Lecture 02 Feb. 05, 2019

More Applications, Robot Subsystems, and Indigenous Robots

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Review of Lecture 1 (Feb. 04, 2019)

- **Robot Applications**
  - **Industrial like Welding, Assembling, Palletizing**
- **Classification of Serial Robots**
  - **Coordinate system (Cartesian, etc.), Control (Servo, etc.) …**
- **Introduction to Mechatronics and PAR Lab. at IIT Delhi**

Outline

- **More Industrial applications**
- **Robotics in India**
- **Students Robotics at IIT Delhi**
- **Summary**

PCB Assembly

- SCARA: *Selective-Compliance-Assembly Robot-Arm*
- Can assemble in vertical motion
- 4-DOF robot
  - Pick up parts located on horizontal plane
  - Bring them to assembly location
  - Orient them, and
  - Insert them in a vertical motion

Machining

- Drilling
  - Robots can drill using template hole with a chamfered guide
  - Gripper holds portable pneumatic drill
  - It is PTP operation → manual teaching
- Deburring
  - Burrs are generated in machining of metal parts
  - Removal of burrs is expensive

- Two basic ways to deburr using robots
- For lightweight, it is picked up by robot and brought to deburing tool
- For heavy, the robot holds the tools
- In both, relative motion bet. tool and part is CP with high repeatability (app. 0.2 mm)

Medical

- Used in surgery (e.g., da Vinci)
- Goal: Not to replace surgeons but to assist
- Provide surgeons with a new set of versatile tools that extend his or her ability to treat patients
- Medical robotic systems are *surgical assistants* that work cooperatively with surgeons
- Training simulators (by IITs) using Haptics

Space

- Explorations of planets, moons, and near bodies in space
- Benefits: Lower cost and without endangering human life
- Such robots must be versatile and robust
- A space robot should have
  - Compactness and Lightness
  - Robustness
  - Versatility and Adaptability

Mining and Underwater

- Mining: To enhance productivity
  - Access unworkable mineral seams
  - Reduce human exposure to dust, noise, gas, water

- Underwater Applications
  - Prospect for minerals on the floor of the ocean
  - Salvaging of sunken vessels
  - Repair of ships
  - Sewage cleaning

Defence

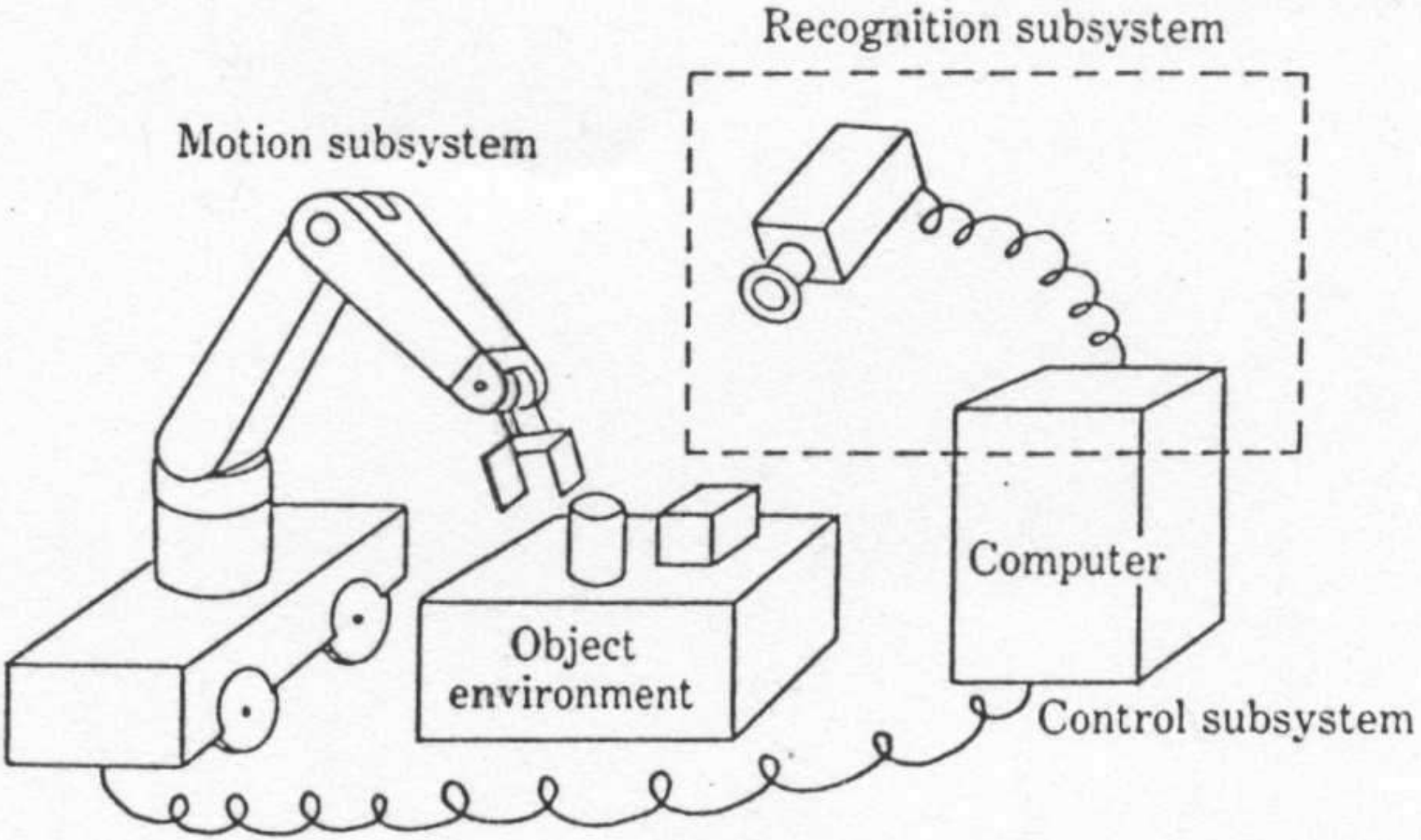
- Air force, navy, and army are interested
- Indian Robots: R&DE Pune; CAIR, and DEBEL Bengaluru
- Applications
  - Surveillance
  - Security guard in power plants, oil refineries, and other large civilian facilities

