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Feedback-invariant optimal control theory and differential geometry. I: Regular extremals.
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This paper is devoted to the unification of the theory of smooth optimal control problems and that part of differential geometry which deals with geodesics of different kinds.

Section 1 analyses the \mathcal{L} -derivatives of smooth mappings. Section 2 realizes a connection between smooth control systems and basic structures of differential geometry. Section 3 gives the computation of \mathcal{L} -derivative of the boundary-value mapping and studies the regular extremals (which are trajectories of a fixed Hamiltonian system). Section 4 introduces and investigates Jacobi curves as curves in a Lagrangian Grassmannian. Section 5 studies the canonical connections of Hamiltonian systems and of DEs of second-order. Section 6 finds explicit geometrical objects defined by two-dimensional control systems.

Reviewer: [Constantin Udriște \(București\)](#)

MSC:

- [49K15](#) Optimality conditions for problems involving ordinary differential equations
- [53C22](#) Geodesics in global differential geometry
- [93B52](#) Feedback control
- [58E25](#) Applications of variational problems to control theory
- [53B05](#) Linear and affine connections
- [53B15](#) Other connections

Cited in **4** Reviews
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Keywords:

smooth optimal control; geodesics; regular extremals; canonical connections; Hamiltonian systems

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References:

- [1] A. A. Agrachev, Quadratic mappings in geometric control theory. (Russian)Itogi Nauki i Tekhniki VINITI; Problemy Geometrii, Vol. 20, 1988.VINITI, Moscow, 111–205. (English translation:J. Soviet Math., Plenum Publ. Corp., Vol. 51, 1990, 2667–2734).
- [2] –, Topology of quadratic mappings and Hessians of smooth mappings. (Russian)Itogi Nauki i Tekhniki VINITI; Algebra, Topologia, Geometria, Vol. 26, 1988,VINITI, Moscow, 85–124. (English translation:J. Soviet Math., Plenum Publ. Corp., 1990, 990–1013).
- [3] A. A. Agrachev and R. V. Gamkrelidze, Exponential respresentation of flows and chronological calculus. (Russian)Mat. Sb. 107 (1978), 467–532. (English translation:Math. USSR Sb. 35 (1979), 727–785). · [Zbl 0408.34044](#)
- [4] – The Morse index and the Maslov index for extremals of controlled systems. (Russian)Dokl. Akad. Nauk SSSR 287 (1986), 11–205. (English translation:Soviet Math. Dokl. 33 (1986), 392–395).
- [5] A. A. Agrachev, The extremality index and quasi-extremal controls. (Russian)Dokl. Acad. Nauk SSSR 284 (1985). (English translation:Soviet Math. Dokl. 32 (1985), 478–481. · [Zbl 0587.49018](#)
- [6] A. A. Agrachev, The quasi-extremality for controlled systems. (Russian)Itogi Nauki i Tekhniki. VINITI; Sovremennyye problemy matematiki. Novejshie dostigeniya, Vol. 35, 1989. (English translation:J. Soviet Math. Plenum Publ. Corp., 1991, 1849–1864).
- [7] A. A. Agrachev, Symplectic methods for optimization and control. (to appear in: Geometry of Feedback and Optimal Control,Marcel Dekker).
- [8] A. A. Agrachev, R. V. Gamkrelidze, and A. V. Sarychev, Local invariants of smooth control systems.Acta Appl. Math.,14 (1989), 191–237. · [Zbl 0681.49018](#) · [doi:10.1007/BF01307214](#)
- [9] V. I. Arnold, Mathematical methods of classical mechanics, Third edition.Nauka, Moscow, 1989.
- [10] B. Bonnard, Feedback equivalence for nonlinear systems and the time optimal control problems.SIAM J. Control and Optimiz.,29 (1991), 1300–1321. · [Zbl 0744.93033](#) · [doi:10.1137/0329067](#)

- [11] L. S. Pontryagin, V. G. Boltyanskii, R. V. Gamkrelidze, and E. F. Mischenko, *Mathematical theory of optimal processes*. Fizmat. giz., Moscow, 1961.

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