Durham University

Robotics – Planning and Motion

Introduction to Robotic

COMP52815

Prof Farshad Arvin & Dr Junyan Hu

Email: farshad.arvin@durham.ac.uk
Room: MCS 2058

Lecture 1: Learning Objectives

The aim of this lecture is to describe the structure of the course and to provide you with an introduction to the field of robotics.

- **Objectives:**
  1. Definition of robotics & it's history
  2. Current robotic sectors
  3. Industrial robotics & manipulators

See also:

- Introduction to Mobile Robot Control, Spyros G. Tzafestas, 2014

Robot Definition

The term robot was first introduced by the Czech playwright Karel Capek in his 1921 play Rossum's Universal Robots (the word robota being the Czech word for worker). The term automaton had been used since ancient Greek times.

Two common definitions are:

- *An industrial robot is a reprogrammable, multifunctional manipulator designed to move parts, tools or special devices through variable programmed motions for the performance of a variety of tasks.*

- *A robot is an artificial physical agent that perceives its environment through sensors and acts upon that environment through actuators.*

However, it is difficult to define precisely, *Joseph Engelberger*:

"I can't define a robot, but I know one when I see one."

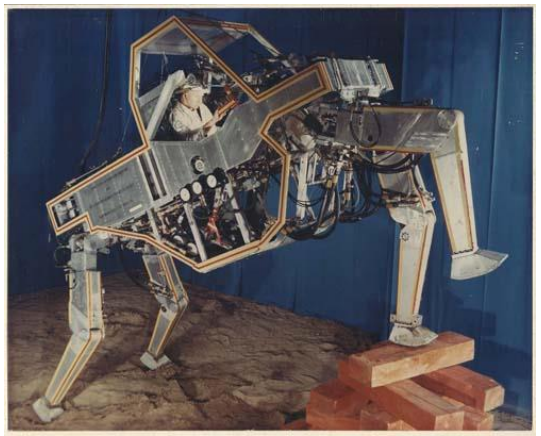
Brief History of Automatons

- **1,000 BC Yan Shi** (China) creates a humanoid automaton (sing and dance)
- **400 BC Archytas of Tarentum** (Greece) designed a mechanical bird, "The Pigeon“, which was propelled by steam.
- **322 BC Homer's Iliad**, Aristotle speculated (*Politics book 1, part 4*) that automatons could bring about human equality by the abolishing slavery.
- **1206 Al-Jazari’s humanoid robot.** A boat with four automatic musicians. It had a programmable drum machine with pegs that bump into little levers that operate the percussion. The drummer could play different rhythms and drum patterns by moving the pegs.
- **1464 Leonardo Da Vinci’s warrior**. Humanoid automaton was dressed in medieval armour, capable of some human-like movements. It was able to sit, wave its arms and move its head and jaw.
- **1737 Jacques de Vaucanson’s Digesting Duck**. Powered by weights, it could flap its wings (each wing has over 400 parts), eat & digest grain, and defecate by excreting matter stored in a hidden compartment.
- **1868 Zadoc P. Dederick's Steam Man** inspired many walking machines, and (science) fictional stories (patented, google patents). Robot was designed to pull a cart.

Durham University

Brief History of Robotics

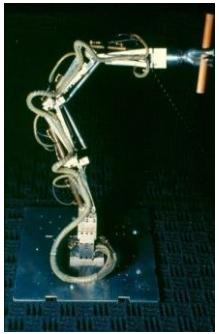
- **1921** The term "robot" was first used in a play published by the Czech Karel Čapek.
- **1938** World's Fair, New York: "Electro" and "Sparko" (Westinghouse Electric Corporation). It could walk by voice command, speak about 700 words, smoke cigarettes, blow up balloons, and move his head and arms.
- **1940-45** Small radio-controlled robot tanks in World War 2 (Goliath & teletanks)
- **1962** First industrial arm robot (Unimate) installed on a General Motor's assembly line. Unimation becomes profitable in 1975.
- **1966** Stanford "Shakey" first general purpose mobile robot with vision system
- **1968** General Electric "walking truck" for the US army. Movements are slaved to an operator.

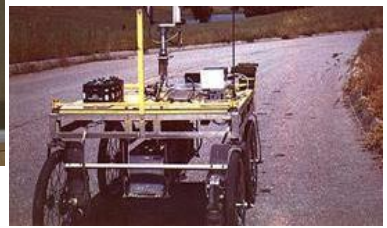


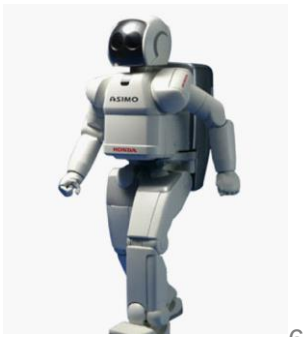
Durham University

Brief History of Robotics

- **1968** Hydraulic Minsky-Bennett arm developed by Marvin Minsky. (Twelve joints)
- **1969** Victor Scheinman (Stanford) created the Stanford Arm
- **1970** The Stanford Cart which can follow lines and controlled via radio
- **1977** Asea produce a microcomputer controlled range of arms. These will go on to become ABB
- **1979** SCARA robot
- **1979** Stanford Cart rebuilt to include vision which permits 3D mapping
- **1981** Takeo Kanade builds the direct drive arm which is the first to have motors installed directly into the arm joints.
- **1986** Honda start a research programme which leads to ASIMO
- **1988** Lego and MIT collaborate to create LEGO Logo



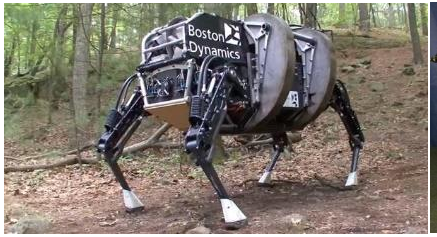


Durham University

Brief History of Robotics

- **1992** John Adler developed Cyber Knife which takes x-rays (tumour) and delivers a dose of radiation
- **1993** Dante (8 legged walking robot) developed at CMU (falls into a crater in the Antarctic)
- **2000** ASIMO unveiled by Honda
- **2001** Lego Mindstorms released
- **2001** Candaarm2 on the ISS (International Space Station)
- **2002** Roomba released by iRobot
- **2003** Mars rovers Spirit and Opportunity land
- **2006** Big dog (and petman) developed by Boston Dynamics (google)
- **2007** HyQ was developed by iit (Italian Institute of Technology)



Durham University

State-of-the-art Robots

- iit HyQ-Max (video)
- Boston Dynamics Spot (video)
- Boston Dynamics Atlas (video)
- iit iCub (video)

Durham University

Current Robotic Application Sectors

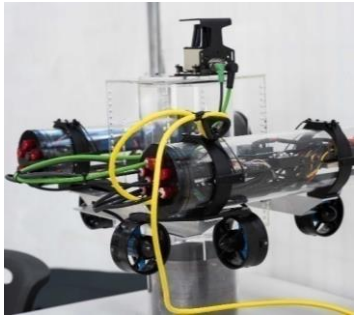
- Manufacturing
- Surgical
- Service
- Military
- Healthcare
- Home
- Space
- Farming
- Security/surveillance
- Rescue
- Extreme Environments












Durham University

Lecture 1 Summary

- Robots and introduction to robotics
- Brief history of robotics
- State-of-the-art robots
- Applications