Introduction to Robotics

Jae Yun JUN KIM

ECE Paris, Graduate School of Engineering
37, quai de Grenelle 75015 Paris, France.

September 28, 2020

What is a **robot**?

A robot is a machine capable of carrying out a complex series of actions automatically.

Robots can be guided by an external control device or the control may be embedded within.

Robots may be constructed to take on human form, but most robots are machines designed to perform tasks with no regard to how they look.

The word robot was first used to denote a fictional humanoid in a 1920 play R.U.R. (Rossumovi Univerzální Roboti (Rossum's Universal Robots)) by the Czech writer, Karel Čapek, but it was Karel's brother, Josef Čapek who was the word's true inventor.

What is **Robotics**?

Robotics is the interdisciplinary branch of engineering and science that includes mechanical engineering, electrical engineering, computer science and others.

Robotics deals with the design, construction, operation and use of robots for their control, action, sensory feedback and information processing.

Science-fiction author *Isaac Asimov* is often given credit for being the first person to use the term robotics in a short story (*Liar!*) composed in 1941.

In this story, he suggested three principles to guide the behavior of robots. That is, **Asimov's three laws of robotics**:

1. Robots must never harm human beings.
2. Robots must follow instructions from humans without violating rule 1.
3. Robots must protect themselves without violating the other rules.

Characteristics of a robot

Mobility

It possesses some form of mobility.

Programmability

It can be programmed to accomplish a large variety of tasks. After being programmed, it operates automatically.

Sensors

It has on or around its body devices that sense the environment and give useful feedback.

Mechanical capability

The robot can interact with the environment, rather than merely functioning as a data processing or computational device.

Flexibility

The robot can operate using a range of programs, can manipulate various objects, and can transport materials in a variety of ways.

Applications of robotics

Defense

Service

Industry

Space

Healthcare

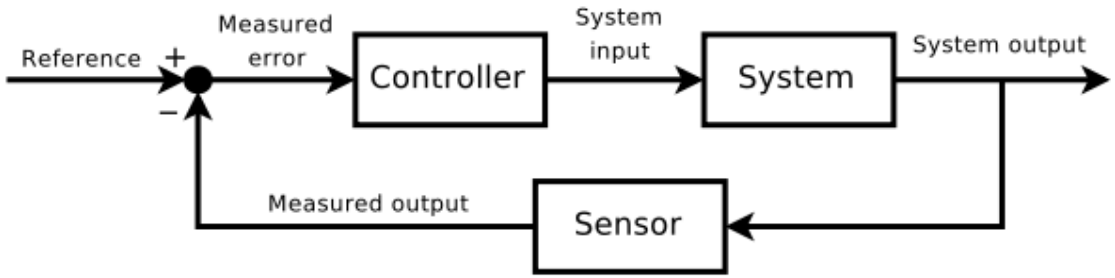
Search and rescue

Kinematics, dynamics, control and motion planning (Wiki)

Kinematics is the branch of *classical mechanics* which describes the motion of particles, bodies, and systems of bodies without consideration of the masses of those objects nor forces that may have caused the motion.

Dynamics is the branch of physics developed in classical mechanics concerned with the study of forces and their effects on motion.

Control theory is an engineering method that deals with the behavior of dynamical systems with inputs, and how their behavior is modified by feedback. The objective of *control theory* is to *control* a system (a.k.a., plant), so its output follows a desired control signal, called the *reference*. This objective is achieved by designing a controller, which tries to bring the actual output closer to the reference.



Kinematics, dynamics, control and motion planning (Wiki)

(continued)

Motion planning is a term used in robotics for the process of breaking down a desired movement task into discrete motions that satisfy movement constraints and possibly optimize some aspect of the movement.

Robot Operating System (ROS) and Python

ROS is a collection of software frameworks (a.k.a. *middleware*) for robot software development, providing operating system-like functionality on a heterogeneous computer cluster.

ROS provides standard operating system services such as *hardware abstraction*, *low-level device control*, *implementation of commonly used functionality*, *message-passing between processes*, and *package management*.

Python is a widely used high-level programming language used for general-purpose programming. It is an interpreted language and has a design philosophy which emphasizes code readability and a syntax that allows programmers to write the same code in fewer lines than in languages such as C++ or Java.