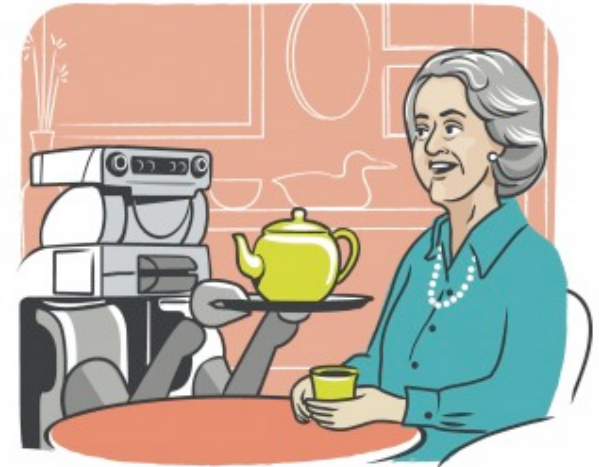
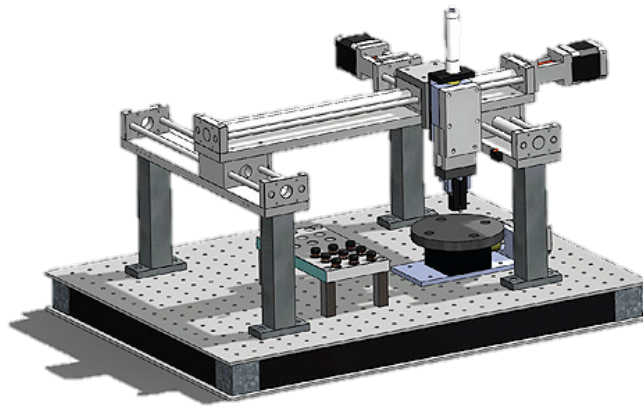
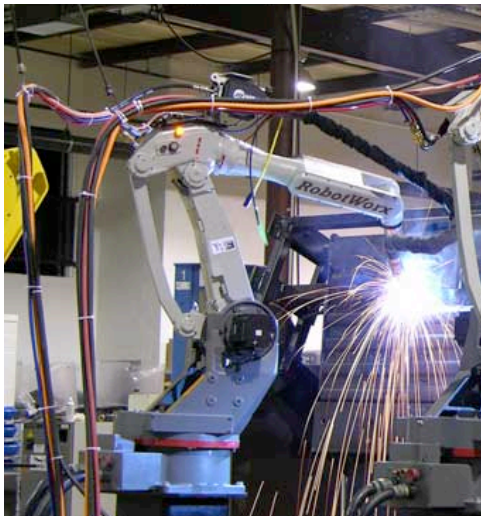


Manipulation

Overview, Concepts, Types



Many slides adapted from:
S. N. Kale, Assistant Professor, PVPIT, Budhgaon
www.amci.com/tutorials/tutorials-stepper-vs-servo.asp
www.modmypi.com/blog/whats-the-difference-between-dc-servo-stepper-motors
en.wikipedia.org

Bookkeeping

2

- ◆ Assignment I finished!
- ◆ Correction: velodynes
- ◆ Projects
 - ◆ First deliverable on ~~Thursday~~ Wednesday night
 - ◆ Goals, milestones, time estimates
- ◆ Reading:
- ◆ Today
 - ◆ Concepts, terminology
 - ◆ Characterization (beginning)



A Talk!

UMBC CSEE Colloquium
2:00pm Friday, 2nd October
ITE325b



3

Programming Robotic Agents: A Multi-tasking Teleo-Reactive Approach

Keith Clark, Imperial College London, University of Queensland, University New South Wales
(joint work with Peter Robinson, University of Queensland)

