ASTRODYNAMICS SYMPOSIUM (C1)
Guidance, Navigation & Control (1) (1)

Author: Dr. Toshio Kamiya
NEC Corporation Space Systems Div., Japan, t-kamiya@bk.jp.nec.com

Prof. Shin-ichiro Sakai
JAXA-ISAS, Japan, sakai@isas.jaxa.jp

TRACKING CONTROL OF FLEXIBLE SPACECRAFT WITH SINC FUNCTION-BASED PROFILER

Abstract

This paper presents a new algorithm for tracking control of flexible spacecraft with sinc function-based attitude profiler where the spacecraft attitude is controlled along a sequentially determined arbitrary trajectory and the residual vibration after the move can be significantly reduced. Sinc function is known as an extra-insensitive function which has no frequency response above a certain threshold frequency. The conventional attitude control algorithms for flexible spacecraft are not effective for multi-mode system with unknown flexible modes, although actual flexible spacecraft usually has such unknown high-order flexible modes. However, if the sinc function is used as a profiler for flexible spacecraft attitude maneuvers such as rest-to-rest maneuvers, residual vibrations after the maneuvers can be significantly reduced to a smaller level compared to conventional methods in case that there are unknown high-order flexible modes in the spacecraft. In this paper, the sinc function-based profiler is extended to tracking control where the spacecraft is controlled along a sequentially determined arbitrary trajectory.

The convolution of sinc function-based profile *f(t)* and a sequentially determined arbitrary trajectory *g(t)* is given as

$h(t) = \int_{-\infty}^{\infty} f(\tau)g(t-\tau)d\tau$

where *f(t)* is previously determined function consisting of sinc function and *g(t)* is an arbitrary trajectory for spacecraft attitude. If *f(t)* is defined in a finite time domain, *h(t)* can be calculated in concurrence with the sequentially determined profile *g(t)*, then the residual vibration after the move can be minimized where the spacecraft attitude is controlled along the sequentially commanded track. Numerical simulations are presented to demonstrate the effectiveness of the proposed sinc function-based tracking control when applied to simplified flexible spacecraft model where two-mode systems with an unknown high-order mode have been used as simplified model of flexible spacecraft. The assumed two-mode system represents the most simplified system with complicated structure, so the same results can be expected for systems equipped with more complicated flexible structures. Comparison of simulation results is made between conventional input shaper-based tracking control and the proposed sinc function-based tracking control.