Design of A Simplified Telemetry System for Small Sounding Rockets

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Abstract

The sounding rocket flight control system is a completely independent control module that can be installed directly in the payload of the rocket. Additionally, the flight control system will not interfere with other subsystems of the sounding rocket. This study proposes a design of a simplified telemetry system for small-sounding rockets. A simple and lightweight measurement and control system will be planned and combined within a small-sounding rocket payload to collect various flight parameters of the rocket launch. During rocket launch and free flight, monitoring signals can collect various rocket flight data (such as vehicle roll, pitch, and yaw direction) and functional inspections of the rocket. The simplified telemetry system of sounding rocket design will include a few subsystems such as the inertial navigation system, barometer, telemetry system, and power supply system. LoRa is a low-power, wide-area, and ultralong-distance wireless transmission network technology. It is used as the communication module in the simplified telemetry system of the sounding rocket design of this study. These subsystems will be illustrated and performance testing in this paper. Finally, all the subsystem modules mentioned above will be integrated, and microchips will be used as the core of system integration. The simplified telemetry system of sounding rockets proposed by this study provides a simplified design and can be used as a reference for future students or novice researchers to simply design.

Introduction

Now that Taiwan is gradually entering the era of sounding rockets, sounding rockets with better control performance has become a major focus in the field of aerospace research. The research goals are all oriented to transport payloads to very high apogees. The BBX 3-section sounding rocket jointly developed by NASA Goddard Space Flight Centre, the National Research Council of Canada, Bristol Aerospace Co., Ltd., Swedish Aerospace Corporation and SAAB-Scania is based on this research goal to conduct research and development. The BBX 3-section sounding rocket uses the SAAB-SSC-S19 guidance system. Originally designed for the single-stage Black Brant VC rocket, the guidance system was adopted to control larger vehicles as sounding rockets improved in performance. But the aerodynamics and other design parameters in different stages of sounding rockets vary greatly. Therefore, the SAAB-SSC-S19 guidance system also needs to adjust the flight control optimization according to the mass, inertia, launch transient and bending mode frequency of the sounding rocket [1-4].

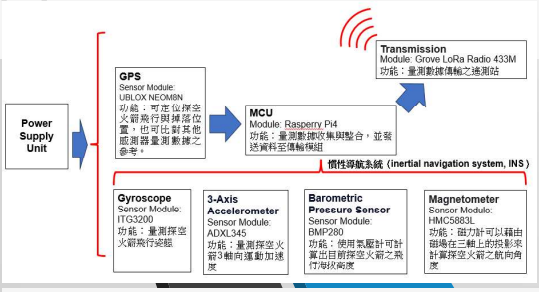

Fig.1. Functional relationship diagram between the sounding rocket and each system

The sounding rocket developed under this project will include subsystems such as an inertial navigation system, gyroscope, accelerometer, magnetometer, barometer, GPS navigation and positioning, and main power supply system.

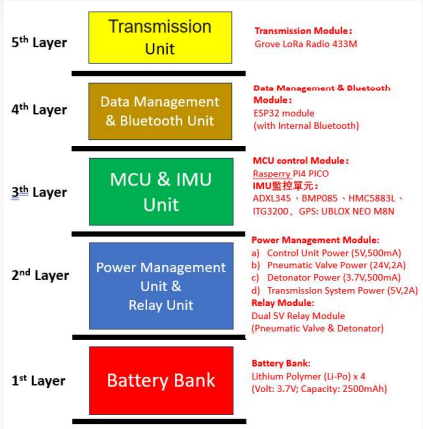

Fig. 2 The Layer structure of the Simplified Telemetry System for Small Sounding Rockets

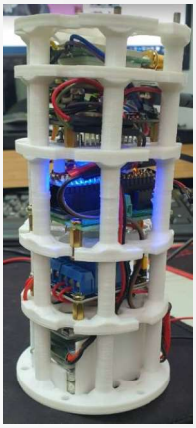

Fig. 3 The physical circuit of the Simplified Telemetry System for Small Sounding Rockets

GPS Navigation (NEO M8N)

NEO-M8N is a standard precision GNSS module with high performance u-blox M8 positioning engine. They feature an industry-standard NEO are easy to integrate, and combine excellent positioning performance with highly flexible power, design, and connectivity options. In this study, the test location of GPS accuracy is selected in the campus of Longhua University for testing. Figure 4 is an aerial image of the test location of GPS of the campus of Longhua University at Tawian.

Fig.4. Aerial image of the aerial playground of Longhua University of Science and Technology of New Taipei City Civil Affairs Geographic Information System of National Land Surveying and Mapping Center

Fig.5. Multi-axis flight attitude measurement system for sounding rocket guidance and control system

Conclusions

The sounding rocket flight control system is a completely independent control module that can be installed into the sounding rocket payload without interfering with other subsystems of the sounding rocket. The telemetry system of the sounding rocket is designed as a small and light control box and a light launch console to facilitate testing and operation before launch. This paper will describe and test the components of the flight attitude measurement system of the sounding rocket flight control system. The sounding rocket inertial navigation system proposed in this study uses multiple sets of different sensors as the feedback of the rocket's flight attitude data to obtain information such as the attitude, heading, or altitude of the sounding rocket. One of the most important sensor integration components is the inertial measurement unit (IMU). There are four types of sensors included in the IMU: gyroscope, accelerometer, magnetometer, and barometer. In addition, this plan also adds GPS positioning measurement to confirm the rocket flight trajectory and final fall location.

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