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17. Control Theory and Optimization

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Bundles with chattering extremals

Pontryagin's maximum principle for affine in control problem leads to the following discontinuous Hamiltonian $(2n)$–system

$$\dot{\psi} = -\partial H/\partial x, \quad \dot{x} = \partial H/\partial \psi,$$

where $H = H_0(\psi, x) + uH_1(\psi, x)$, $u = \text{sgn } H_1(x)$. For generic systems possessing a singular extremal of order $q \geq 3$ we prove that there exist $[q/2]$ $(2n-2q+2)$–dimensional bundles with the common $(2n-2q)$–dimensional base and two–dimensional piece–wise smooth fibres such that each fibre consists of chattering extremals, i. e. trajectories having a countable number of switches at finite time. The result is a generalisation of a theorem on bundles proved in [1] for systems possessing singular extremals of order $q = 2$.

[1]. Zelikin, M. I., Borisov, V. F. *Theory of Chattering Control with Applications to Astronautics, Robotics, Economics, and Engineering.* Birkhäuser, Boston, 1994.