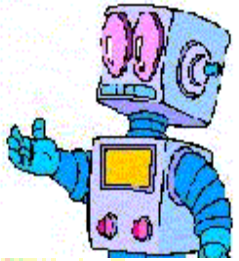
INTRODUCTION TO ROBOTICS

(Kinematics, Dynamics, and Design)



SESSION # 2:

HISTORY OF ROBOTICS

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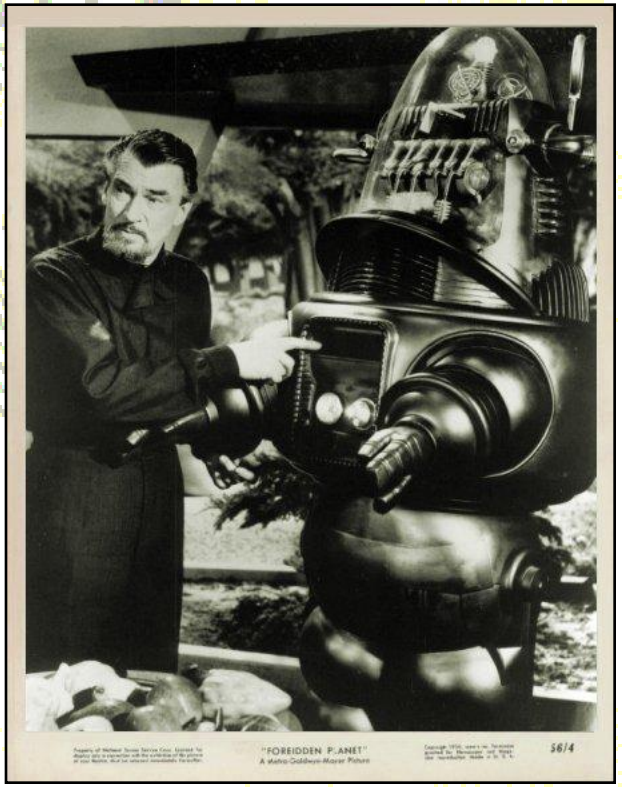
Applications of Robotics: A Historical Overview

Topics:

- ➔ A Brief History of Robotics
- ➔ Robot Definitions
- ➔ Robot Applications in Various Fields & Industries

Historical Overview

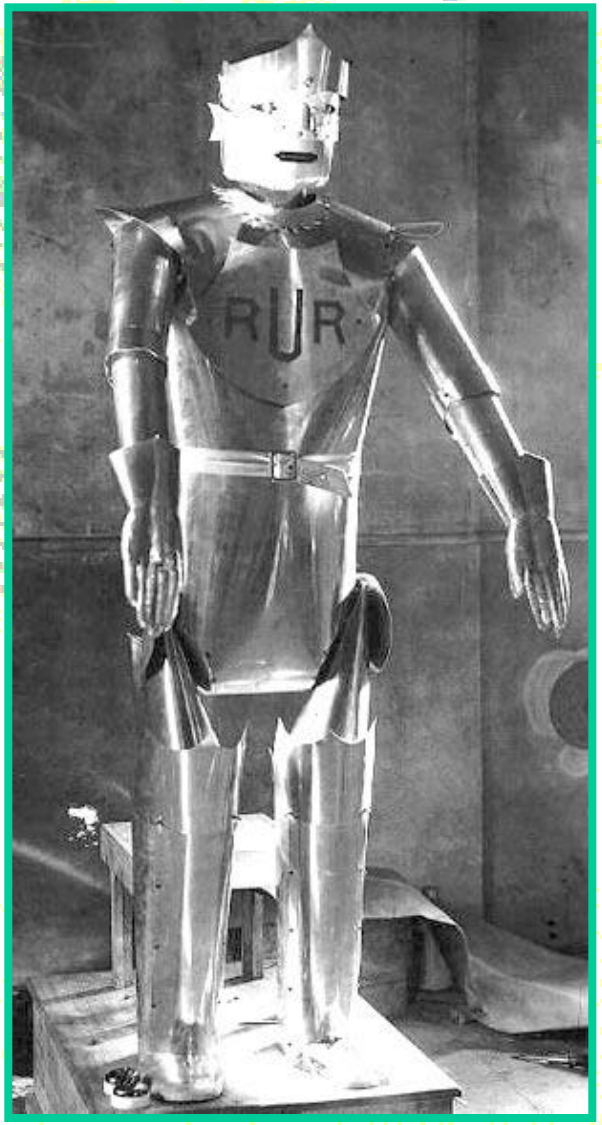
- Human desire has always been to duplicate/copy himself (mechanical dolls to play music mid-1700).
- Great civilizations of the past (Romans, Greeks, Egyptians, Persians) were based on Slavery.
- Robots can act as slaves without injustice. They can eliminate many of today's economic injustices.