Robotics@IIT Delhi

- PAR Lab. (II-433A): Shown in Lecture 1

- IITD's robots: Walking simulator; Motion Platform; Robocon → RoboMuse

Robot Subsystems [Serial Robots]



Subsystems (Contd.)

- Motion: Manipulator (Arm & Wrist), End-effector, Actuators (Set in motion), and Transmission
- Recognition: Sensors (Measure status), and ADC
- Control (Supervision): DAC, and Digital Controller

Motion Subsystem

i) Manipulator: Mechanical arm + wrist

(Difference between Robot and Manipulator?)

ii) End-effector

- Welding torch, painting brush, etc.
- Simple Gripper and Robot hand

(iii) Actuator

- Pneumatic, Hydraulic, Electric

(iv) Transmission 

- Belt and chain drives
- Gears
- Link mechanisms

Recognition Subsystem

(i) Sensors (Essentially transducers)

- Converts a signal to another

(ii) Analog-to-Digital Converter (ADC)

- Electronic device

Control Subsystem

(i) Digital Controller

- CPU, Memory, Hard disk (to store programs)

(ii) Digital-to-Analog Converter (DAC)

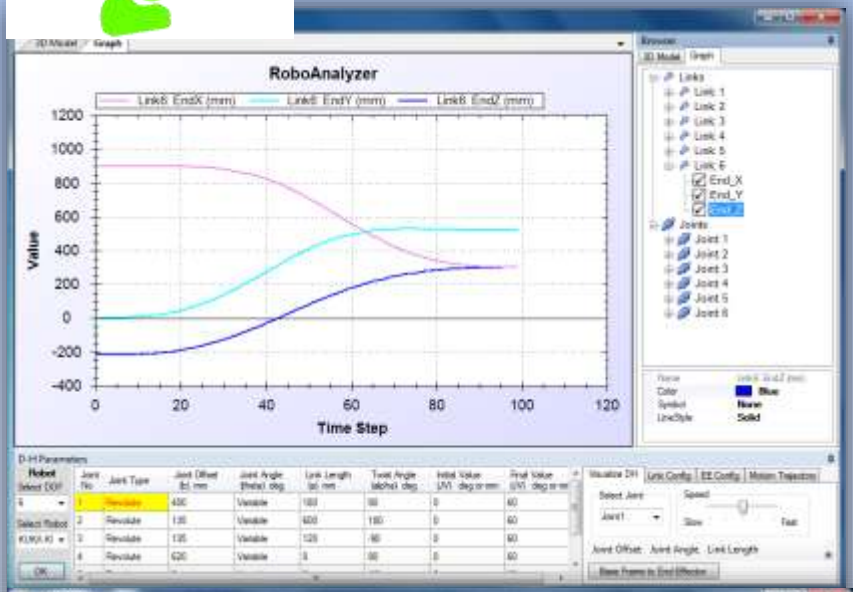
(iii) Amplifier

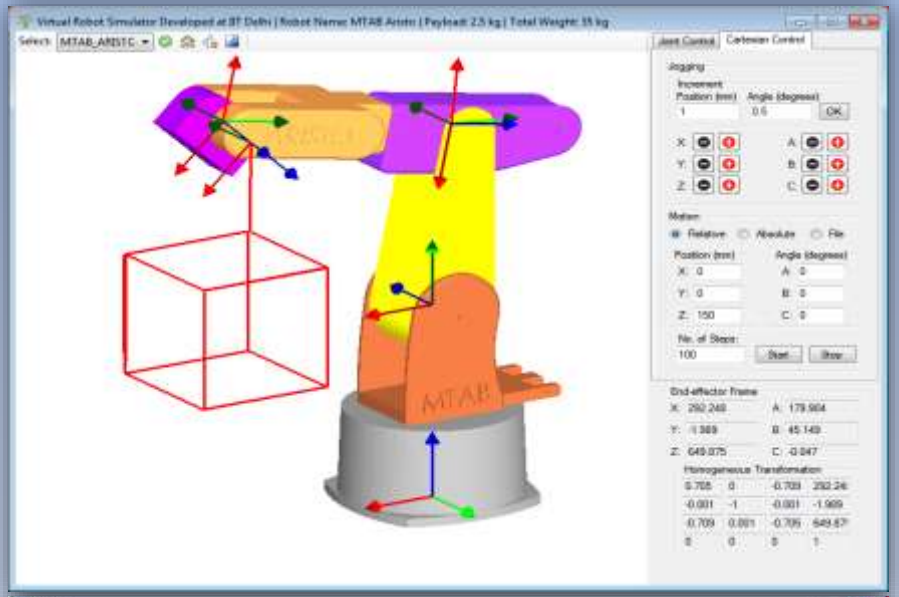
- Amplify weak commands from DAC

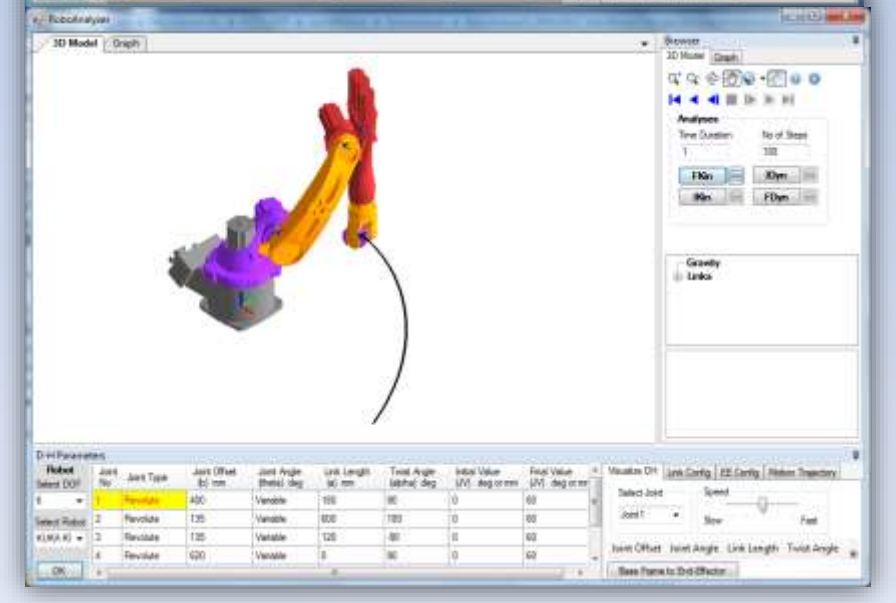
Classifications (Taught in Lecture 1)

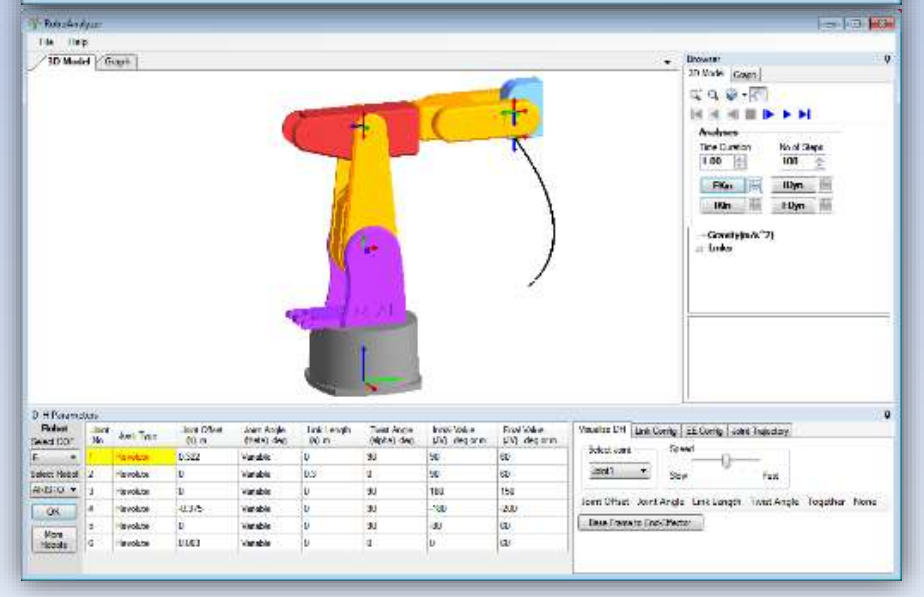
- By Applications, e.g., Welding, Machining
- By Coordinate System, e.g., Cartesian
- By Actuation System, e.g., Hydraulic
- By Control Method, e.g., Digital
- By Programming Method, e.g., PTP

Robot Software









Summary

- More applications were presented
- Indian robots were shown
- Videos of the robots by IIT Delhi students were shown.

Thank You

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