World Academy of Science, Engineering and Technology
International Journal of Aerospace and Mechanical Engineering
Vol:9, No:09, 2015

Near Optimal Closed-Loop Guidance Gains Determination for Vector Guidance Law, from Impact Angle Errors and Miss Distance Considerations

Authors : Karthikeyan Kalirajan, Ashok Joshi

Abstract : An optimization problem is to setup to maximize the terminal kinetic energy of a maneuverable reentry vehicle (MaRV). The target location, the impact angle is given as constraints. The MaRV uses an explicit guidance law called Vector guidance. This law has two gains which are taken as decision variables. The problem is to find the optimal value of these gains which will result in minimum miss distance and impact angle error. Using a simple 3DOF non-rotating flat earth model and Lockheed martin HP-MARV as the reentry vehicle, the nature of solutions of the optimization problem is studied. This is achieved by carrying out a parametric study for a range of closed loop gain values and the corresponding impact angle error and the miss distance values are generated. The results show that there are well defined lower and upper bounds on the gains that result in near optimal terminal guidance solution. It is found from this study, that there exist common permissible regions (values of gains) where all constraints are met. Moreover, the permissible region lies between flat regions and hence the optimization algorithm has to be chosen carefully. It is also found that, only one of the gain values is independent and that the other dependent gain value is related through a simple straight-line expression. Moreover, to reduce the computational burden of finding the optimal value of two gains, a guidance law called Diveline guidance is discussed, which uses single gain. The derivation of the Diveline guidance law from Vector guidance law is discussed in this paper.

Keywords : Marv guidance, reentry trajectory, trajectory optimization, guidance gain selection
Conference Title : ICAET 2015 : International Conference on Aerospace Engineering and Technology
Conference Location : Rome, Italy
Conference Dates : September 17-18, 2015