Historical Overview

- In 1920, the word Robot was first used in a play by Karel Capek entitled "Rossum's Universal Robots" performed in Paris. In this play small artificial creatures strictly obeyed their master's orders. In Czech and Russian they were called Robotnic, from "Robota" = hard work, drudgery. Rossum (Rozum) = Reason, Wisdom, Intellect.

- These robots eventually turned against their creators, and two of them named Primus and Helina fell in love with each other (Cohen J., Human Robots, 1966; Kato I., Robotica J. 1983).



Historical Overview

- The first robots were thought to be evil human-looking machines.

- In 1950, Isaac Asimov introduced the idea of good robots (Androids) in his stories and popularized the word "Robotics".

(Lost in Space, 1964)

Asimov's Laws of Robotics

- A robot may not injure a human being or, through inaction, allow a human being to come to harm.
- A robot must obey the orders given it by human beings except where such orders conflict with the First law.
- A robot must protect its own existence as long as such protection does not conflict with the First or Second law.

Important Events in Robotics

Important Historical Events in Robotics	Year
Fabrication of the first android clocks in Germany and Switzerland	**1400**
Fabrication of mechanical dolls that could play music, and draw pictures	**1770**
The first automatic calculator/computer	**1870**
First use of the word "Robot" by Carl Capek in RUR play	**1921**
Creation of the first paint spraying machine for a known motion trajectory	**1930**
Fabrication of the first controller at Harvard University	**1942**
Design and fabrication of the first teleoperator	**1944**
Fabrication of the first NC machine tool at MIT	**1952**
Design of the first programmable robot by George Devol	**1954**
Denavit-Hartenburg representation to describe robot configuration	**1955**
Joseph Angle-Berger starts the Unimation Co. using Devol's robot design	**1956**
The first Unimate robot installed at Ford Motor Co. for die-casting operation.	**1961**
Design of the Stanford Manipulator	**1970**
Design and Fabrication of the Cincinnati-Milacron T^3 industrial robot	**1974**
The 1st PUMA (Programmable Universal Machine for Assembly) robot at G.M.	**1978**
Fugitsu-Fanuc Co. started the first automated factory	**1980**

Robot Definitions

➔ **Webster's Dictionary**:

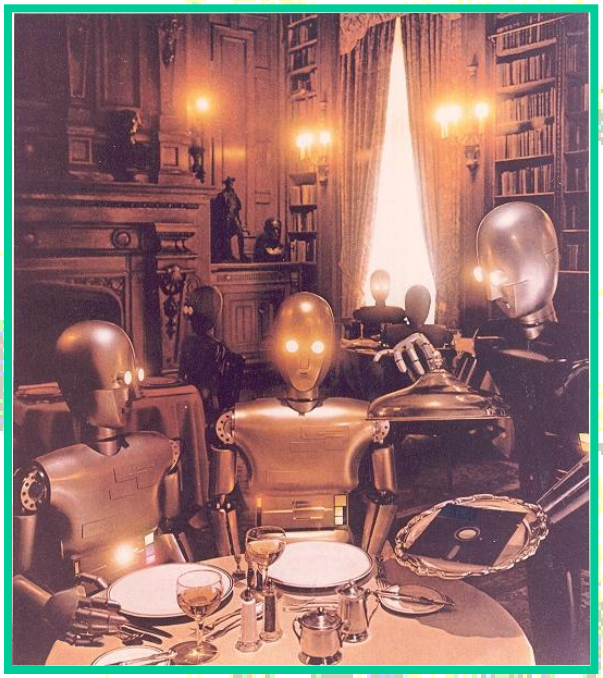
"An automatic apparatus or device that performs functions ordinarily ascribed to human beings" (not a very accurate description, Ex: washing machines, traffic lights, etc.).

