

Cooperative Manipulators

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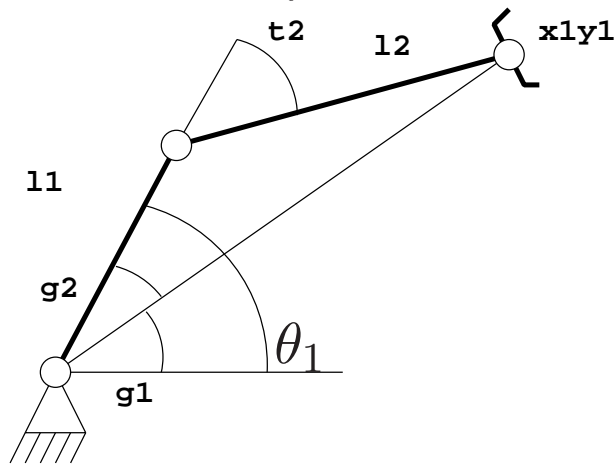
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1 Introduction

1.1 What is a Robot? What is a Manipulator?

At first sight a **robot** is very similar to a crane for example. Both are made from several **links** attached serially with either revolute or prismatic **joints**, at both the end effector can be placed in any place in the **workspace** by defining the **joint parameters** of each individual joint. The only difference between a robot and a **manipulator** (the crane) is that the manipulator is controlled by a human and the robot is guided by a program running on a computer.



1.2 What is so important about robots being cooperative?

2 Rigid Manipulators

3 Cooperative Rigid Manipulators

4 Flexible Manipulators

To calculate deformations and stresses of structures, **finite element analysis** is an important and often used method. It divides the structure in several points, called **nodes**, and **elements** between those nodes.

As the finite element analysis divides a part in very many elements and there are a lot of equations to solve for every node, the finite element analysis was not very popular until the 1950s. With the rise of the computer it was possible to solve thousands of equations in a few minutes. The more the computer was developed, the more programs were developed.

5 Cooperative Flexible Manipulators