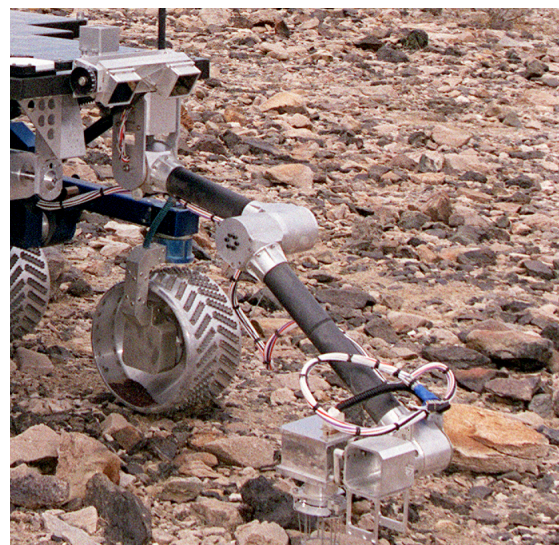
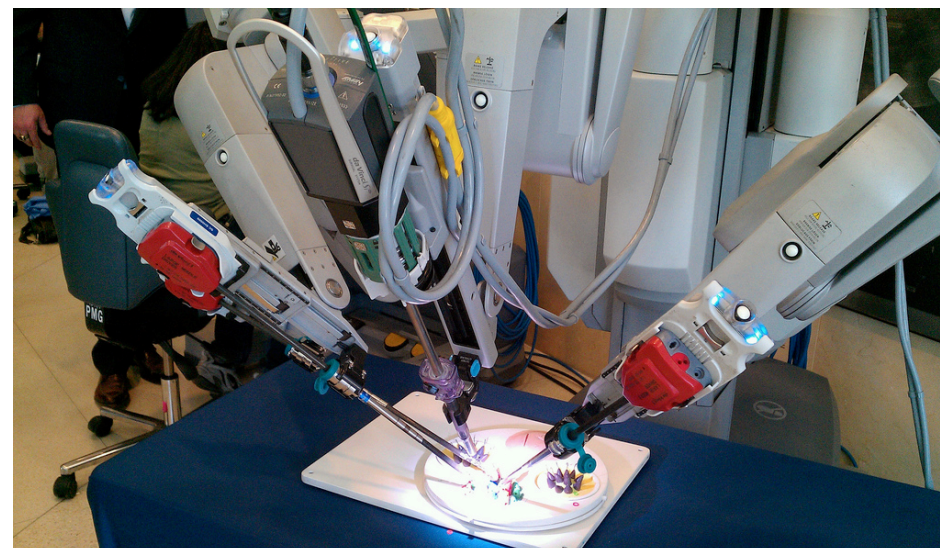
A multi-threaded/multi-tasking message communicating robotic agent architecture in which the concurrently executing tasks are programmed in TeleoR...which extends TR in typing, knowledge representation, having task atomic procedures to control the deadlock, starvation free sharing of several robotic resources by concurrently executing tasks.

Its use is illustrated in the video at:

<http://bit.ly/teleor>

Manipulators

4



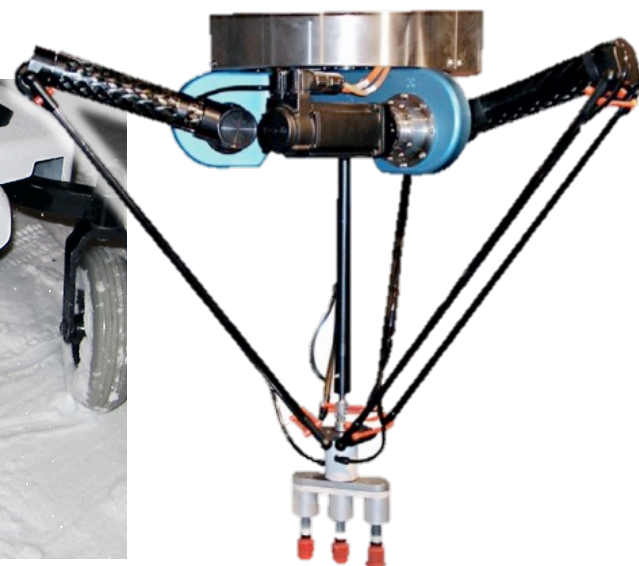
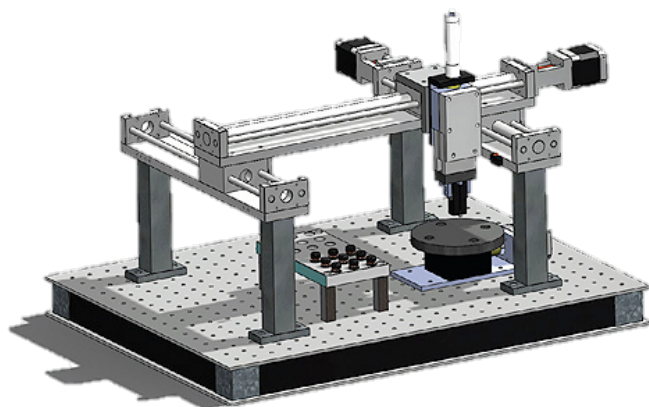
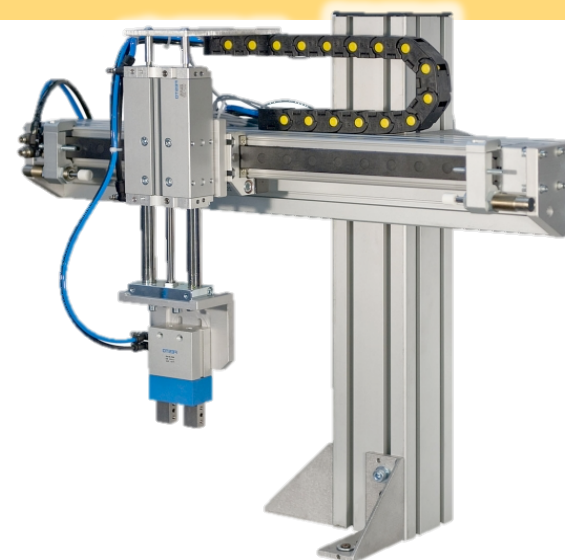
Manipulators

