Chapter 1
Basic Concepts of Manipulator Robot Control

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ABSTRACT

Robots presently occupy a large place in diverse activities. The robots currently in service are manipulator-type robots. They are often used in modern manufacturing processes to increase the production volume as well as to improve the quality of the product. This type of robot consists of a base, a carrier composed of segments, mobile joints expressed in the degree of freedom (rotoid and prismatic), actuator, sensor, and terminal organ. It is known that these systems have defects, such as insufficient accuracy, very slow reaction time, and instability. Furthermore, to adjust them, control systems are used: classic, dynamic, and adaptive. These commands need geometric, kinematic, and dynamic modeling of the studied systems. Most often, non-linear systems are transformed into linear systems using linearization methods. This chapter presents a short overview of robot manipulator control.

INTRODUCTION

Robotics is one of the sciences of the automaton, which represent techniques that allow the design and construction of automatic machines and robots. The robot is an automated device capable of handling objects or performing operations painful, tedious, and/or exhausting to the human being according to a fixed, modifiable or adaptable program. For the design, simulation or control of robots, it is necessary to have a model of their mechanism.

Robots can be classified into several types; in this chapter, we will focus on a single type called robotic manipulator. Several sectors of the industry are based on the use of robot manipulation (industrial) as is the case in the automotive industry or in shipbuilding (Sayers, 1999). They play an important role in reducing production costs, improving accuracy, quality, productivity and efficiency. The control of a rigid robotic manipulator is confronted with major difficulties such as non-linear, coupled behavior and time varying. In addition, the dynamic model of the system remains uncertain, particularly with regard to external disturbances and the uncertainty parameter, so that linear control methods are ill-adapted to strongly coupled behaviors, nonlinear and time-variables; and improvement thereof is the purpose of this work. A review of the literature on robotics can be found in Refs (Billard & Kragic, 2019; Cui & Trinkle, 2021).

The remainder of the chapter is organized as follows: Section 2 defines the manipulator robot. Section 3 describes the components of the manipulator robot. Section 4 illustrates modeling of these robots. Sections 5 and 6 discuss the control and linearization in manipulator robots. Section 7 illustrates an example. Finally, the last section concludes the chapter.

DEFINITION OF MANIPULATOR ROBOTS

A manipulator robot is a mechatronic device (combining mechanical, electronic, automation, and computer science) which automatically performs various tasks. It is a system designed to autonomously perform repetitive tasks in a fixed and ordered environment in which movements recorded in a memory are repeated cyclically (Isermann, 2005). It is position controlled, reprogrammable, and versatile with several degrees of freedom, capable of handling materials, parts, tools and specialized devices during the variable and programmed motion for execution. It is generally composed of two distinct subsets: a terminal organ and an articulated mechanical structure consisting of a set of solids, generally, one after the other where each solid is mobile relative to the previous one (see Figure 1) (Qin, 2013). This mobility is expressed in degrees of freedom.

Figure 1. Manipulator robots.

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