Stabilized Optimal Control with Applications in Aerospace Engineering

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Three-dimensional optimal flight trajectories including singular subarcs are computed for a single-stage, suborbital hypersonic demonstrator system under a new type of constraint. An optimal *nominal* trajectory is only permissible if it offers a prescribed level of safety along the total flight path. As an example, the problem of mission abort is considered. The flight vehicle has to reach an emergency landing site from every point of the nominal ascent trajectory after a total failure of the aircraft engine. The mathematical model describing the motion of the demonstrator is based on the three-dimensional equations of motion of a point mass with reference to the spherical rotating Earth. Mathematically, the constraint is transformed into a series of secondary problems of optimal control. The complete problem can be formulated as a boundary value problem for a very large system of highly nonlinear differential equations. The safety condition is fulfilled pointwise by an adaptive strategy. The numerical solution is by the advanced multiple shooting method *JANUS*. Several special extensions are necessary to treat the new type of constraint efficiently. The demand for full safety in case of mission abort leads to significant deformations of the unperturbed trajectory.