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Global optimization approach for the climbing problem of multi-stage launchers[1]

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Abstract:
This paper deals with a problem of trajectory optimization of the flight phases of a three-stage launcher. The aim of this optimization problem is to minimize the consumption of ergols that is need to steer the launcher from the Earth to the GEO. Here we use a global optimization procedure based on Hamilton-Jacobi-Bellman (HJB) approach. An interesting by-product of the HJB approach is the synthesis of the optimal control in feedback form. Once the HJB equation is solved, for any starting point, the reconstruction of the optimal trajectory can be performed in real time.
We aim at showing that combining several new techniques for the HJB approach we can obtain efficient solutions to a fully nonlinear control problem. The global optimization procedure proposed here takes also into account parametric optimisation that appears in the flight phases.
Several recent advanced numerical techniques for HJB equations (high order finite difference schemes, parallel computing) are used to solve a 6-dimensional optimal control problem within a reasonable CPU time.
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