

# New Vistas in Control of Complex Systems:

*Logical and Geometric Aspects of Hybrid Control  
and their Application to Real-Time Systems*

*presented by* Anil Nerode, Goldwin Smith Professor of Mathematics, Cornell University

**Friday**  
**November 3, 2006**  
**4:05–4:55 p.m.**  
**282 Reitz Union**

Opening Remarks by Krishnaswami Alladi  
Chair, Department of Mathematics  
Refreshments: 3:30–4:00 outside of JWRU 282



**Abstract:** Many complex systems, such as aircraft traffic control, have many non-linearities in immense phase spaces and interact with discrete systems, which are logic-based systems and not amenable to traditional linear or optimal control technology. Nerode and Wolf Kohn have developed a theory of interacting systems of discrete digital programs and continuous devices. The “Fundamental Problem of Hybrid Systems” is to develop methods for extracting digital control programs for such systems, which force them to obey their performance specifications. The community in Hybrid Systems lies at the interface of logic, computer science, and control engineering. Nerode and Kohn have developed in many papers and in a commercial company their own method of modeling hybrid systems by Finsler manifolds, which incorporate both a continualized version of all discrete logical rules or constraints and all the continuous constraints given by ordinary differential equations, and a Lagrangian optimization function on trajectories to the desired goal. Optimal controls give optimal trajectories to the goal, which are Finsler Geodesics.

**Anil Nerode** is a world leader in applied logic. He earned his Ph.D. in 1956 from Saunders MacLane at the University of Chicago and was an NSF postdoctoral fellow under Kurt Godel at the Institute for Advanced Study (IAS), Princeton before settling at Cornell University, where he was Chair of the Mathematics Department from 1982–1987, Director of the Mathematical Sciences Institute from 1987–1996 and is now Goldwin Smith Professor of Mathematics. Nerode was a member of the Institute for Defense Analysis in Princeton during 1963–64 and Distinguished Visiting Scientist for Artificial Intelligence at the Environmental Protection Agency from 1985–87. He was founder and Chairman of the Hybrithms Corporation from 1995–1998. He has been a consultant for IBM, Schlumberger, the Commonwealth of Puerto Rico and the American Board of Family Practice. He has served on the Committee on Applied Mathematics of the National Research Council, the Advisory Panel for Mathematical Sciences of the NSF, the Committee on Mathematics of the National Academy of Sciences, and the Committee on Science Policy of the American Mathematical Society (AMS). He was Vice President of the AMS from 1991–1994.