ECE 447: Robotics Engineering

Lecture 1: Introduction to Robotics

Dr. Haitham El-Hussieny

Electronics and Communications Engineering
Faculty of Engineering (Shoubra)
Benha University

Spring 2019

Lecture Outline:

1. What is a Robot?
2. Types of Robots.
3. ECE 447 Course Plan.

Table of Contents

Definition of a Robot:

What is a Robot?

Definition of a Robot:

What is a Robot?

Robots in Science Fiction

Astro Boy (1952)

Mazinger (1974)

Robots (2005)

WALL·E (2008)

Definition of Robots:

What is a Robot?

Human beings have constantly attempted to seek **substitutes** that would be able to **mimic their behaviour** in the various instances of interaction with the surrounding environment.

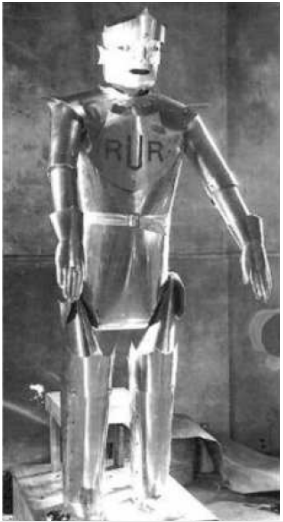
Definition of Robots:

What is a Robot?

Human beings have constantly attempted to seek **substitutes** that would be able to **mimic their behaviour** in the various instances of interaction with the surrounding environment.

The origin of word "Robot"

- The term **robot** was first introduced into English vocabulary by the Czech playwright *Karel Capek* in his 1921 play **Rossum's Universal Robots**.



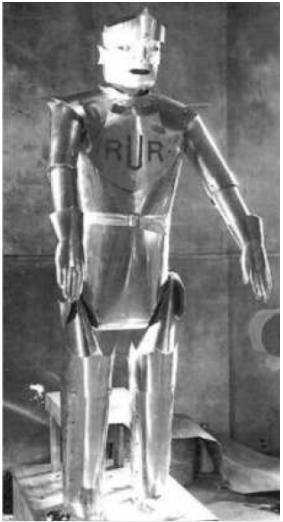
Definition of Robots:

What is a Robot?

Human beings have constantly attempted to seek **substitutes** that would be able to **mimic their behaviour** in the various instances of interaction with the surrounding environment.

The origin of word "Robot"

- The term **robot** was first introduced into English vocabulary by the Czech playwright *Karel Capek* in his 1921 play **Rossum's Universal Robots**.
- The word **robota** being the Czech word for **work**.



Definition of Robots:

What is a Robot?

Usage frequency of word "robot".

Definition of Robots:

What is a Robot?

Robot Institute of America (RIA):

A robot is a **reprogrammable multifunctional manipulator** designed to move material, parts, tools, or specialized devices through **variable programmed motions** for the performance of a variety of tasks.

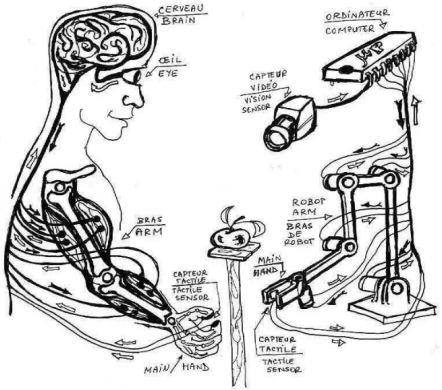
KUKA KR 500-3 Robot

Definition of Robots:

What is a Robot?

Modern Definition, **David M. Bradley**:

Robotics is the **intelligent** connection of the **perception** to **action**.



Human Vs. Robot

Definition of Robots:

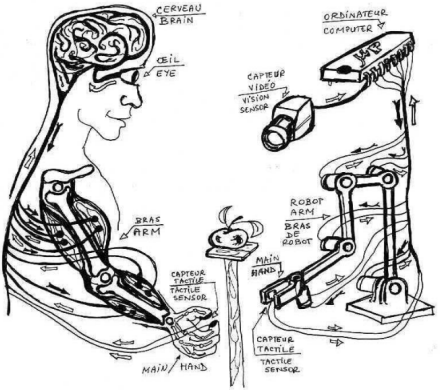
What is a Robot?

Modern Definition, **David M. Bradley**:

Robotics is the **intelligent** connection of the **perception** to **action**.

