DIFFERENTIAL GEOMETRY OF OPTIMAL CONTROL PROBLEMS AND HAMILTONIAN SYSTEMS

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ABSTRACT: The course is devoted to the recently developed theory which pretends to provide natural feedback (or gauge) differential invariants for a wide class of control systems and geometric structures. The theory is based on the study of singularities of the Boundary Mapping (which sends admissible trajectories of the control system to their end points) and systematically exploits Symplectic language.

REFERENCES.

Some acquaintance with the following two textbooks would be useful although these books contain much more material than we really need:

1. V. I. Arnold, Mathematical methods of classical mechanics. Springer-Verlag, 1989.

2. A. A. Agrachev, Yu. L. Sachkov, Control theory from the geometric viewpoint. SISSA preprint, 2002 (available in web: www.sissa.it/fa/am/topics_am.html). Technical publications on the subject see in the Journal of Dynamical and Control Systems, v.3(1997), 343-389; v.4(1998), 583-604; v.8(2002), 93-140, 167-215. In the course, I plan to give much more friendly presentation than in the technical papers.

PROGRAMME:

1. Constrained extremal problems: Lagrange multipliers and Lagrangian submanifolds.
2. Regular optimal control problems and smooth Hamiltonian systems on the cotangent bundles.
3. Basic differential invariants of Hamiltonian systems: canonical connection and the curvature operator.
4. Conjugate points, Maslov index, and comparison theorems.
5. Degenerate extremal problems and L-derivative.
6. Basic curvature-type invariants for affine in control systems and vector distributions.