

M7 : Optimality, Stabilization and Feedback in Nonlinear Control

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This course presents some modern tools for treating truly nonlinear control problems, including nonsmooth calculus and discontinuous feedback. The need for such tools will be motivated, and applications made to central issues in optimal and stabilizing control. Topics include:

1. Dynamic optimization: from the calculus of variations to the Pontryagin Maximum Principle
2. Some constructs of nonsmooth analysis, and why we need them
3. Lyapunov functions, classical to modern
4. Discontinuous feedback synthesis for stabilization
5. Sliding modes and hybrid systems: a new approach

References:

R1. "Nonsmooth Analysis and Control Theory", by F. Clarke, Yu. Ledyaeu, R. Stern and P. Wolenski, Graduate Texts in Mathematics Vol. 178, Springer -Verlag, New York, 1998.

R2. F. Clarke, "Lyapunov functions and feedback in nonlinear control," in "Optimal Control, Stabilization and Nonsmooth Analysis", M.S. de Queiroz, M. Malisoff, P. Wolenski (Eds.), Lecture Notes in Control and Information Sciences Vol. 301, pp. 267-282, Springer-Verlag, 2004.

R3. F. Clarke, "Necessary Conditions in Dynamic Optimization", Memoirs of the Amer. Math. Soc., No. 816, vol. 173 (2005) (113 pages).

R4. F. Clarke, "Nonsmooth analysis in control theory: a survey," European J. of Control 7 (2001) 63 - 78.

R5. F. Clarke, Yu. Ledyaeu, L. Rifford and R. Stern, "Feedback stabilization and Lyapunov functions," SIAM J. Control and Optim. 39 (2000) 25 -48.

Francis Clarke was born in 1948 in Montré al. His PhD is from the University of Washington (1973); he became full professor at the University of British Columbia in 1978. In 1984 he was named director of the Centre de Recherches Mathématiques (CRM) at l'Universit'é de Montré al. During his nine -year tenure, CRM evolved into Canada's first national research center for mathematics and its applications. Clarke was also founding director of ISM, a mathematics institute spanning Montré al's four universiti es. He is now a faculty member at l'Universit'é de Lyon, in l'Institut Camille Jordan, and also holds a chair in mathematical control theory at l'Institut universitaire de France. Francis Clarke's research interests lie in nonsmooth analysis (a term he coi ned), differential equations, control theory, optimization, and the calculus of variations. His contributions have involved the development of nonsmooth calculus, its applications to dynamic optimization, regularity and existence theory in the calculus of variations, Hamiltonian mechanics, generalized solutions of the Hamilton-Jacobi equation, and feedback control synthesis. Francis Clarke is the author of the book Optimization and Nonsmooth Analysis (Wiley 1983, now in SIAM's Classics in Applied Mathematic s Series), which has been translated into Russian. A Fellow of the Royal Society of Canada, he has received the Coxeter -James and the Archambault research prizes, and a Killam Fellowship. He has been a featured speaker at the International Congress of Mathematicians (Helsinki 1978), plenary speaker at the CDC (Brighton 1991) and the ECC (Porto 2001), and keynote speaker at the Congress of Nonlinear Analysts (Athens 1996). In 2004 he was president of the scientific committee for the first joint meeting of th e six mathematical societies of Canada and France.

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