

Visionary Changes Control Engineering Industry



Eduardo D. Sontag, a researcher whose contributions to modern nonlinear control systems theory have become fundamental building blocks in the field and have impacted a wide range of engineering disciplines, is being honored by IEEE with the 2011 IEEE Control Systems Award. IEEE is the world's largest technical professional association. The award, sponsored by IEEE Control Systems Society, recognizes Sontag for fundamental contributions to nonlinear systems theory and nonlinear feedback control. The award will be presented on 14 December 2011 at the IEEE Conference on Decision and Control and European Control Conference in Orlando, Fla.

Sontag's devotion to the foundational mathematical aspects of nonlinear feedback for control and signaling systems opened the floodgates to creativity in nonlinear designs, which were previously held back by a reliance on linear systems theory concepts. Feedback loops are important to applications where a quantity needs to be tightly regulated, such as position, temperature, current, or chemical concentration. Sontag's pioneering introduction of control Lyapunov functions (CLF), input-to-state stability (ISS), and other concepts are key to ensuring stability in nonlinear feedback systems.

The impact of his work is far reaching, with applications ranging from the design of automobile active suspensions, robotics, aerospace guidance, and the mixing of pipe flows, to the development of algorithms for leader-follower autonomous vehicle formations. He has affected an entire generation of control engineers who have used his concepts to solve nonlinear problems that seemed impossible to handle during the 1980s.

In 1989 Sontag presented the CLF concept, quickly pervaded the control literature. What is now known as "Sontag's formula" provides control practitioners with the ability to make stabilizing feedback control choices. Sontag's work overcame previous factors such as linear gains and sector growth by providing a single fundamental concept. CLF has stood the test of time and is still used in control designs today.

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Also in 1989, Sontag's ISS concept tackled the difficulties presented by uncertainty in nonlinear systems. With ISS, Sontag showed how to capture the effect of persistent disturbances in nonlinear systems, which has enabled engineers to solve many robust stabilization problems. This concept also continues to play an important role in control applications today.

Sontag is also considered a pioneer of tools for hybrid control, which combines digital and analog devices, as well as the introduction of measures of computational complexity into control theory. His more recent work has focused on the study of dynamical and information processing aspects of molecular biology. He has shown how mathematical systems theory and feedback can be used to understand the behavior of cells and the function of complex genetic and protein signal transduction cellular networks.

An IEEE Fellow, Sontag is also a Fellow of the Society for Industrial and Applied Mathematics (SIAM). His awards include the SIAM Reid Prize in Mathematics, the IEEE Hendrik W. Bode Lecture Prize and the Board of Trustees Award for Excellence in Research and the Teacher/Scholar Award from Rutgers University. Sontag received a "licenciado" degree from the University of Buenos Aires, Argentina, and a doctorate from the University of Florida, Gainesville, both in mathematics. Sontag is currently a professor with the Department of Mathematics at Rutgers University, Piscataway, N.J., where he has worked since 1977, where he is also in the graduate faculty of the Computer Science and the Electrical and Computer Engineering Departments. Sontag is also a long-term research affiliate at MIT's Laboratory for Information and Decision Systems.

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