➔ **Robotics Institute of America**:

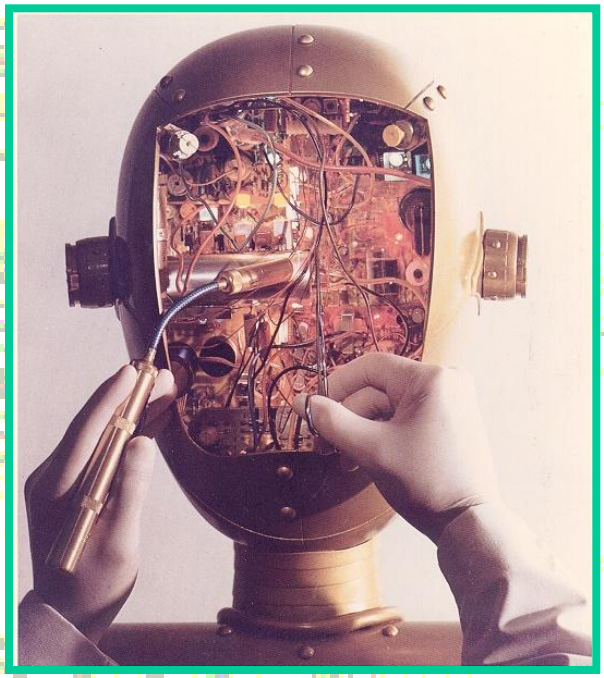
"A re-programmable multifunctional manipulator designed to move materials, parts, tools, or specialized devices, through variable programmed motions for the performance of a variety of tasks" (more accurate and complete).

➔ **Working Definition**:

"A physical agent that has an intelligent connection between sensors and actuators".



Fact and Fantasy



Fantasy
Human-like capabilities
Complex perception
Complex reasoning

Fact
Bug-like capabilities
Primitive perception
Primitive “reasoning”

Two Major Types of Robots

- **Industrial Robots**
  - Operates in a stable and known environment
  - Fixed or limited mobility
  - Relatively simple control program
- **Mobile Robots**
  - Operates in the “real” world
  - Mobile!
  - Requires a high degree of autonomy

Advantages of Industrial Robots

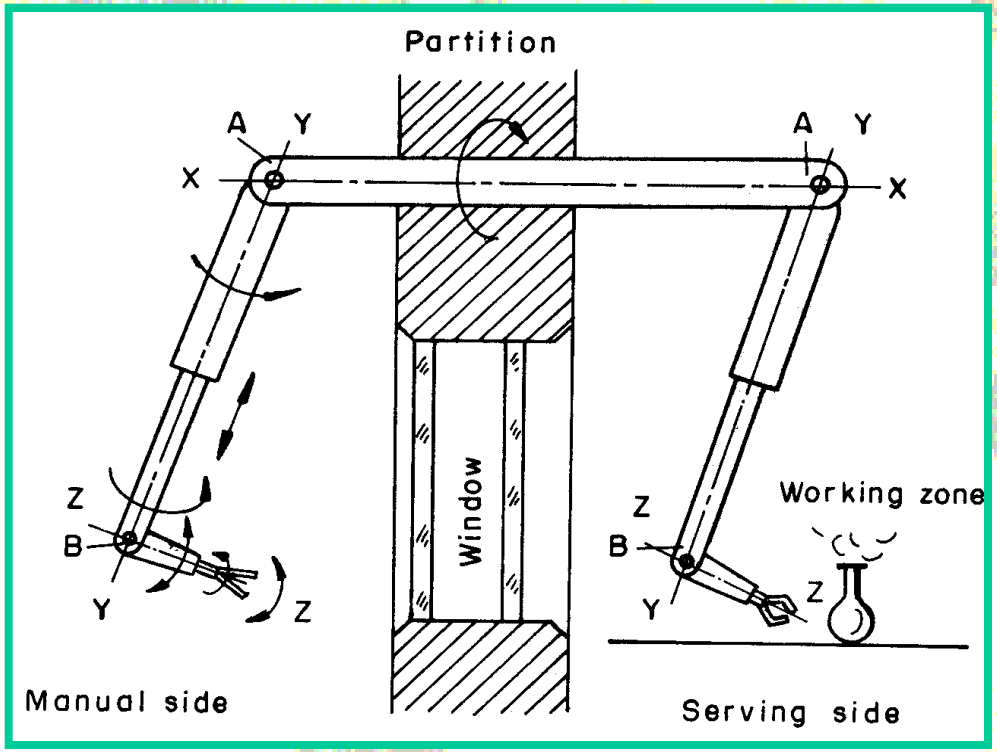
- Flexibility in production.
- High productivity.
- Improve quality of products.
- Improve quality of human life (safety of personnel) by performing the undesirable jobs.

