

1. INTRODUCTION

Space technology is a comprehensive advanced technology for space exploration, development and utilization, and has significant benefits in military application, scientific and technological progress and economic development. In the current world, the space technology is an important symbol to measure the comprehensive national power of each country. Therefore, every country puts the development of space technology into an important position and has carried out numerous space projects. In recent years, many countries and regions are hoping to establish low-cost regional coverage satellite system with non-geostationary orbit (Feng 2010 and Crossley 2000). Compared with GEO satellite system, the MEO and LEO satellite system has the following advantages: short propagation delay, low transmission loss, low launch cost and can effectively improve the payload resolution, etc. Satellite constellation is composed of a number of satellites running with certain rules, and has benefits include higher coverage performance, short revisit time interval while comparing with single satellite. The satellite constellation can satisfy the application requirements of communication, navigation, positioning, space exploration, hot area imaging and scientific experiments, etc. Therefore, the MEO and LEO satellite system has unlimited potential for political, economic and disaster rescues application, etc. (Li 2010)

In the civil aspect, major natural disasters occurred frequently all over the world in the past decades. For example, about 160 thousand people died in the India Ocean tsunami in December 26, 2004; About 70 thousand people died in the Wenchuan earthquake in May 12, 2008. These major disasters have caused huge casualties and property losses to the country. Disaster information acquisition is an urgent need for disaster rescues and post-disaster reconstruction. Using a satellite constellation to achieve continuous imaging of the disaster area, it can provide timely and accurate information for the rescue forces to race against time for rescuing the wounded, and reducing the loss caused by the lag of information (Sweeting 1996).

The above application demands put forward more requirements for remote-sensing system: fast platform establishing, quick information acquisition, short revisit observation period and large coverage rate, which are difficult to be achieve for the existing on-orbit imaging satellite in the short term. With the development of small satellite technology, it can be very convenient, rapid and flexible to achieve these functions, and has become a very important means of emergency remote-sensing. For example, the SeeMe project proposed by DARPA is a tactical reconnaissance satellite program (Yang 2013 and Li 2013), and it can provide reliable and continuous remote-sensing information. Using imaging small satellite for emergency network can reach the effect which other methods cannot achieve, such as the flexibility of launching small satellite, the rapidity of networking small satellite.

This paper aims at the requirement of the fast imaging of the future micro-satellite constellation for the hot area, and develops a user-oriented ground simulation platform satellite remote sensing and operating. This paper focuses on the design of the platform general framework, and sub-systems scheme and hardware-in-the-loop simulation, etc. The developed platform can significantly reduce the risk of space mission, and will provide a useful tool for evaluating algorithms for satellite image acquisition scheduling and multi-task operational planning. The rest of the paper is

organized as follows. In section 2, platform architecture and its main functions will be discussed in detail. An experiment that demonstrates the functionality of the platform will be presented in section 3. Finally, section 4 presents the conclusion.

2. GENERAL SCHEME OF THE DEMONSTRATION PLATFORM

The remote operating demonstration system is composed of three parts, including a Satellite Emulator, a Mobile Terminal system and a Global Geographic Image Displaying System. The three subsystems use WiFi to achieve communication. The system block diagram is shown in Fig. 1.

