Optimal Control of Re-entry Aircraft Trajectories with Minimum Heating

B. Pablos[1] **and M. Gerdts**[2]

Abstract: Re-entry maneuvers subject orbital aircrafts to extreme thermal conditions. In order to find optimal re-entry trajectories minimizing heating, a 3D flight dynamic model coupled with a heating rate model is considered in order to formulate an optimal control problem. The Sutton-Graves formula for 1D convective stagnation point heating has been used so far to model the heat flux, although more sophisticated heating models using PDEs and shape optimization will be considered in the future. To solve the problem, an SQP method for general finite dimensional nonlinear optimization problems with a piece-wise control approximation and multiple shooting method for the state approximation have been used to solve the problem. However, these methods have been proven to be inefficient for the large-scale, sparse structure of the problem. Therefore, tailored SQP and interior point methods that exploit this kind of structure explicitly must be used. Several numerical simulations have been performed using realistic initial data and boundaries in order to obtain optimal trajectories. The influence of imposing different state constraints and considering different objective functions is analyzed in the results.

[1,2] Institute of Mathematical Engineering of the Department of Aerospace Engineering
Universität der Bundeswehr München
Werner-Heisenberg-Weg 39, D-85577 Neubiberg/Muenchen, Germany
{*blanca.pablos, matthias.gerdts*}*@unibw.de*