CAN on Parallel Robots: How to Control a Stewart Platform using CAN based motor controllers

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The Stewart Platform is a well known and studied parallel robot. It is composed by an upper ring and six linear actuators. The actuators can be hydraulic, pneumatic or electrical, being the last used on applications where moderated forces and moments are required. In this paper a control of a Stewart Platform with electrical motors is described, the motors are regulated by CANopen based controllers. A CAN network is built to communicate and synchronize the motion of the six motors. A PC104 board and a Real Time Operating System (RTOS) are selected to create a fast and reliable CANopen master. The software running in the PC104 is developed from scratch; however some basic features are ported from open-source software. The PC104 board is connected to a desktop PC through an Ethernet network, allowing a remote controlled system. The Stewart platform control is running on the desktop PC due to its high computational requirements.

Introduction

The Stewart platform is a parallel robot with six linear actuators joined in an upper ring. It is used on several applications, like flight simulators [4], see figure 1, CNC machines, [5], and surgical devices, [6]. Its main advantages are high stiffness and high precision. This has been a focus of research in the last decades.

The control of an electric Stewart parallel robot is performed with a synchronized motion of six motors, one located in each linear actuator. In order to achieve a reliable control, a fast and easy way to send data to the motors is required. This can be obtained through a CAN based motor controller, commonly available in the market.

Like any other robot, the control algorithm of the Stewart platform is a task requiring high computational load, therefore it must run on a PC. On the other hand, in some applications where the robot can not be sufficient near a human operator, like inspections of nuclear facilities, [7], another PC, like an embedded PC104, is required to send data to motors.

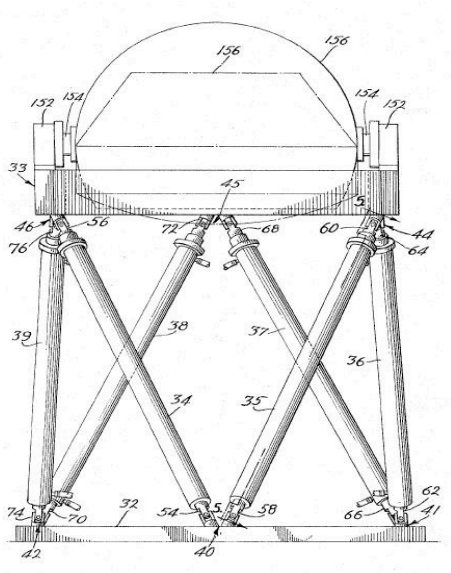

Figure 1: Stewart Parallel Robot used as a flight Simulator. US pat. 3,295,224. Jan 3 1967.

In addition, a visual feedback will be necessary due to the distance between the operator and the control PC. This approach requires a high communication protocol between the main computer and the embedded PC104 to allow the visual data be sent to the PC. The protocol communication used to this task is Ethernet. Figure 2 shows the hardware and software control layout explained