

On the Results of the MFD Flight Operations

Masanori Nagatomo, Takahisa Sato, Chikara Harada

Koshi Wada, Yasushi Hisadome, Kenji Morishita, Keiichi Ito

National Space Development Agency of Japan(NASDA)

ABSTRACT : The Manipulator Flight Demonstration (MFD) payload was flown on the Space Shuttle Discovery with the STS-85 mission in August, 1997. Included in the MFD mission were the flight demonstration test of the MFD robot arm, an advanced robot arm technology experiment to control the MFD robot arm from the ground (Ground Commanding; GC), and two piggyback experiments of the Evaluation of Space Environment and Effects on Materials (ESEM) and the Two Phase Fluid Loop Experiment (TPFLEX). The flight operations control on the ground to support on-orbit crew operations related to the MFD payload was jointly conducted by NASDA and NASA at the NASA Lyndon B. Johnson Space Center (JSC). This paper is to summarize the MFD flight operations and flight operations control on the ground, and to report their results.

FLIGHT OPERATIONS : The STS-85 was launched from NASA John F. Kennedy Space Center (KSC) on August 7, 1997, 10:41 EDT. The MFD robot arm flight demonstration tests were conducted by two Mission Specialists (MS) on Flight Day (FD) 2, 4, 5, and 7. The arm control performance test without the Orbital Replacement Unit(ORU) was conducted as the first attempt of the MFD on FD2, then the ORU replacement demonstration, the arm control performance test with the ORU and the Door open and close demonstration were conducted on FD 4. The arm compliance performance test and the ORU replacement demonstration with different conditions were conducted on FD5. FD 7 was added real-time to accomplish the fourth ORU replacement demonstration carried over due to some unexpected situations of the MFD payload which occurred on the previous days. All the payload systems worked perfectly as designed. Some payload operations procedures were modified real-time and crew operations period was expanded real-time. As a result of the MFD flight operations, all the planned tests and experiments were accomplished, including the ground commanded operations experiment of the MFD robot arm and two piggyback experiments.

EVALUATION : During the flight, telemetry, video, and voice data were down-linked via the Orbiter to the ground and displayed and recorded with the MFD flight operations control system located in the Payload Operations Control Center (POCC) at JSC. These data were used for the MFD post flight analysis in conjunction with the crew commentary obtained onboard and during the debriefings after the landing. Based on the fact that the MFD payload worked perfectly throughout the flight, its design including Shuttle compatibility, manufacturing, and verification was proven appropriate. Also system functional requirements for Japanese Experiment Module (JEM), such as ORU handling functions, were proven appropriate. Regarding the functions and performances of the MFD robot arm under the weightless environment, useful data were obtained. Also found were points to be improved for the arm control software and operations of the JEM Remote Manipulator System (JEMRMS).

CONCLUSION : The MFD robot arm worked well in space and findings which were obtained during and after the flight were summarized and some of them will be reflected to the JEM development and operations. In GC experiment, a file-transfer based GC system was confirmed effective and basic data for a future application of this technology was obtained. ESEM and TPFLEX have also got their own useful results. As a result of the MFD flight

operations, all of the MFD mission objectives were accomplished.