GPS based prediction of the Instantaneous Impact Point for KSLV-I

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Korea has a plan to launch the satellite about 100kg weight into the low earth orbit using KSLV-I(Korea Space Launch Vehicle) which is three-stage liquid rocket in the some years. One of the most important things in launching vehicle is to ensure public safety during launch and flight. The instantaneous impact point(IIP) describes the touch down point of the launch vehicle under the assumption of an immediate termination of the boosted flight. A real time prediction of IIP is performed to monitor the expected impact position in case of flight termination. If necessary, we should terminate the flight of malfunctioning vehicles. Because IIP must be predicted in real time, it is necessary to use the rapid calculation algorithm. There are two methods commonly used. One method uses the Lambert theory assuming that flight trajectory is the Keplerian orbit. The other method uses the linearized model which is a simple parabolic trajectory assuming the flat earth. For this method, various corrections can be adopted to account for the curvature of the surface of the earth as well as the integral effects of the Coriolis force and gravity field changes along the trajectory. For the prediction of IIP, it is necessary to know the real time position, and velocity informations of launch vehicle. After obtaining flight informations of KSLV-I from numerical simulations of six degrees of freedom equations of motion, we predict the instantaneous impact point of KSLV-I using the two methods mentioned above. The precision of instantaneous impact point depends on the quality of real time information for the position, and velocity of the vehicle. Flight information observed by radars usually includes large errors while flight information observed by the GPS receiver includes relative small errors. Hence, we can predict more accurate IIP and reduce the cost, when GPS receiver is used to obtain the flight information. For the studies, it is assumed that the flight informations of KSLV-I through both the radars and GPS receivers are obtained. With the fictitious flight data, we can compute the IIP by using the two methods. We analyze the advantages and disadvantages of each IIP prediction method.