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Relative motion guidance, Navigation and control for autonomous orbital rendezvous (Article)

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Abstract

View references (21)

In this paper, the dynamics of the relative motion problem in a perturbed orbital environment are exploited based on Gauss' variational equations. The relative coordinate frame (Hill frame) is studied to describe the relative motion. A linear high fidelity model is developed to describe the relative motion. This model takes into account primary gravitational and atmospheric drag perturbations. In addition, this model is used in the design of a control, guidance, and navigation system of a chaser vehicle to approach towards and to depart from a target vehicle in proximity operations. Relative navigation uses an extended Kalman flter based on this relative model to estimate the relative position and velocity of the chaser vehicle with respect to the target vehicle and the chaser attitude and gyros biases. This filter uses the range and angle measurements of the target relative to the chaser from a simulated Light Detection and Ranging (LIDAR) system, along with the star tracker and gyro measurements of the chaser. The corresponding measurement models, process noise matrix and other filter parameters are provided. Numerical simulations are performed to assess the precision of this model with respect to the full nonlinear model. The analyses include the navigations errors, trajectory dispersions, and attitude dispersions.

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References (21)

Related documents

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Okasha, M. , Newman, B.
(2015) International Journal of Aeronautical and Space Sciences

Relative motion modeling and control in a perturbed orbit

Okasha, M. , Newman, B.
(2011) Advances in the Astronautical Sciences

Relative motion guidance, navigation and control for autonomous orbital rendezvous

Okasha, M. , Newman, B.
(2011) AIAA Guidance, Navigation, and Control Conference 2011

1 Brown, R.G., Hawag, P.
(1997) *"Introduction to Random Signals and Applied Kalman Filtering"*. Cited 3043 times.
3rd Edition, John Wiley & Son Inc., United States

2 Broucke, R.A.
Solution of the elliptic rendezvous problem with the time as independent variable
(2003) *Journal of Guidance, Control, and Dynamics*, 26 (4), pp. 615-621. Cited 95 times.
View at Publisher

3 Carter, T.E.
State transition matrices for terminal rendezvous studies: Brief survey and new example
(1998) *Journal of Guidance, Control, and Dynamics*, 21 (1), pp. 148-155. Cited 204 times.
View at Publisher

4 Cho, H.-C., Park, S.-Y.
Analytic solution for fuel-optimal reconfiguration in relative motion
(2009) *Journal of Optimization Theory and Applications*, 141 (3), pp. 495-512. Cited 27 times.
doi: 10.1007/s10957-008-9482-3
View at Publisher

5 Clohessy, W.H., Wiltshire, R.S.
"Terminal Guidance System for Satellite Rendezvous"
(1960) *Journal of the Aerospace Sciences*, 27 (9), pp. 653-678. Cited 1282 times.

6 Crassidis, J.L., Junkins, J.L.
(2004) *Optimal Estimation of Dynamic System*. Cited 837 times.
1st Edition, CRC Press LLC, United States

7 Fehse, W.
(2003) *Automated Rendezvous and Docking of Spacecraft*. Cited 425 times.
1st Edition, Cambridge University Press, United Kingdom

8 Inalhan, G., Tillerson, M., How, J.P.
Relative dynamics and control of spacecraft formations in eccentric orbits
(2002) *Journal of Guidance, Control, and Dynamics*, 25 (1), pp. 48-59. Cited 373 times.
doi: 10.2514/2.4874
View at Publisher

9 Jenkins, S.C., Geller, D.K.
"State Estimation and Targeting For Autonomous Rendezvous and Proximity Operations"
(2007) *Proceedings of theAIAA/AASAstrodynamics Specialists Conference*. Cited 6 times.
AAS 07-316, Mackinac Island, MI