Minimum-Fuel Interkontinental Hypersonic Flights
under Aerothermic Heat Constraints

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Abstract

Many studies on hypersonic (passenger) flights are currently going on worldwide. In this talk a minimum-fuel trajectory optimization problem for a hypersonic passenger aircraft is investigated where the main part of the model is given by an aerothermic heat constraint for the thermal protection system (TPS) which is essential at speeds of Mach 4–5. This trajectory optimization problem is modelled by a system of ordinary differential equations (ODE) which is controlled by the usual control variables of flight dynamics under their common control and state variable inequality constraints. In addition, a state constraint on the temperature of the TPS must be taken into account. It is governed by a quasi-linear heat equation with non-linear boundary conditions and coefficients depending on the ODE state variables and controls. This non-standard pointwise state constraint couples the PDE with the ODE system reversely. Numerical results show the influence of the aerothermic heat constraint on the trajectory along its boundary arcs, but also exhibits the current limitations of the computability of PDE constraint optimization problems of real-life nature.