5



Manipulators

6



Manipulation

7

- ◆ What is a manipulator?
 - ◆ Manipulates something in the world
 - ◆ Physically alter the world through contact
 - ◆ As a primary goal
 - ◆ But not its own position
 - ◆ Directly or indirectly
- ◆ When is this desirable?
 - ◆ Dangerous workspaces
 - ◆ Space; foundries; underwater; factories
 - ◆ Human-intractable workspaces
 - ◆ Too small; too big; too much precision needed
 - ◆ Boring, repetitive, unpleasant work





Uses

8

◆ Current

◆ Industrial

- ◆ Welding
- ◆ Drilling
- ◆ Attaching (screws, rivets)
- ◆ Painting
- ◆ Loading/unloading

◆ Surgery

◆ Space exploration

◆ Chores

◆ Patient care

◆ Delivery

◆ Future

◆ Elder care

◆ Entertainment

◆ Environment sampling

◆ Compliant-material interactions (sewing)

◆ Police work

◆ Plus: more chores, more patient care, more surgery, more space, &c. (but better)



Terminology

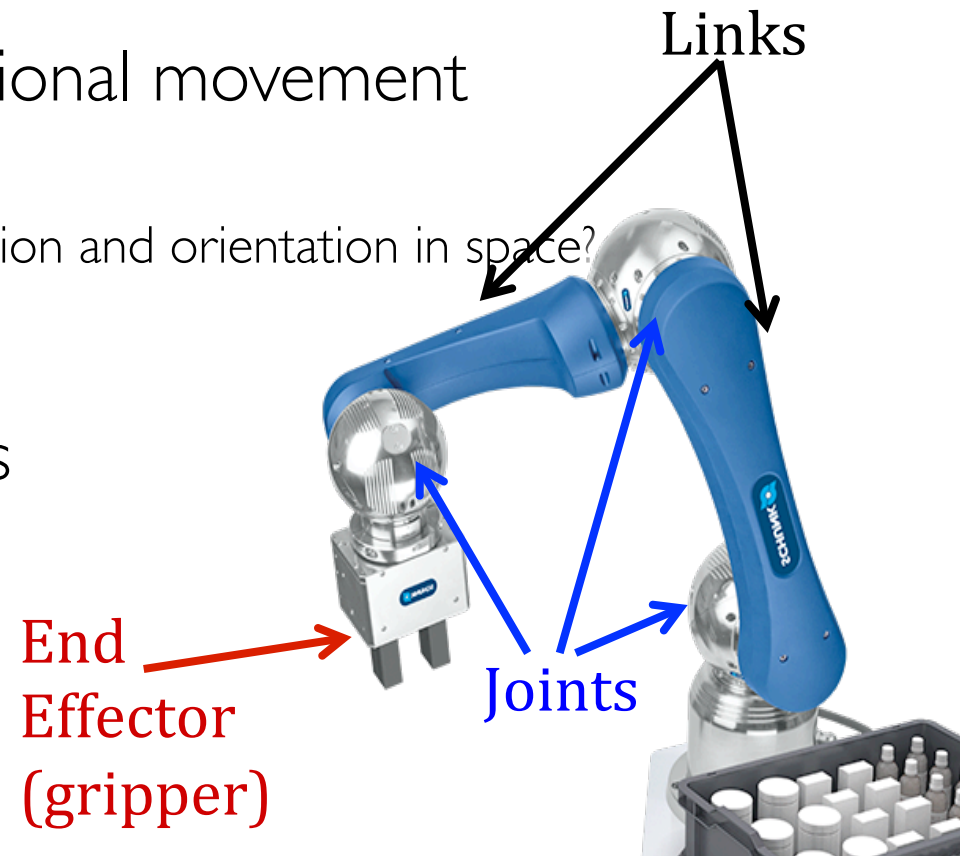
9

- ◆ Actuator
 - ◆ Generates motion or force; usually a motor
 - ◆ “Drive type”
- ◆ End Effector
 - ◆ Device at the end of an arm; interacts with environment
- ◆ DoFs
- ◆ Gripper
 - ◆ What it sounds like; a type of manipulator
- ◆ Actuation
 - ◆ How are the individual parts made to move?

Manipulator Robot

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- ◆ Modeled as a chain of *rigid links* connected by *joints*
- ◆ Links: unjointed length of robot
