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MAGNETIC NAVIGATION FOR NON COLLABORATIVE SATELLITE RENDEZVOUS

Abstract

Satellite servicing and active debris removal missions require an orbital rendezvous between a chaser satellite and a target satellite. If the target considered has not been designed to perform a rendezvous, the complexity of this manoeuvre is dramatically increased. In some of these non-cooperative rendezvous, the target satellite may not be able to stabilize itself or to communicate. It then falls to the chaser to determine the attitude and relative position of its target, in order to compute the manoeuvers it must undertake. This study shows that the chaser can use magnetic measurements to find the attitude and relative position of its target, as long as a fixed magnetic dipole is located in the target. As many satellites in LEO use magnetorquers to control their attitude, this assumption seems realistic. To obtain the pose, The measurements of the magnetic field and the magnetic field gradient produced by the dipole are combined with their analytical expression . The influence of model approximation, like the use of far-field expressions, as well as measurement errors, is studied. This methodology gives the position of the dipole and the orientation of its axis, but does not give access to the orientation of the satellite around this axis. As the free motion of a body in the absence of a privileged rotation direction is determined by the so-called tumbling equations, a Kalman filter is implemented in order to access this last degree of freedom.