1.4 Modern History (1961- )

Figure 1.46: George Devol and Joseph Engelberger founded Unimation (1961), which installed the first industry robot at a GM plant in Trenton, New Jersey.

Figure 1.47: American Machine Foundry (AMF 1960) markets Versatran, a cylindrical robot.

Figure 1.48: Stewart and Gough (1960): Stewart platform
1.4 Modern History (1961- )

Figure 1.49: H. A. Ernst (MIT 1961): Computer control of mechanical arms using touch sensor.

Figure 1.50: Stanford University (1963): Rancho Arm, the first artificial robotic arm to be controlled by a computer.

Figure 1.52: R. Mosher at General Electric (1968): quadrupled walking machine (11 ft tall, 3000lb)

B. Roth  K. J. Waldron

1.51: Research on robot kinematics and design initiated by B. Roth (1964), D. Pieper (1968), K. J. Waldron (1972), etc.
1.4 Modern History (1961- )

Figure 1.53: Kawasaki robots in Japan with a patent from Unimation (1968)

Figure 1.54: V. Scheinman (1969): The Stanford arm

Figure 1.55: Draper Lab (1970) (RCC Device), SCARA robots by H. Makino, Japan (1978), Adept Robotics (1982)

Figure 1.56: Yaskawa engineers coined the term "Mechatronics" (1971)
1.4 Modern History (1961-)

Figure 1.57: Waseda University develops Wabot-1 (1973) and Wabot-2 (1980)

Figure 1.58: Cincinnati Milacron (1974): (T3 Robots) Payload (100lb)

Figure 1.59: S. Hirose (1976): The soft gripper

Figure 1.60: Viking 1 and 2 space probes, equipped with robot arms (1976)
1.4 Modern History (1961-)

Figure 1.61: OSU Hexapod (1977)

Figure 1.62: Star Wars (1977): R2-D2 and C-3PO

Figure 1.63: Robotics Institute at CMU is established (1979), leading to first PhD program in Robotics.

1.4 Modern History (1961- )

Figure 1.65: M. Raibert (1980) (RI, CMU & AI lab, MIT): Hopping, Robots, Monoped, biped and Quadpeds. Dynamically stable quadruped robot BigDog created by Boston Dynamics (founded by M. Raibert in 1992) with the NASA Jet Propulsion Laboratory, Caltech (2005).

Figure 1.67: H. Asada and T. Kanade at CMU (1981): Direct drive robots

1.4 Modern History (1961- )


Figure 1.69: NASA (1981): Candarm

Figure 1.70: K. Salisbury (1981): Salisbury Hand

Figure 1.71: Fanuc of Japan and General Motors form a joint Venture (1982): Fanuc Robotics America
1.4 Modern History (1961-)


Figure 1.74: Sarcos, Utah (1983): Entertainment robot.


1.4 Modern History (1961-)

Figure 1.76: J. Craig (1986): *Introduction to Robotics: Mechanics and Control*. Addison-Wesley.

Figure 1.77: Odetics Walking robots (1988)

Figure 1.78: Utah/MIT (1989): Utah/MIT hand

1.4 Modern History (1961– )

Figure 1.80: ABB of Switzerland acquires Cincinnati Milacron, creator of PUMA (1990)

Figure 1.81: iRobot was founded in 1990 by Rodney Brooks, Colin Angle and Helen Greiner after working in MIT’s Artificial Intelligence Lab (1990)

Figure 1.82: R. Clavel (1991): Delta robot

Figure 1.83: Da Vinci robot by Intuitive surgical (1995)
1.4 Modern History (1961- )

Figure 1.84: NASA (1996): Sojourner, NASA (First Manned Robot to land on Martian Surface)

Figure 1.85: DLR Hand (1998)

Figure 1.86: Sony (1999): AIBO robots

Figure 1.87: EPFL (1999): High Mobility Wheeled Rover, SHRIMP
1.4 Modern History (1961- )

Figure 1.88: Honda (2000): Humanoid Robot, ASIMO

Figure 1.89: Defense Advanced Research Projects Agency (DARPA, 2004-): DARPA Grand/Urban Challenge
NEW VISTAS: INDUSTRIAL ROBOTICS

KUKA LBR iiwa

Amazon/Kiva

Figure 1.82: R. Clavel (1991): Delta Robot

Figure 1.80: ABB of Switzerland acquires Clinic.

Figure 1.85: Henry Ford (1933): Assembly-Line

Figure 1.90: The first articulated robotic arm to be con-
New Vistas: Autonomous Driving

Challenge Agency (DARPA, 2004): DARPA Grand/Urban

Figure 1.89: Defense Advanced Research Projects

Play/Pause Stop

Logos of various companies and research institutes related to autonomous driving.
New Vistas 3: Aerial Robotics

A.M. Low's "Aerial Target," 1916

Austria attacks Venice, 1849

Berkeley Aerobots Sastry 2003

DJI Phantom

Crazyflie
New Vistas: Extreme Locomotion

Salto, UCB Fearing Lab

Snake robots, CMU Choset Lab

ATLAS, Boston Dynamics

Figure 1.8: NASA (1995): Solowr. NASA

New Vistas: Manipulation

Figure 1.8: DLR Hand (1998)

Figure 1.7: Utah/MIT (1989): Utah/MIT hand

Figure 1.9: P. Ambrose (Parrs 1564): Design of a mechanical hand.
New Vistas: Human-Robot Interaction (HRI)

APEX exoskeleton, UCB Bajcsy Lab

MIT Her Lab

BCI, University of Pittsburgh, 2008

Kinova Jaco arm

Human Intent Inference, UCB Dragan Lab

BiOM prosthesis, MIT Herr Lab

BiO, University of Pittsburgh, 2008

Figure 1.39: I. Asimov (1950): Three Laws of a Robot

1. A robot may not injure a human being.

2. A robot must obey the orders given it except as those orders conflict with the First Law.

3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

""
Phantom haptic device

Robot cutting and suturing,

UCB Goldberg/Abbeel Lab

Telesurgery Workstation 1999

Frontier 6: Robot-Aided Surgery

Figure 1.83: Da Vinci robot by Intuitive Surgical
New Vistas: Soft Robotics


GelSight sensor, MIT

Octobot, Harvard

3D Reconnaissance

Soft exoskeleton, UCB
Bajcsy/Fearing/Goldberg lab

Soft optical sensor/actuator, UCB
Bajcsy/Fearing/Goldberg lab

Vine robots, Stanford

Okamura Lab
1.5 References