22nd IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Generic Technologies for Small/Micro Platforms (6A)

Author: Dr. Zhang Yongkang
Technology and Engineering Center for Space Utilization, Chinese Academy of Sciences, China

Dr. Wenbo Dong
Technology and Engineering Center for Space Utilization, Chinese Academy of Sciences, China

CONTROL SYSTEM DESIGN FOR MICRO SATELLITE IN-CABIN BASED ON VISUAL NAVIGATION

Abstract

Spacecrafts and the space station provide an ideal microgravity environment for space science experiments and applications. Moreover, the astronaut's participation makes scientific experiments more flexible and convenient. With this help, one good opportunity is to use micro satellites in the cabin to make low-cost control technology. We design a miniature satellite prototype for such applications. The navigation system uses the information fused by the vision navigation system and accelerometers. Its propulsion system is based on high-pressure air propulsion, which is clear and safe for in-cabin environment. The system is tested on an air-bearing table in three dimensions.The vision system includes an active light target, two cameras, signal sample circuits and an embedded computer. The target is composed of several LEDs with fixed array, so as easy to process and recognize by computer image algorithms. After precise calibration of camera parameters, we can accurately calculate the position based on vision geometry through the image. In real time (about 10 frames per second), we get the position and angular information, and then use a low-pass filter for post-processing.The propulsion system is made up of a high-pressure air cylinderan air capacity, nozzles and electromagnetic valves. So as to realize the closed-loop for positioning, a basic PID controller and ADRC controller are implemented on a digital signal processor (DSP). Performance and performance variations of the system are theoretically determined and then compared to data generated experimentally.Simulation results and ground air-bearing table experiments verify the effectiveness of the design. The system can make positioning within 1cm accuracy in 1 meter area and automatically move along a setting trajectory so far.