The manipulator is an anthropomorphic arm, complete with "shoulder", "elbow" and "wrist" joints and the equivalent of "fingers" for gripping. With seven degrees of freedom, the arm will be more flexible than its human counterpart. It must be able to handle objects in outer space of up to 65,000 lb (29 500 kg) mass and up to 60 ft (18 m) in length and 15 ft (4.5 m) in diameter. The arm must be able to operate in the hostile environment of outer space — zero pressure, wide temperature extremes and significant radiation levels — and withstand the stresses imposed during the launch and return of the Orbiter. The flexibility of the arm as well as the speed and accuracy of operation required means that computer augmented control is a necessity. This requires the development of computer software for the overall control system. In addition, the whole system must be extremely reliable and so designed that if failures do take place, they must not be such that the safety of the shuttle or crew are compromised.

All this amounts to a stringent set of requirements compounded by the fact that in the design of the manipulator the team is operating under very severe weight constraints — for very obvious reasons — each pound weight of manipulator meaning one pound less of payload. Also, the manipulator will only be called upon to operate in zero-gravity conditions. Therefore, the arm will not be operable under earth's gravity (to build it strong enough to do so would be wasteful) so the final test of the hardware will be on an actual shuttle mission. Many earth-bound tests of the manipulator system will be carried out with the aid of a mathematical model of the manipulator arm and its control system using a simulation facility to be developed as part of the overall RMS project.

The NRC-funded simulation facility is being designed to meet two major objectives: to provide a design and test facility specifically for the space shuttle RMS and to provide a multi-purpose simulation capability for the development of remote manipulator systems for more general applications. The simulation facility will comprise three principal items: an Operator Section, housing the operator who controls the mathematically simulated manipulator and observes the arm's behavior on monitor screens which present computer-generated images of the arm and its background; a Computer Section, where the mathematical model of the arm responds to the signals from the manual controller, predicts the response of the arm, and sends this information to the third section, the Scene Generation System, where the mathematical output from the model is converted into a series of television images.

Since the only portions of the facility specific to the space shuttle RMS are the "software" sections, that is the mathematical model of the manipulator arm, the facility can be used for simulating a range of different manipulator systems.

The sophisticated computer models used in the simulation facility will require intensive development work in the area of analytic techniques. The position of the manipulator's hand at any instant will be a function of the angles through which its three articulated members move. From the shoulder joint, the "upper arm" of the manipulator can move in two planes (with two degrees of freedom), from the elbow joint the "forearm" has a single degree of freedom, and the wrist joint provides three degrees of freedom, the seventh degree of freedom being the gripping action of the "end effector" or fingers. The movements in all these planes must be integrated by the mathematical model in order to determine the location of the manipulator's hand. Some idea of the complexity of this task can be gained by trying to visualize the path one's fingertips might follow

Satellite-mounted sensors can provide information on crops, including identifying diseased or insect-infested areas and help agricultural specialists predict food availability on a world-wide basis.

Des capteurs à bord de satellites peuvent renseigner sur les récoltes et permettre d'identifier les maladies ou les parasites de sorte que les satellites fournissent une aide précieuse aux agronomes pour prévoir les quantités de produits alimentaires disponibles dans le monde entier.

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