Historical Overview

- Robot Manipulators were first realized in 1945 with the onset of nuclear age.
- In 1947-48, scientists at M.I.T. and General Electric Co. developed manipulators to handle toxic nuclear/radioactive materials.
- "Tele-operators" were the first mechanisms developed for handling of nuclear materials. They were later called as the "Master/Slave Manipulators". They are remotely controlled by the human operator from a distant safe position by means of a device or joystick, which is kinematically similar to the manipulator itself.

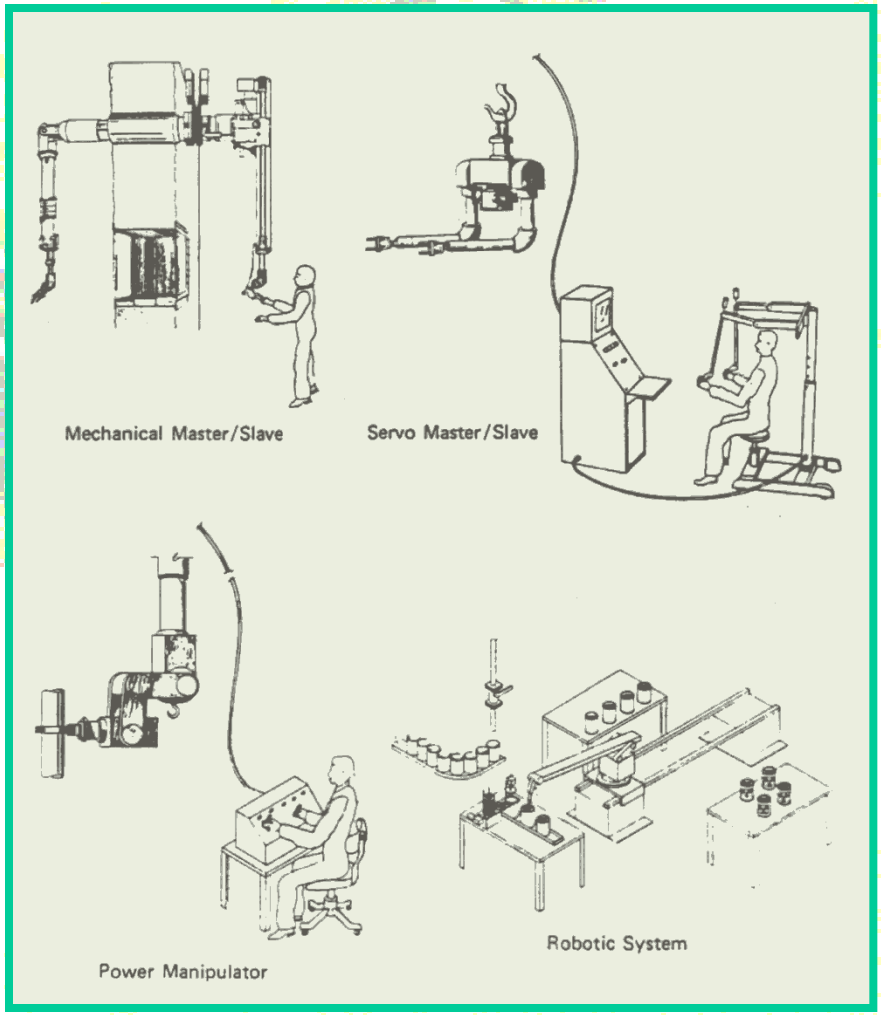
Master/Slave Manipulators

Master/Slave Manipulators

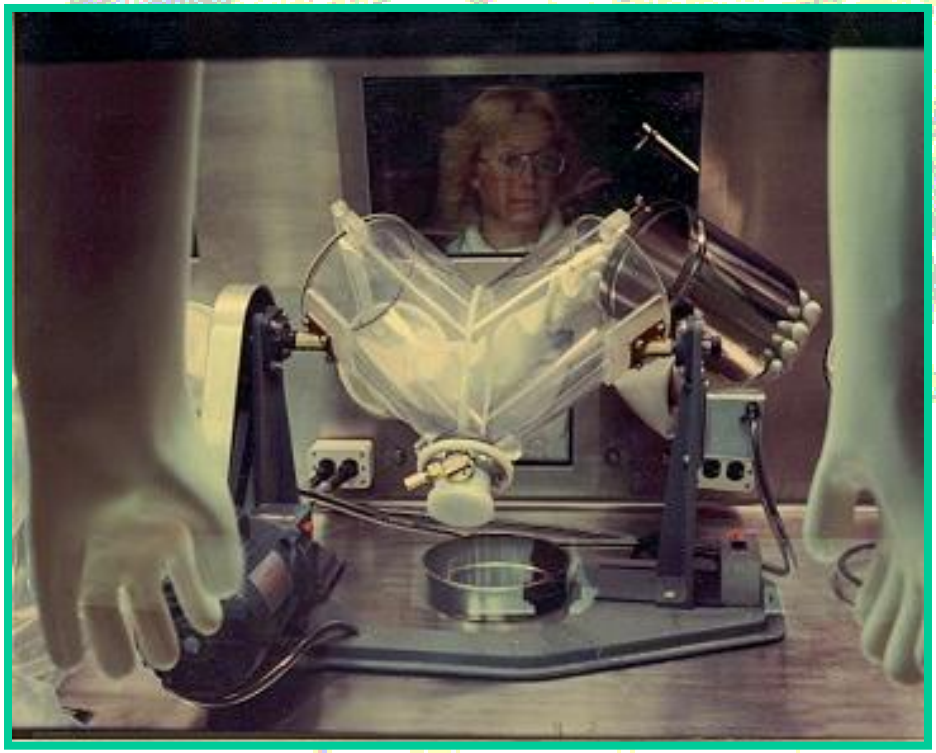


Manipulators Suitable for Nuclear Operations

- Mechanical Master/Slave
- Servo Master/Slave
- Power Manipulator
- Robotic System

