

SPACE SYSTEMS SYMPOSIUM (D1)  
Innovative and Visionary Space Systems Concepts (1)

Author: Dr. Yong Zhao  
China, nudtzhzy@163.com

Prof. Xiaoqian Chen  
China, chenxiaoqian@nudt.edu.cn

Dr. Yiyong Huang  
China, Huanyiyong@sina.com

Ms. Yang Weiwei  
China, wendy0782@sina.com

STUDY OF KEY TECHNOLOGIES OF SERVICEABLE SPACECRAFT

**Abstract**

The on-orbit servicing technologies, which include components maintenance, fuel refueling, module replacement, function upgrade as well as structure assembly after the spacecrafts are into the orbit, are very important for enhancing the performance and extending the life of the spacecraft and stand for a new trend of spacecraft development. Serviceable spacecrafts, which will act as the target of the on-orbit servicing, have a lot of different characteristics with the traditional spacecraft and need special considerations. In the past 5 years, our research group has completed several projects on the on-orbit servicing technologies, and the results will be introduced systematically in this paper. Firstly, after comparing the difference of the serviceable spacecraft with the traditional spacecraft, we summarize the key technologies of serviceable spacecrafts as follows: (1) modular design of spacecraft; (2) Orbital Replacement Unit (ORU) technology; (3) universal rapid docking interface. We will show our interpretations and solutions for each key technology, and the effect of the standard modular interface as well as the ORU to the system layout and assembly way is analyzed using computer simulation. Secondly, on the basis of the computer simulation, a ground experimental system is designed, which is used to demonstrate and test these key technologies. This system is mainly composed of a polished granite test bed? a serviceable spacecraft simulator as well as a servicing spacecraft simulator. The polished granite test bed will supply a three-freedom frictionless environment, on which the autonomous docking and separation control of combination body, navigation and guidance of the servicing as well as the serviceable spacecraft will be studied. The results of the experiment done using this system are shown and the effects of them for the key technologies of serviceable spacecraft are analyzed. On this basis, a prototype of serviceable spacecraft is given. Finally, the future research direction is discussed and some improvements are suggested on current experimental system. The introduction of the paper provides a wide overview of the on-going research efforts to make serviceable spacecraft a reality.