Proceeding of the 6th International Symposium on Artificial Intelligence and Robotics & Automation in Space: i-SAIRAS 2001, Canadian Space Agency, St-Hubert, Quebec, Canada, June 18-22, 2001.

Recent Japanese Activities in Space Automation & Robotics-An Overview

Tsutomu Iwata

National Space Development Agency of Japan (NASDA)

2-1-1 Sengen, Tsukuba-city, Ibaraki 305-8505 Japan

Iwata.Tsutomu@nasda.go.jp

Keywords JEMRMS, MUSES-C, Orbital Servicing System, Human-like Machines

Abstract

Recent Japanese Activities are introduced in the fields of ISS/Japanese Experimental Module (Kibo) Remote Manipulator System (JEMRMS), Muses-C robotic asteroid lander/sample return mission, orbital service system, and non-space scenery of human-like machines development.

1 Introduction

At this turn of the millennium, the Japanese space community is now undergoing the hardiest time in its history. The consecutive failures of the two H-II launchers which lost the experimental communication satellite COMETS in 1998 and the multipurpose transportation satellite MTSAT in 1999 were followed by the failure in 2000 of M-V launch vehicle which lost its X-ray astronomical satellite ASTRO-E. The only chance to survive this hardship and regain the support of the nation is the success of the next two test launches of the upgraded H-IIA rocket which are scheduled in this summer and the coming winter.

Technological interest is mainly concentrated in reliability and risk analysis. The demands for reformation of development and verification processes by introducing more advanced methods of information technology and external expertise outside the project people are incessant. But on the other hand, arguments around rather fundamental issues such as the quest for the long-range goal of Japanese space efforts are keeping temperature at roundtables in and outside government. The need for restructuring is commonly shared by whole space community in order to survive this turmoil. The basic researches, which include robotics and AI, cannot enjoy higher priority in this tightening situation.

Meanwhile in Japan, in the arena other than space application, public demonstrations of robotic models by industry and academia are gaining applause. The human-like or animal-like robots perform simulated movements of living body. Local governments and academic as well as industrial institutions sponsor robot contests or exhibits every month and every area in Japan. It is of interest that such mass curiosity and participation to robot demonstration are not observed in Europe and America. We learn at least in Japanese context of space robotics and AI, there lies the mass psychology calling for “robot”; a human-like friend.

Topics to be presented here in 2001 are ISS/Japanese Experimental Module (Kibo) Remote Manipulator System (JEMRMS), Muses-C robotic asteroid lander/sample return mission, Research on orbital service system and non-space scenery of human-like machines development in Japan.

2 JEMRMS

The Japan Experimental Module (Kibo) of International Space Station is now just before the final integration this autumn at Tsukuba Space Center. The manipulator of Kibo is now under the final checkout on the air bearing test-bed. This end-to-end test verifies the performance of the manipulator system as a whole, which consists of Small Fine Arm (SFA), Main Arm (MA), and Console with software and human operator. The overall system of Kibo will be tested this autumn.

3 MUSES-C

Asteroid sample return mission MUSES-C will be launched in 2002 destined for a newly discovered asteroid 1998SF36. This mission is to demonstrate following novel technologies, which are essential to explore small bodies in inner solar system.

- Solar electric propulsion workable longer than 16000 hours
- Autonomous navigation and guidance
- Sample capture, sealing, and preservation
- Reentry and recovery of the capsule

For autonomous navigation and guidance, the spacecraft employs Optical Navigation Camera (ONC), Light Detection and Ranging (LIDAR), Laser Range Finder (LRF), and Fan Beam Sensors (FBS) to know the spatial information relative to the asteroid surface. Three-dimensional model of the surface will be formulated in two months of fly around the asteroid before landing for sample collection.

Laboratory test of the sample catcher system demonstrated one gram of sample from hard brick captured by detonating ejection.

Micro/Nano Experimental Robot Vehicle for Asteroid (MINERVA) is developed as an optional payload of MUSES-C. This robot equipped with a camera weighs 0.6kg and after deployed from the mother spacecraft, hops around the surface of the asteroid to collect scientific data.

4 Orbital Servicing System

Orbital servicing system is the key concept of research for future space infrastructure and selected as the focal point of NASDA R&D. On-orbit care for diagnoses, tugging, refurbish, de-orbit as well as restructuring of spacecraft will facilitate and enlarge utilization of space. Use of space AI, robotics and automation is essential for this design. The experience and technological result of ETS-VII is inherited to this research work. The test-bed model of Hyper Servicing Vehicle (HOSV) employs a reconfigurable computer network, which enables fault tolerant parallel processing at high speed to adapt flexibly to versatile tasks. The mobile software agent with distributed computer will bring further flexibility to design future missions.

5 Human-like Machines

While the Japanese space community is suffering from the losses of its rockets and its fame as well at this turn of the millennium, Japanese leading manufacturers are rushing to demonstrate their technological competence by exhibiting human-like machines. Sony, Honda, NEC, and Fujitsu presented variety of human-like robots. It is interesting that those robots are all for entertainment or advertisement purpose. The emergences of a new technological concept such as airplane or rocket, the first applications are often amusement or military. Space use might be of this kind.

6 Conclusion

With regards to space automation and robotics, recent Japanese Activities were introduced through several examples such as ISS Japanese robotics, Muses-C asteroid mission, orbital service system, and non-space scenery of human-like machines development.