- ◆ Joints: translational or rotational movement
 - ◆ Joints have DoFs
 - ◆ How many to describe its position and orientation in space?
 - ◆ Sliding or jointed
- ◆ Manipulator / End Effectors
 - ◆ Grippers / Tools
 - ◆ Sensors



Characterization

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- ◆ Types
 - ◆ By drive
 - ◆ By actuation
 - ◆ Tendons
 - ◆ Direct servoing
 - ◆ Underactuation
 - ◆ By motion
 - ◆ Prismatic (linear)
 - ◆ Revolute (rotational)
 - ◆ By Characteristics
 - ◆ Payload
 - ◆ Working area/radius



Joints

12

- ◆ Prismatic: sliding / translational

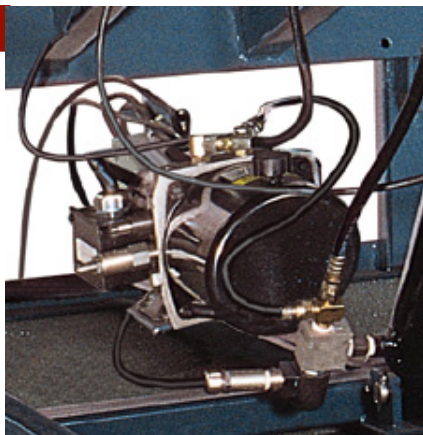


- ◆ Revolute: rotational



Actuators

13



Hydraulic Motor



Pneumatic Cylinder



Stepper Motor



Pneumatic Motor



DC Motor



Servo Motor

When Do We Use...

14

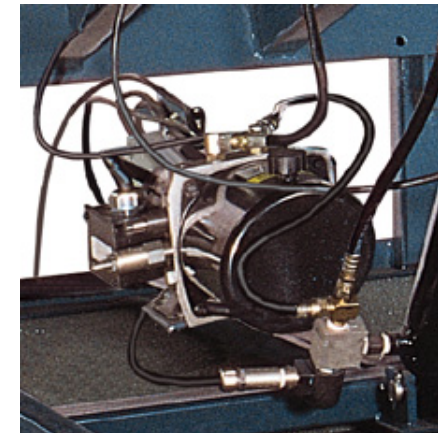
- ◆ Hydraulic/pneumatic
 - ◆ Heavy loads, high speeds
 - ◆ Sometimes hard to control (esp. pneumatic)
 - ◆ Doesn't produce sparks



Pneumatic Motor



Pneumatic Cylinder



Hydraulic Motor

When Do We Use...

15

- ◆ Most common robotic actuators utilize combinations of different electro-mechanical devices
 - ◆ Stepper motor
 - ◆ Subdivides a rotation into 4-10 increments
 - ◆ Open Loop
 - ◆ Servo Motor
 - ◆ Subdivides a rotation arbitrarily
 - ◆ Closed Loop
 - ◆ AC servo motor
 - ◆ Brushless DC servo motor
 - ◆ Brushed DC servo motor
- ◆ But usually *motors*.

