

## SPACE STATION - AN APPLICATION FOR COMPUTER VISION

by

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### ABSTRACT

Space Station, aimed at fostering peaceful exploration and commercial exploitation of space, is the most significant international space project of this century. The partners are the United States, Canada, Europe and Japan, each of which is contributing elements of the station infrastructure and sharing in the operation.

Canada's contribution is the Mobile Servicing System consisting of roving robotic elements which support assembly, servicing and maintenance of the core station. By building on past success with the Canadarm and by developing even more sophisticated space manipulator systems, Canada intends to stimulate technology development in the area of Automation and Robotics which is so crucial to keeping Canada industrially competitive on earth.

A key technical discipline needed to implement advanced automation and robotics capabilities is that of computer vision. On the space station the broad domain of computer vision will include human/machine interface aspects where simulated images will be generated for training purposes and where true stereo viewing or synthetic camera views will be needed for direct operator control of manipulators.

Computer vision systems will also be needed in closed-loop control of robot manipulators in order to increase accuracy and to compensate for the structural flexibility of space manipulators. As well, vision systems will be used to guide manipulators in tasks such as tracking and capturing of moving payloads or space craft. To achieve these robot control tasks, vision systems are needed which are capable of determining, in real-time, a remote objects position and attitude.

In the general automation of the operations of the Mobile Servicing System, vision systems will play a crucial role in the guidance of the system about the station, the detection of imminent

collisions and in the recognition of objects to be serviced and tools to be used.

A number of vision systems are currently being evaluated for the initial configuration of the Mobile Servicing System. These include a real-time photogrammetry system which processes video camera scenes to derive an objects 6 degrees-of-freedom at video frame rates. An experimental version of this system, termed the Space Vision System, is scheduled to be tested in space by a Canadian astronaut on an upcoming Space Shuttle flight.

Another vision sensor system being investigated is a laser scanned depth profiling camera, developed by the National Research Council, which provides a true 3 dimensional view of the world. As well, a stereo camera processing approach to deriving depth information is also being developed. In cooperation with various universities, object recognition schemes for both 2-D and 3-D images are being investigated.

The computer vision activity described so far is aimed at the initial Mobile Servicing System (MSS) capability. However, the Space Station will have a 30 year life during which the MSS will see a growth in capabilities by incorporating technical advances. In order to plan for and develop new technology for the Space Station, the Space Station Program has initiated, in addition to the main contracts to build and operate the MSS, a Strategic Technology subprogram which will involve Canadian industry outside the MSS contracting team in the identification and development of advanced technology. This program will form the basis for future technology upgrades in space and also will be a major source of technology spinoff on earth.

(This Abstract is just a high level overview of the full paper which can be obtained by writing to one of the authors.)