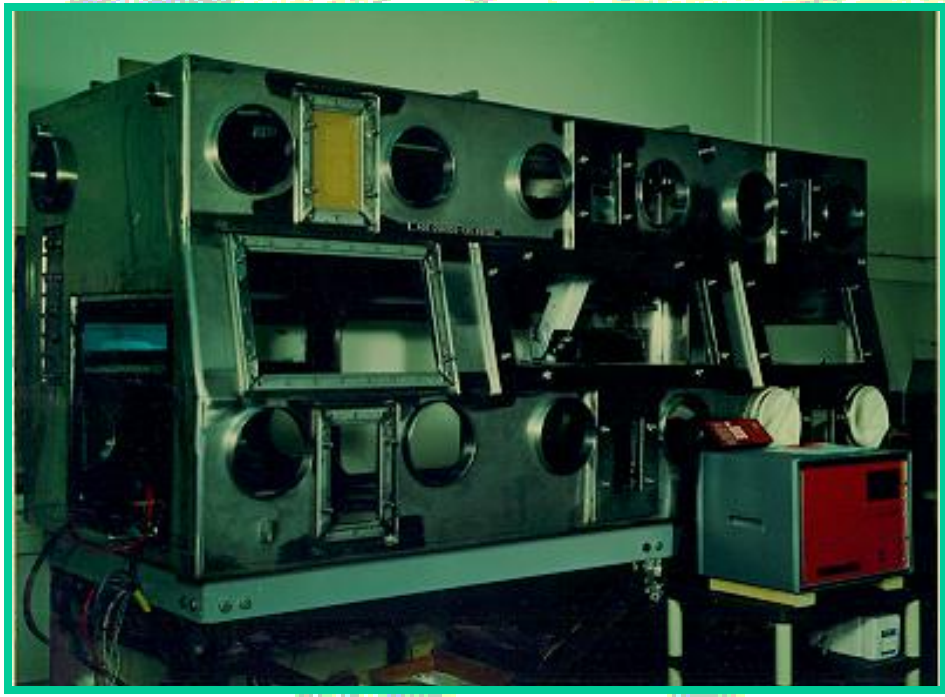


Manual Handling of Toxic Materials in Glove Boxes

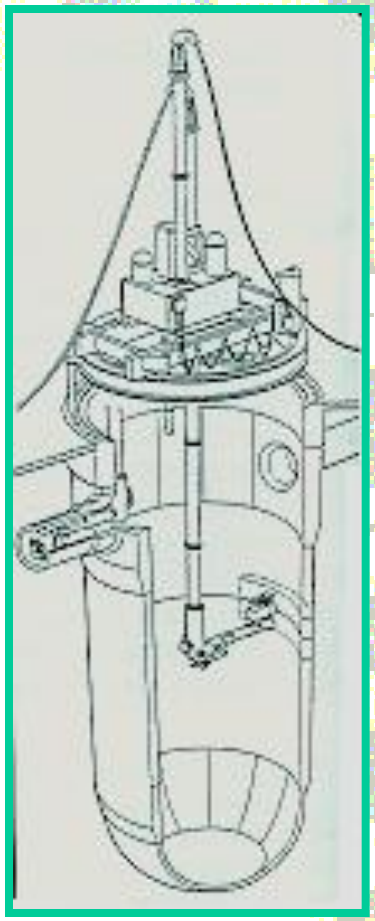


The Glove Box Chain

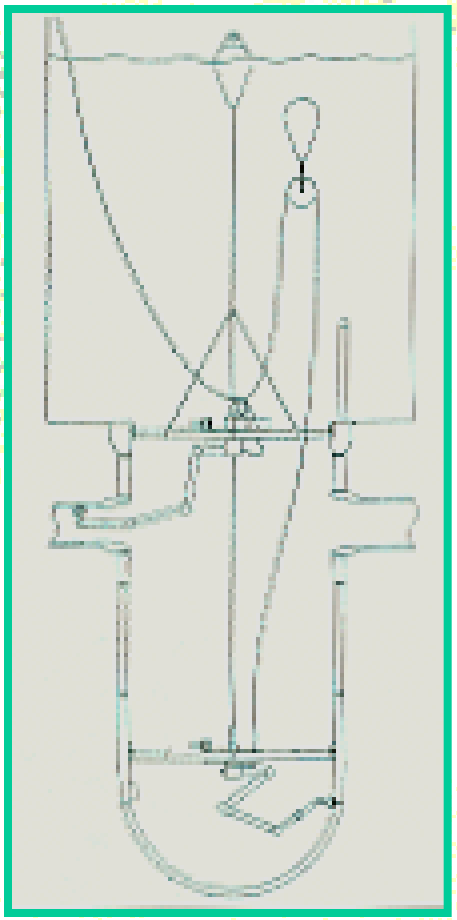
Applying Robots in the Glove Box Environment to Automate Usual Tasks



