping that he would accept me as a PhD student. I didn't expect a reply, but In an incredible stroke of good fortune, he accepted me as his student in 1978. This would be a major turning point in my life.

Professor Kalman and the Center for Mathematical System Theory at the University of Florida provided a very rich environment for my intellectual growth where I started my research in algebraic system theory. I met Erol Emre in my first month and published my very first research papers with him. Eduardo Sontag was a frequent visitor and he spoke mathematics faster than anyone I knew! He became an early mentor and research collaborator, we became lifelong friends, and I am most indebted to him. Tryphon Georgiou and Bulent Ozguler joined a year after and we became close friends and collaborators. I am most grateful to Tryphon for his lifelong friendship. Edward Kamen and Allen Tannenbaum joined near the end of my PhD and I was very lucky to be able to collaborate with them. Thank you Allen, for teaching me algebraic geometry, and all sorts of mathematics. Kameshwar joined as PhD student, Ed Kamen and I became his co-supervisors. During this time, I went to Waterloo at Vidyasagar's kind invitation. He has been an

inspiration, a lifelong mentor, and friend, and I want to express my gratitude to him. This was also the time when Yutaka Yamamoto, another student of Kalman, came as a visitor and we became lifelong friends and collaborators. It is impossible to thank Professor Kalman enough for making my professional life possible.

Around 1983, we read a ground-breaking paper on robust control by John Doyle and Gunter Stein. We invited John for a seminar at Florida, and that led to the next major turn in my life. Bruce Lee, Head of the Electrical Engineering department at the University of Minnesota, offered me a job in 1984. Bruce was a legend in the field and an exceptional gentleman, I owe an enormous debt to him. The opportunity to work in the exciting field of robust control with John and Gunter at Honeywell was a huge attraction. It was one of my smartest and luckiest professional decisions. Much has been said about the 1984 Honeywell-ONR workshop, including at the last CDC in a special session to celebrate the life of late Bruce Francis. In addition to John and Gunter, I met Bruce Francis, Keith Glover and many other luminaries of the field. I had greatly admired their superb papers. It led to my collaboration on state-space H-infinity control theory with John, Bruce and Keith, three of the most brilliant people in our field. I will forever be grateful to them for their friendship, mentorship, and collaboration.

In the late 80's, Elmer Gilbert, another giant of our field who passed away earlier this year, came to Minnesota for a sabbatical. We instantly bonded and I moved to the University of Michigan in 1989. The 12 years at Michigan were a time of transformative growth and maturation. These included forays into control and manufacturing. Inspired by Semyon Meerkov's sabbatical at Stanford with Tom Kailath, we developed large multidisciplinary projects on semiconductor manufacturing. Our work was a collaboration with Semyon, Mike Elta, Jim Freudenberg, Jessy Grizzle, Pierre Kabamba, Stephane Lafortune, Demos Teneketzis, Fred Terry and many others. They have become lifelong friends and I am grateful to them for everything they taught me.

After my years as Engineering Dean at Florida, I went to Berkeley for a sabbatical in 2010. Kameshwar was my host. We have been friends for most of our adult lives. Words are insufficient to express my gratitude to him. There began a new chapter in my research life around renewable electricity and smart grids. I was very lucky to get to know Pravin Varaiya and have benefitted greatly from his brilliant intellect, expansive vision of systems research, wide intellectual outlook and great generosity. Exposure to energy systems led to me become Deputy Director for Technology at ARPA-e where I was involved in creating several research programs in renewable energy and energy efficiency. In one of the luckiest breaks of my life, I was appointed to head the Engineering Directorate at NSF in 2013. In my tenure there, I had the incomparable opportunity to contribute to the leadership of NSF and creation of numerous research programs in engineering, sciences, and STEM education, including in IEEE fields. Several of these enabled our community to expand the impact of our field to a variety of important problems.

In recent years, I have started to explore the confluence of machine learning and control. I am particularly fascinated by neuro and cognitive science inspired approaches to learning and control. It is early and much remains to be discovered.

So far, I have avoided the important duty and the great temptation to mention my students by name. There is not enough time to thank them individually. Let me say just this: I have been incredibly fortunate to have worked with very talented, hardworking PhD students and post-doctoral fellows. They have taught me most of what I know, have become members of my family, and have gone onto very successful careers in academy and industry. In many ways, this award is really on their collective behalf. I am extremely proud of them and thank them most sincerely. I also sincerely thank many other distinguished colleagues, many present here, who have helped me with direct collaborations on indirect influences.

I have completed the easy part of Kierkegaard's directive: looking back. Let me now try and do the hard part: look forward. I strongly believe that the opportunities for our field have never been greater. Potential applications are everywhere: energy, transportation, health, agriculture, security, to name just a few. Historically, we have intellectual roots in mathematics but now we have the opportunity to leverage computing, biology, economics, and social-behavioral sciences, and humanities to enrich the intellectual soil of our field. But neither of these opportunities is going to be easy to seize. The single biggest systemic challenge is to discover, value and celebrate new paradigms for interdisciplinary research that increase the impacts, expand the scope, and attract and educate new talent into our field. If we are able to do this to the fullest potential, there will be no limits to our success. I see many signs for optimism, including several of the awards presented this evening. I believe that together as a research community, we are up to meeting this challenge. Let us work together to develop an inspiring, expansive, shared vision of the future for our field. We can make valuable contributions, intellectual and substantial, to our fellow human beings and a healthy, peaceful and prosperous future. And I hope to work on this with you.

I want to close with my most important emotions of gratitude: I want to thank my wife of 36 years, Seema for her love and sacrifices without which I could have done nothing. I met her in Gainesville, Florida in 1982, and she has unstintingly supported me in all my endeavors since. No words can suffice to express my gratitude to her. I also want to thank our son Aditya, daughter Shivangi, daughter-in-law Manasi, and son-in-law Vikram, for their deep love, sacrifice, and support. And we are so pleased that we received the biggest gift of all: our grandson Vihaan who was born last week. 2019 has, indeed, been a truly lucky year.

In closing, I want to once again express my heartfelt gratitude to each and every one who has helped me in my journey and bringing me to the CSS award. I wish each one of you great professional successes, deep personal fulfillment, enduring happiness, and excellent health. Thank you all.