Breakfast Robot

Lipstick Robot



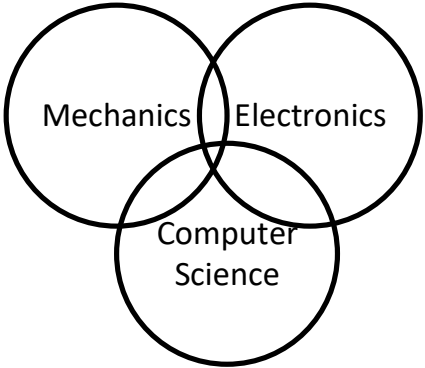
Human Vs. Robot

Definition of Robots:

Robots in general:

A **robot** is a complex machine composed by:

- A **mechanical system** for interacting with the environment.
- An **actuation system** for task execution.
- A **sensory system** for getting proper information.
- A **control system** for the run-time control and programming.



Multi-disciplinary "science"

Definition of Robots:

Three Laws of Robotics:

Isaac Asimov, 1942:

- **Law 1**: A robot may not injure a **human being** or, through inaction, allow a human being to come to harm.

Issac Asimov

Definition of Robots:

Three Laws of Robotics:

Isaac Asimov, 1942:

- **Law 1**: A robot may not injure a **human being** or, through inaction, allow a human being to come to harm.
- **Law 2**: A robot **must obey orders given** to it by human beings, except where such orders would conflict with the First Law.

Issac Asimov

Definition of Robots:

Three Laws of Robotics:

Isaac Asimov, 1942:

- **Law 1**: A robot may not injure a **human being** or, through inaction, allow a human being to come to harm.
- **Law 2**: A robot **must obey orders given** to it by human beings, except where such orders would conflict with the First Law.
- **Law 3**: A robot must **protect its own existence** as long as such protection does not conflict with the First or Second Law.

Issac Asimov

Definition of Robots:

Three Laws of Robotics:

Isaac Asimov, 1942:

- **Law 1**: A robot may not injure a **human being** or, through inaction, allow a human being to come to harm.
- **Law 2**: A robot **must obey orders given** to it by human beings, except where such orders would conflict with the First Law.
- **Law 3**: A robot must **protect its own existence** as long as such protection does not conflict with the First or Second Law.
- **Law 0**: A robot may not injure **humanity**, or, by inaction, allow humanity to come to harm.

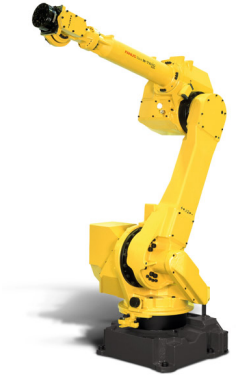
Issac Asimov

Table of Contents

Types of robots by application:

Industrial Robots (Manipulators)

SCARA Robot



FANUC M-710iC

Types of robots by application:

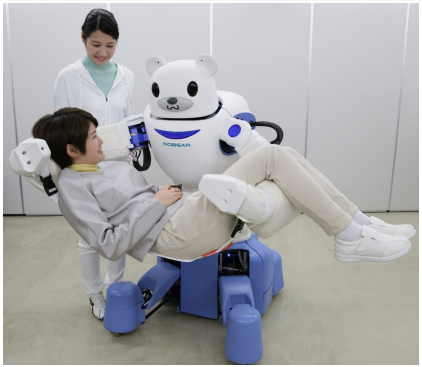
Domestic or Household Robots

iRobot Roomba

SpotMini (Boston Dynamics)

Types of robots by application:

Medical Robots

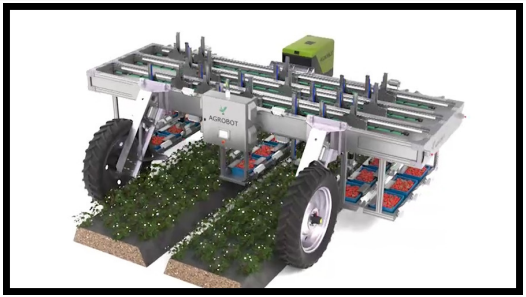


Robear Nursing Robot

Davinci Surgical Robot

Types of robots by application:

Service Robots



Agrobot Strawberry Harvesters

AIST Construction Robot

Types of robots by application:

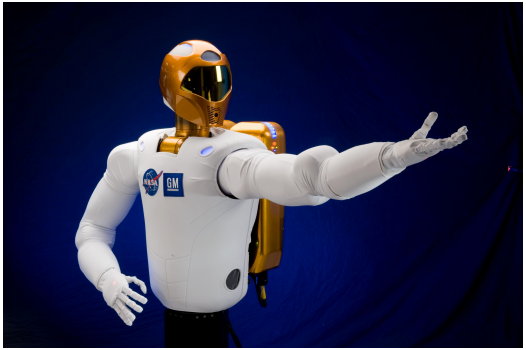
Military Robots

RQ-1 / MQ-1 Predator

DRDO Daksh ROV

Types of robots by application:

