Summarize: Autonomy and Control in Animals and Robots

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Abstract—**In this paper, we will summarize the first chapter of *Autonomous robots: from biological inspiration to implementation and control*[1] by George A. Bekey. This first chapter named *Autonomy and Control in Animals and Robots*, introduces basic notions regarding robotic. The purpose of this chapter is to give an overview about the idea of building of a robot.**

I. INTRODUCTION

In this paper, we will try to write a summarize of the first chapter of *Autonomous Robots: from biological inspiration to implementation and control*[1] by George A. Bekey. This first chapter defines basic notions. First, the author defines both notions of *autonomy* and *robot*. Then, he presents more precisely architecture of robots. Finally, he discussed about several different types of robots. We will follow the same outline and present a summarize of this first chapter.

II. DEFINITION OF BASIC NOTIONS

A. Definition of autonomy

In this subsection, we will define what we call autonomy. We called something autonomous when it performs in an environment without external control. The perfect autonomous system is a system which can live. Basically, an autonomous system should have these different capacities:

- Grab data from environment
- Process data
- Analyze data

These capacities define the adaptability of the system to a random environment. Autonomous robots are inspired widely from the biology. Currently, robots are not completely autonomous because robots cannot adapt to any environment. However, actual robots can adapt to stable environment.

B. Definition of robots

The definition of a robot is a system which can *sens, think and act*. That is why, robots should have these different systems:

- Sensors to grab data from the external and internal environment
- Software allowing to process data and act

Robots are different degrees of autonomy, intelligence and mobility. These different characteristics depend on application wanted.

III. CONSTITUTION OF ROBOTS

Robots are more or less constituted with these following parts:

- Control architecture
- Sensors
- Actuators
- Intelligence

These different characteristics are presented in following subsection.

A. Control architecture

The architecture of a robot is constituted basically of three different levels:

- High level which depends of the human
- Low level which is autonomous
- Intermediate level which are more or less autonomous.

The high level is commanded by the user. The high level has to provide inputs to the low level or intermediate level. The low level is autonomous and can be governed by techniques control theory. This theory is based on differential equations. However, this system can be instable and need a system providing fast feedback to

control different elements such as motion of a robot. The traditional techniques control theories are linear systems. Currently, we try to design systems which can follow biological systems. These biological systems are non linear system and are completely different of traditional methods.

B. Sensors

Sensors allow to a robot to grab data. Inside a robot, two types of sensors exist:

- Exteroceptive sensors which are used to obtain information from the external environment. These sensors are called hardware. Generally, these sensors are copulated with software to perform and simplify data. Software is implemented by the user and depends on utilisation wanted.
- Proprioceptive sensors are used to supervise internal information of the robot.

C. Actuators

Actuators allow to the robot to interact with the external environment. Three types of actuators exist:

- Artificial muscles
- Electric motors
- Hydolic and pneumatic actuators

D. Intelligence

Intelligence of robots is represented by the computer which treats data. Currently, technology is not a problem regarding the autonomy of robots because performances increase with smaller size and weight of electronic and faster processors and memories. The main problem is to design software. Software should control:

- Sensors and treat data from sensors
- Reflex behaviour
- Special programs for navigation, localization, obstacle avoidance
- Cognitive functions

IV. PRESENTATION OF DIFFERENT ROBOT TYPES

Two main types of robots exist:

- Manipulation robot
- Mobility robot

A. Manipulation robot

Manipulation robots are used in the industry field and have more or less the same characteristics but the software part is different and is specific to each application.

B. Mobility robots

Different types of mobility robots exist:

- Composed of wheels
- Composed of legs
- Based on snake
- Based on helicopter
- Humanoid

Applications of robots are different. Hence, architecture and development of software are very different.

V. CONCLUSION

We presented a summarize of the first chapter of *Autonomous Robots: from biological inspiration to implementation and control*[1] by George A. Bekey. First, we introduced definitions of basic notions. Then, we presented the basic constitution of a robot. Finally, we concluded with a presentation of several types of autonomous robots.

REFERENCES

[1] G. A. Bekey, "Autonomous robots: From biological inspiration to implementation and control," *Knowl. Eng. Rev.*, vol. 20, no. 2, pp. 197–198, 2005.