Heinz Schättler
Department of Electrical and Systems Engineering
Washington University, St. Louis, USA

From Necessary to Sufficient Conditions in Optimal Control Theory: Solutions to Practical Problems

I will highlight how the methods of optimal control theory—starting with the necessary conditions for optimality from the Pontryagin maximum principle and proceeding to sufficient conditions in form of a regular synthesis of optimal controlled trajectories constructed using the method of characteristics—can be utilized to solve practically relevant problems in engineering. Examples will be taken from the following practical areas:

- flight control (Ground Collision Avoidance Systems): perturbation feedback control laws with free terminal time,
- physics (minimum-time frictionless atomic cooling in harmonic traps): a problem with many cut-loci,
- semiconductors (the minimization of the base transit time in homogeneous bipolar transistors semiconductors): synthesis for problems with state-space constraints.

In these solutions, interesting mathematical questions arose (e.g., desingularization of singularities, homotopy of a synthesis) that needed to be addressed and will be discussed.