Space Robots



NASA - Robonaut

NASA - Curiosity

Types of robots by locomotion:

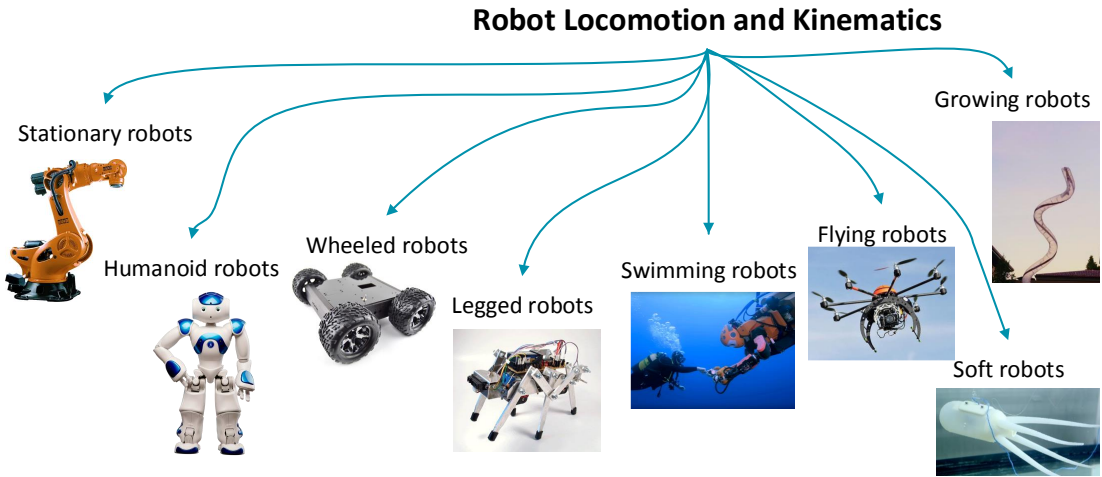


Table of Contents

ECE 447 Course Plan:

ECE 447: Robotics Engineering

Industrial Robots (Me!)

Mobile Robot (Dr. Ashraf Hafez)

- Industrial Automation & Robotics:
  - A brief introduction to robotics.
  - Structure and main components of industrial robots.
- Rigid Body Kinematics, Homogeneous Transformations:
  - Rigid bodies and their representation in 3D.
  - Homogeneous coordinate frames.
  - Homogenous transformations.
- Kinematic Model of Industrial Manipulators:
  - Direct and Inverse Kinematics.

ECE 447 Course Plan:

Grades Mapping:

- Course work (25):

ECE 447 Course Plan:

Grades Mapping:

- Course work (25):
  - Quiz (10).

ECE 447 Course Plan:

Grades Mapping:

- Course work (25):
  - Quiz (10).
  - Midterm (15).

ECE 447 Course Plan:

Grades Mapping:

- Course work (25):
  - Quiz (10).
  - Midterm (15).
- Final Exam (50).

Total points (75)

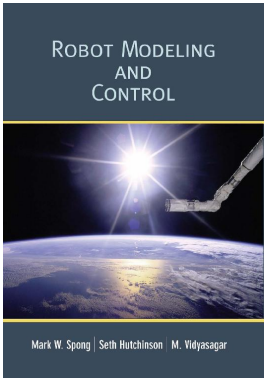
ECE 447 Course Plan:

Grades Mapping:

- Course work (25):
  - Quiz (10).
  - Midterm (15).
- Final Exam (50).

Total points (75)

Textbook:
Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, "**Robot Modeling and Control**", 2nd. Edition.



ECE 447 Course Plan:

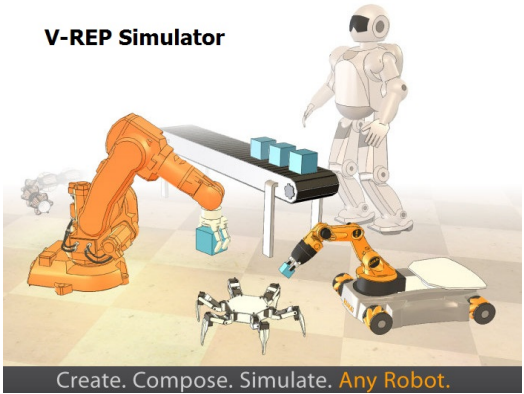
Tolboxes:

- MATLAB Robotics Toolbox (Peter Corke).
- V-REP Simulator.

course Material and Handouts:

Personal website

- Courses >> ECE 447 Robotics Engineering (Spring 2019).



Prof. Hiroshi Ishiguro, Japan

Questions?

haitham.elhussieny@feng.bu.edu.eg