Roger W. Brockett, Harvard University, USA

Traveling Waves and the Law–Eberly Problem in Quantum Control

The general character of the time optimal control of systems of the form $\dot{x} = \sum u_i B_i x$ depends not only on the structure of the Lie algebra generated by $B_1, B_2, \ldots, B_k$ but also on the details of how the Lie algebra is generated. Problems of this kind play a role in the control of quantum mechanical systems in which case the B_I are skew-hermitean operators acting on a Hilbert space. As is well known, parametric adjustment of the quadratic potential of quantum mechanical harmonic oscillator affords only very limited controllability but when the oscillator is coupled with spin the controllability situation changes greatly. However, finding optimal control policies has proven to be difficult. In this talk I will discuss a special traveling wave solution and use it to show the asymptotic optimality of policies which are analogous to the famous turnpike theorems in economics.

Roger Brockett has contributed widely to control theory and applied mathematics, including early work on linear systems, frequency domain stability theory, differential geometric methods in nonlinear control, the computation of the Volterra series, a geometric approach to the sufficient statistics problem in nonlinear estimation, feedback linearization and feedback stabilization, robot kinematics and dynamics, formal languages for motion control, hybrid systems, computational problems related to tensor ranking and integrable systems, quantum control, and optimal control of Markov processes. His research and teaching has been recognized with awards from the IEEE, ASME, Society for Industrial and Applied Mathematics (SIAM), and AACC and, most recently, International Federation of Automatic Control. He is a Fellow of IEEE, SIAM, and American Mathematical Society and a member of the National Academy of Engineering. As a Harvard faculty member, he served on the faculty council for several years, initiated long-standing introductory-level courses in design and developed major funding for group efforts in robotics and computer vision. He retired from his teaching position in 2012 after nearly 50 years of lecturing while advising more than 60 Ph.D. students at Harvard University, Massachusetts Institute of Technology, and Brandeis University. His 1970 textbook on linear systems has recently been reprinted in the SIAM Classic Series.