

46th STUDENT CONFERENCE (E2)
Educational Pico and Nano Satellites (4)

Author: Dr. Rui Zhang

National University of Defense Technology, China, zhangrui150126@mail.tsinghua.edu.cn

Dr. Zhaokui Wang

Tsinghua University, China, wangzk@tsinghua.edu.cn

AN INTELLIGENT NANO-SATELLITE FOR ASTRONAUT ASSISTANCE

Abstract

China Space Station will launch around 2020. Operating on orbit for more than ten years, the long-term care of the Space Station and the implementation of complex scientific studies will mainly depend on the astronauts. However, available astronaut time is usually limited. Thus the improvement of astronauts' work efficiency becomes particularly important for space missions.

In this paper, an intelligent Nano-satellite for astronaut assistance is proposed. The satellite is called Intelligent Formation Personal Satellite (IFPS). It weighs 2.6 kilogram and shapes in a sphere with diameter of 20 centimeters. A RGB-D camera and IMU are chosen for the implementation of visual navigation. Six sonar sensors are laid out evenly on the sphere for obstacle avoidance. Onboard Information processing and computing hardware mainly consists of a Jetson TX2 and a FPGA. Six pairs of fans and three orthogonal flywheels are designed for position and attitude maneuvering. A docking station is designed to provide IFPS with support of docking and energy supplying. It will be mounted on the inner wall of the cabin. And it can also communicate with IFPS through high bandwidth wireless network, offering the satellite extra off-board parallel computing resources with graphic processing units.

Based on regularly updated map inside the cabin and the advanced 3D SLAM algorithm, the satellite can fly autonomously everywhere in the Space Station without any cooperative identifiers. Thus it can cruise inside the cabin and replace the astronaut to perform inspection activities for safety guarantee. Formation flying and face-to-face interacting with the served astronaut through gestures and voice, the satellite offers assistance tasks such as data inquiry, panoramic video recording and HD video recording in the Space Station. Overall design and research on the key technologies of the satellite are completed, and it will be sent to China Space Station around 2020.