

The Role of Broken Extremals in Nonholonomic Optimization

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1001 LSB Rathmann Auditorium

Abstract:

We will discuss a problem which has a deceptively simple description. We want to transfer a nonsingular matrix $X(0)$ to a second nonsingular matrix $X(1)$ under the assumption that the matrix evolves according to $\dot{X}=UX$ with $U(t)=U^T(t)$. This system is controllable on the space of nonsingular matrices with positive determinant and the first order necessary conditions associated with minimizing $\eta = \int_0^T \|U(t)\| \, dt$ subject to the condition that U should steer the system from $X(0)=X_0$ to $X(1)=X_1$ imply that U should take the form $U(t) = e^{\Omega t} H e^{-\Omega t}$ with $\Omega = -\Omega^T$ and $H=H^T$, both constant. What makes this problem interesting, however, is the abundance of conjugate points, the non uniqueness of the solutions of the first order necessary conditions and the possible necessity for broken extremals. These and other surprises make this a candidate for the new poster child of optimal control.

About the Speaker:

Roger Brockett is the An Wang Professor of Electrical Engineering and Computer Science in the Division of Applied Science at Harvard University. He received his BS., MS., and Ph.D. degrees from Case Western Reserve University and taught for six years in the Electrical Engineering Department at MIT before joining the Harvard faculty in 1969. He has contributed extensively to the theory of automatic control with work on stability, nonlinear control, feedback linearization, system identification, nonlinear estimation, pole placement, hybrid systems, and robotics. Areas of particular interest include the problem of motion control, and the investigation of new paradigms involving the concept of attention in high data rate, sensory rich environments. Professor Brockett has been recognized by the American Automatic Control Council and the IEEE through their Richard Bellman award and the Control System Science and Engineering Award and has received the Reid Prize from the Society of Industrial and Applied Mathematics. He has served on a variety of National Research Council Panels and is a member of the National Academy of Engineering.
