Politecnico di Milano

AUTOMATION AND CONTROL ENGINEERING

Study and Control of the Mechanichal System: Rotary Flexible Joint

Course

Automation and Control Laboratory

Student

Andrea Archetti – 10616682

Alp Recep Dayan – 10823110

Alessandro Firetto – 10633148

Jesucristo Torres Toledo – 10822036

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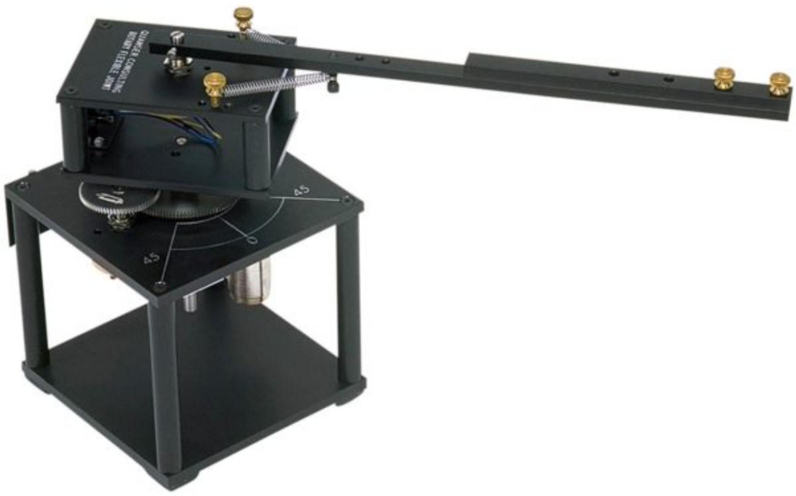
Problem Description

This report will describe our model of the system and our solutions to control the system.

The system is composed by a motor block that provide torque to the turret, that turret has attached above a beam at one of the two edges with a screw. The beam will follow the movement of the base due to two spring attached from the turret to the beam.



The interfaces:

- Actuators:

  Power Supply input of the motor (changing the voltage);

- Sensors:

  Incremental Encoder for the position of the turret with respect to to the motor module;

  Incremental encoder for the relative position of the arm with respect to the turret.

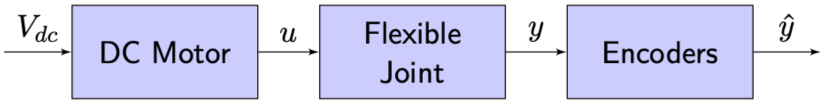
The connection between the physical system and the computer is provided with a system DAQ+Amplifier already configured.

The tasks are:

1. position control of the top base;
2. position control of the arm tip;
3. position control of the arm tip with uncertainty in the spring stiffness and arm moment of inertia.

Model Identification

The system is composed by a coupling of a DC electric motor, schematically the system is:



The physical equations of The DC Motor follow the static motor dynamic (neglecting the $L_a \cdot pI_a$ component), in fact that the resonance frequency is pretty higher with respect to the maximum frequency that the system can acquire. So the equations are:

$$\begin{cases} V_a = R_a I_a + E \\ E = k_m \Omega \\ \tau = k_t I_a \end{cases} \tag{2.1}$$

After several mathematician steps and considering the gearbox effect:

$$\tau = \frac{\eta_m \eta_g K_t K_g (V - K_g K_m \dot{\theta})}{R_m}$$

To model the inertia and the friction of the gearbox instead we consider their equivalent effect using the coefficient J_{eq} and B_{eq}. The turret

Position Control of the Base

Position Control of The Tip

Position Control of the Tip with Uncertanties

Conclusioni