

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

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

Dr. Wen Yao
China, yaowen@nudt.edu.cn
Dr. Yiyong Huang
China, Huanyiyong@sina.com
Mr. Zhao Yong
China, Zhaoyong4455@sina.com

IDES: AN INTEGRATED DESIGN AND EXPERIMENT SYSTEM FOR ON-ORBIT SERVICING

Abstract

On-orbit servicing (OOS), including space assembly, maintenance, and servicing (SAMS), is very important for enhancing the operational life and capability of spacecrafts. It represents a new trend of spacecraft development. The research and development (R&D) of OOS are very complex, time-consuming and risky. To improve R&D efficiency, it's very important to utilize digital and physical tools to assistant the design. Since 2005, we began to develop an Integrated Design and Experiment System for on-orbit servicing (IDES). It incorporates design and experiment into a whole system with seamless information integration. Now we have set up IDES and completed several OOS research projects.

IDES is consisted of two main parts. One is the digital design environment, and the other one is the experiment testbed. The digital design environment is consisted of CAD/CAE softwares, disciplinary design code packs, digital simulation softwares and design data management database organized in a web-based distributed environment. In this design environment, designers can fulfill the whole process of OOS design from mission analysis to detailed design, including OOS task requirement analysis, mission programming, servicing spacecraft design, digital simulation and demonstration. The experiment testbed is consisted of five parts: test platform, spacecraft simulator, monitoring and control system, displaying system and data collecting system. The test platform provides a frictionless base for the movement of spacecraft. Spacecraft simulator is supported with air bearing system with three degrees of freedom. The monitoring and control system includes the sensors, the signal transmitting subsystem, and the control computer. The displaying system is constituted of a globose screen and projectors, which can simultaneously display the sky background and the operation status. The data collecting system will collect the experiment data for analyzing. In the experiment testbed, designers can conduct semi-physical and physical simulations to validate and demonstrate the design scheme and OOS mission handed down from the design environment, and the experiment results can provide important guidance for further improvement of the design. The circulation of IDES can lead to a final optimal and feasible OOS scheme.

We have already carried out several OOS research projects with IDES successfully, such as the formation flying of 4 small satellites, the automatic rendezvous and docking of 2 spacecrafts, the on-orbit refueling demonstration, etc. The design process as well as the results of these experiments will be given in this paper. These results illustrate that IDES will be very useful for OOS research.