Applying Underwater Robots for Nuclear Reactor Vessel Inspection

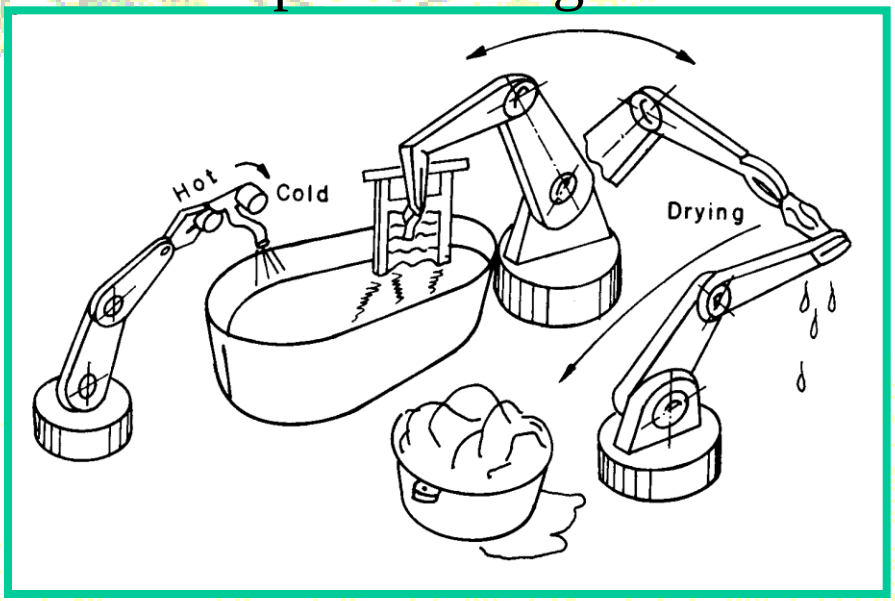


Periodically, reactor vessel welds must be ultrasonically inspected to ensure the pressure boundary integrity. (Underwater and radiation environment place high demands on robotic inspection systems).

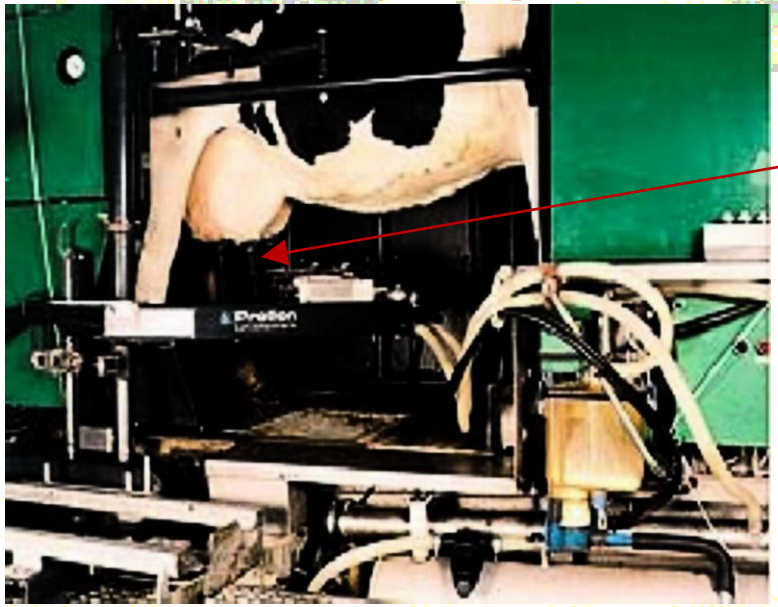


General Applications of Robotics in Industry

- Arc Welding
- Assembly Operations
- Die Casting
- Forging
- Glass Placement
- Grinding
- Handling Dangerous Materials
- Inspection of Parts, Produce, Livestock,...
- Injection Molding
- Laser/Waterjet Cutting
- Lawn mowing
- Machining
- Machine Loading
- Milking Cow
- Packaging
- Polishing
- Spray Painting
- Spot Welding

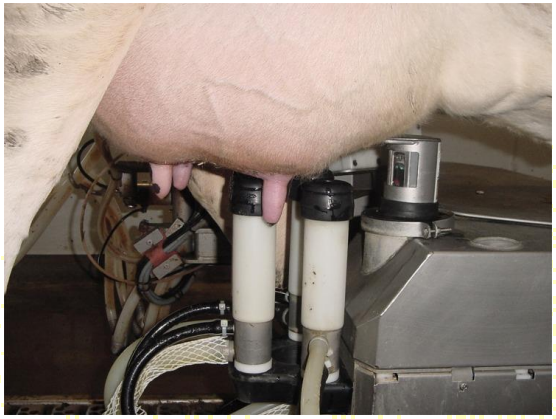


Robotic Milking Systems



Robots clean the area to be milked and place the suction cups using vision system

VMS robotic milking.flv



Robotic Tree Cutter

Robot Samples