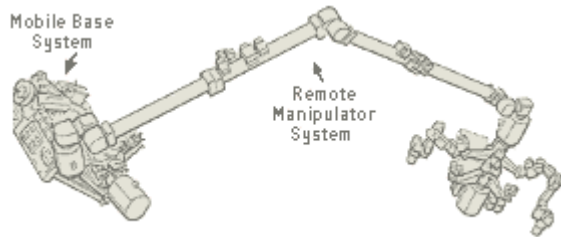


CANDARM WRESTLING



Canada is contributing an essential component of the International Space Station, the Mobile Servicing System, which is also known as the MSS. This robotic system plays a key role in Space Station assembly and maintenance. It moves equipment and supplies around the Station, supports astronauts working in space, and services instruments and other payloads attached to the Space Station. Astronauts receive robotics training to enable them to perform these functions with the arm.

The Space Shuttle already uses Canadarm for many of its purposes in orbit. It is used to unload the cargo bay of the Shuttle, maneuver satellites in orbit, and perform assistance to astronauts during Extravehicular Activity (EVA). The ISS will use Canadarm2 to help construct the rest of the Station by moving parts, equipment, and aiding astronauts during EVA.

Both robotic arms were built in Canada, but each is unique in its own way. Canadarm is attached to the Shuttle, so it cannot move from its fixed position and always returns to Earth after each mission. Canadarm2 is attached to a Mobile Base System that allows it to move along the ISS, so it stays in orbit all the time. Canadarm has 6 degrees of freedom, similar to a human arm; while Canadarm2 has 7 degrees of freedom, making it very much like a human arm. Canadarm's elbow rotation is limited to 160 degrees, while Canadarm2 can make a 540-degree turn. The Canadarm2 has been equipped with force and optical sensors to give it a feeling of touch and sight. Canadarm is 15 meters [m] in length, with Canadarm2 being 17.6 m. The Canadarm seems to be really heavy at 410.5 kilograms [kg] until you compare it to the 1,800 kg of the Canadarm2. In terms of size, the Canadarm is 33 centimeters [cm] in diameter, and the Canadarm2 is 35 cm in diameter. This is due to Canadarm having 16 layers of carbon fiber for protection, and Canadarm 2 having 19 layers of carbon fiber. Canadarm2 was able to handle more mass than Canadarm until recently. Canadarm2 can handle 116,000 kg, with Canadarm handling 266,000 kg. In terms of speed, the Canadarm can move at a speedy 60 centimeters per second [cm/s] unloaded, and 6 cm/s fully loaded. Canadarm2 moves slower at 37 cm/s unloaded, and about 2 cm/s fully loaded. For external viewing, Canadarm has two cameras and Canadarm2 has four cameras.

CANDARM WRESTLING

Objectives

Upon completion of this activity, students will be able to:

- compare and contrast the two type of Canada arms.
- draw a version of their own robotic arm.

Time Allowance

45 min.

Materials

Student Worksheets

Pencils

Related Links

NASA Human Spaceflight–Space Station Assembly

M Theory–Pride in Space: Canada’s Robotic Arm

NASA Kennedy Space Center Directory–STS–111 Canada Arm Q&A

The Canadian Crane

Procedure

1. Read orally the 9-12 NASAexplores article, “The Canadian Crane.”
2. Distribute the Student Sheets.
3. Each student will read the Background Information and fill in the chart.
4. After filling in the chart, students can answer the questions at the end.

Discussion

- Discuss the uses for the Canadarm on the Space Shuttle.
- Discuss the uses for the Canadarm2 on the ISS.
- Discuss possible uses for the Canadarm and Canadarm2 in future Shuttle missions.
- Contrast the various specifications of the Canadarms.

Extensions

- Using the Internet, search for the missions on which the Canadarm has been used. Have the students answer this question, “Has Canadarm ever worked with Canadarm2? If so, what did they do?”
- Go to the Canada homepage, and look for other technology advancements being done in Canada.
- Using the Internet, find other advancements in robotics.

CANDARM WRESTLING

1. Answers to the chart:

Detail		Canadarm	Canadarm2
Location		Space Shuttle	ISS
Degrees of Freedom		6	7
Joint Rotation		160 degrees	540 degrees
Sensors		None	Force and optical
Length		15 m	17.6 m
Weight		410.5 kg	1,800 kg
Diameter		33 cm	35 cm
Protection thickness		16 layers	19 layers
Speed	Loaded	6 cm/s	2 cm/s
	Unloaded	60 cm/s	37 cm/s
Mass Handling		266,000 kg	116,000 kg
Cameras		2	4