{tag} {/tag}International Journal of Computer Applications
Foundation of Computer Science (FCS), NY, USA

Volume 152
-
Number 1

Year of Publication: 2016

Authors:

Farhad Fani Saberi, Soheil Khalajian, Mahmoud Mani

10.5120/ijca2016911754

{bibtex}2016911754.bib{/bibtex}

Abstract

The most important problems in satellites are their energy supply and decreasing weight. One of the solutions is using flexible appendages. Flexibility can supply both energy and weight loss in satellites. Also other appendages like antennas and mechanical arms can be flexible. But flexibility can produce some vibrations. These vibrations cause complexity attitude control systems due to flexible appendages.

In this paper, the attitude control of flexible satellite by using four reaction wheels in presence of gravity gradient and orbit frequency has been considered. The dynamic of flexible appendages have been derived from energy equations and Lagrange method. Also, momentum management and minimization of the momentum have been employed to avoid of reaction wheels saturation. Then, the control command law using the quaternion error vector for attitude control of rigid body and sliding mode control (SMC) for active suppuration of flexible appendages have been used. Finally the performance of control system between presence and absence of reaction wheels has been compared.

References

1. Singh, Sahjendra N., and Rong Zhang. "Adaptive output feedback control of satellite with flexible appendages by modeling error compensation." Acta Astronautica 54.4 (2004): 229-243.
2. Zhou, Wenya, et al. "High Accuracy Attitude Control System Design for Satellite with Flexible Appendages." Mathematical Problems in Engineering 2014 (2014).
3. Bang, Hyochoong, Min-Jea Tahk, and Hyung-Don Choi. "Large angle attitude control of satellite with actuator saturation." Control engineering practice 11.9 (2003): 989-997.
4. Wang, Qiyu, Jianping Yuan, and Zhanxia Zhu. "The application of error quaternion and PID control method in Earth observation satellite's attitude control system." Systems and Control in Aerospace and Astronautics, 2006. ISSCAA 2006. 1st International Symposium on. IEEE, 2006.
5. Boulet, Benoit, et al. "Uncertainty modeling and experiments in ℋ∞ control of large flexible space structure." Control Systems Technology, IEEE Transactions on 5.5 (1997): 504-519.
6. Guan, Ping, Xiang-Jie Liu, and Ji-Zhen Liu. "Adaptive fuzzy sliding mode control for flexible satellite." Engineering Applications of Artificial Intelligence 18.4 (2005): 451-459.
7. Ma, Yajie, et al. "Uncertainty decomposition-based fault-tolerant adaptive control of flexible satellite." Aerospace and Electronic Systems, IEEE Transactions on 51.2 (2015): 1053-1068.
8. Slotine, jean , -jacques E . Applied nonlinear control. Prentice, 1991.
9. Wertz, James R., ed. Satellite attitude determination and control. Vol. 73. Springer Science & Business Media, 2012
10. Shuster, Malcolm D. "A survey of attitude representations." Navigation 8.9 (1993): 439-517
11. Gennaro, S. Di. "Output stabilization of flexible satellite with active vibration suppression." Aerospace and Electronic Systems, IEEE Transactions on 39.3 (2003): 747-759.
12. Sidi, Marcel J. Satellite dynamics and control: a practical engineering approach. Vol. 7. Cambridge university press, 1997.
13. Qian, Dianwei, Jianqiang Yi, and Dongbin Zhao. "Hierarchical sliding mode control for a class of SIMO under-actuated systems." Control and Cybernetics 37.1 (2008): 159.

Index Terms

Computer Science Applied Sciences

Keywords

Flexible satellite, Three-axis attitude control, Sliding mode control, Reaction wheel, Momentum management