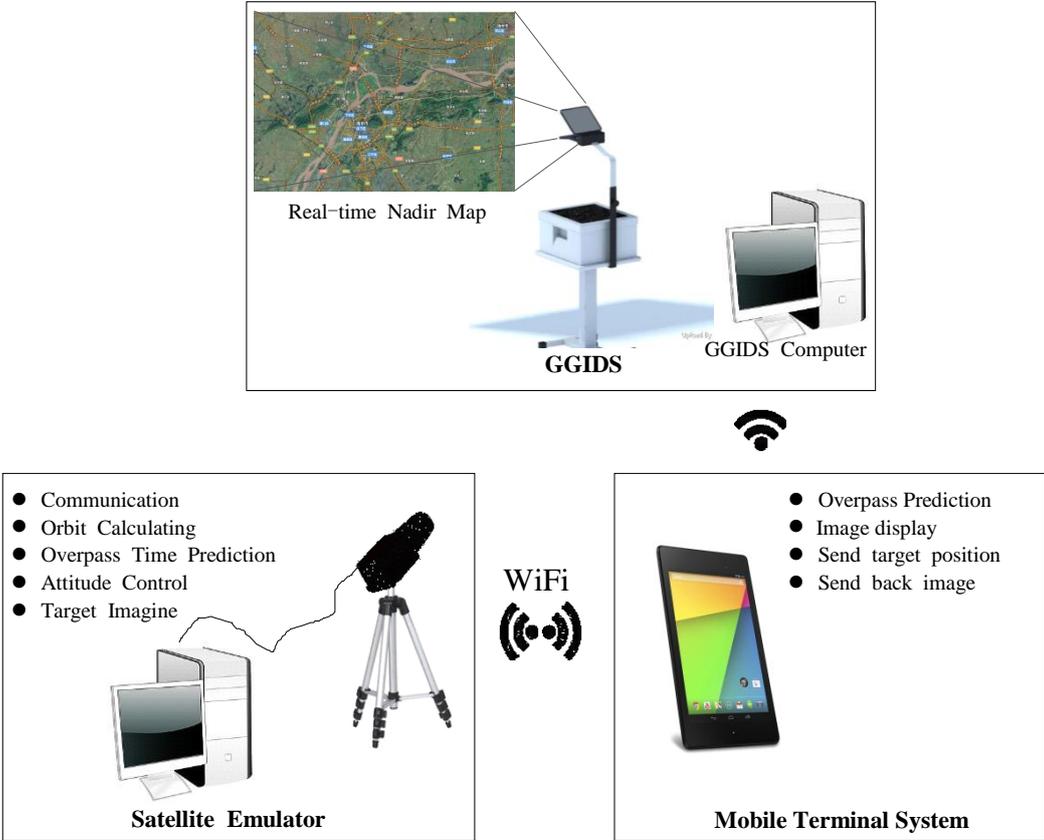


Fig. 1 System Block Diagram

The Satellite Emulator is composed of a satellite dynamics simulation computer, real-time dynamics simulation software, an image acquisition camera, a camera control pan tilt unit and a support. Its main functions are as follows: communicating with the Mobile Terminal system, receiving instruction from the Mobile Terminal system, setting simulation parameters, calculating satellite orbit, predicting overpass time, calculating attitude maneuvering angle, controlling attitude maneuver, driving pan tilt unit and camera, imaging target area and transmitting target image to the Mobile Terminal system.

The Mobile Terminal system is composed of a mobile terminal and terminal App. In order to obtain the image and geographic latitude and longitude of the target, the PC Table needs to install navigation software (such as Google maps) in advance and has the wireless communication capability. The main functions of the Mobile Terminal system include: calculating and displaying the three dimensional orbit of the satellite constellation, inputting and editing satellite orbit, displaying target area image and acquiring geographic position, predicting satellite passes, sending target geographic position, receiving target image from Satellite Emulator.

The GGIDS is composed of the image displaying computer, real-time image display software and a image projector. In order to ensure the operation of the GGIDS system, the experiment environment should have internet. The main functions of the GGIDS system include receiving satellite orbit parameters and target geographic position information from the Mobile Terminal system, acquiring global geographic information online, updating nadir geographic image in real time and projecting the real-time geographic image to a appropriate plane.

The general scheme of each subsystem will be introduced in detail later.

2.1 Scheme of Satellite Dynamics Simulator

The dynamics simulator software of this paper is developed in LabVIEW. In order to achieve the operation of the hardware, such as camera driving, image acquiring and pan tilt unit controlling, the dynamics simulator needs to run in real time. The operation period and the orbit/attitude dynamics calculation period are both 0.5 seconds. The dynamics simulator uses a common PC computer or a mobile notebook with the following basic configurations: the CPU is Intel Core i5, the memory is 4G, and the disk capacity is 120G. The software version is Labview2011 or above, Microsoft Visual Studio 2010. The GUI interface of satellite Emulator is shown in Fig. 2.

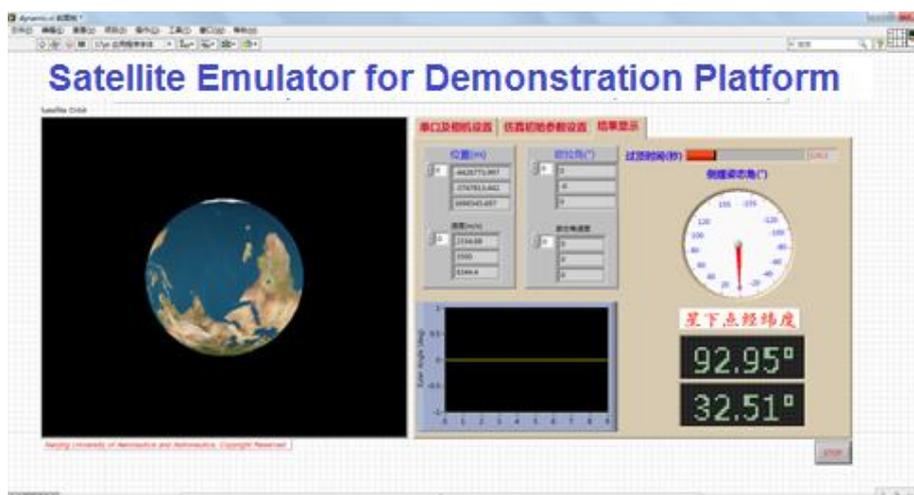


Fig. 2 GUI Interface of the Satellite Emulator

The GUI interface of the simulator is divided into two parts; the left side is the 3D animation of the satellite orbit, while the right side is the parameter setting and the

