

Servo Robot Experiment

Summary of the Work Schedule

1. Make yourself familiar with the robot's components for different degrees of freedom and usage of the virtual Pegasus RSS software for executing the basic actions.
2. Conduct experiments with the actual robot to experience its basic motions using the teach pendant.
3. Learn how to teach the robot different points of motion.
4. Plan a path for picking and placing an object by avoiding obstructions in the way. In the current lab set up, you are expected to create the obstructions as well as initial and target points.
5. Teach that path to the robot.
6. Write a short program for executing the planned path. The path must have a well-defined avoidance point, Hover point, and approach point before grasping and releasing the object.
7. Execute the program and demonstrate it to Instructor.
8. Take printout of programs and the coordinates of different points and submit the report.

Purpose of this Experiment

The purpose of this experiment is to learn about the different components of robot and gain hands-on experience on Pegasus Servo Robot system. These experiments will also demonstrate programming features on the robot. Figure 1 shows the schematic diagram of a Pegasus servo Robot and is marked with different axes and their degrees of freedom.

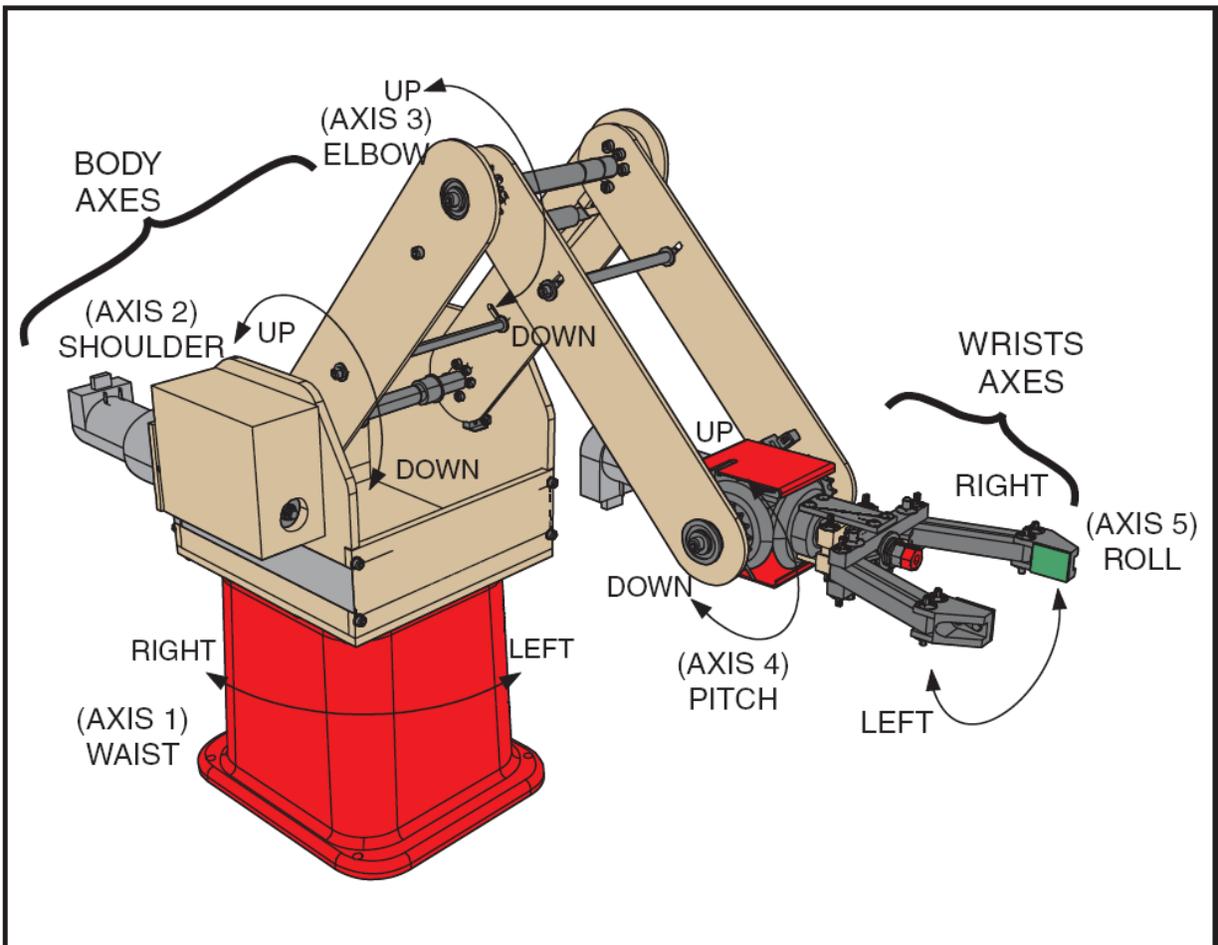


Figure 1: Axis of movement of Pegasus Servo Robot

The robot has five axes of rotation as shown in Figure 1. Additionally, there is a sixth motion, Grab and Release, which is performed by the end effector. All possible movements can be controlled using the interface software called Pegasus control software loaded on the computer. The robot can thus be programmed using a set of instruction to complete a certain task within its range of movement. Before manipulating motion of the machine, you must first learn about the Robot.

The robot has five basic components:

1. Manipulator
2. End Effector (Hand)
3. Controller
4. Drives
5. Teach Pendant

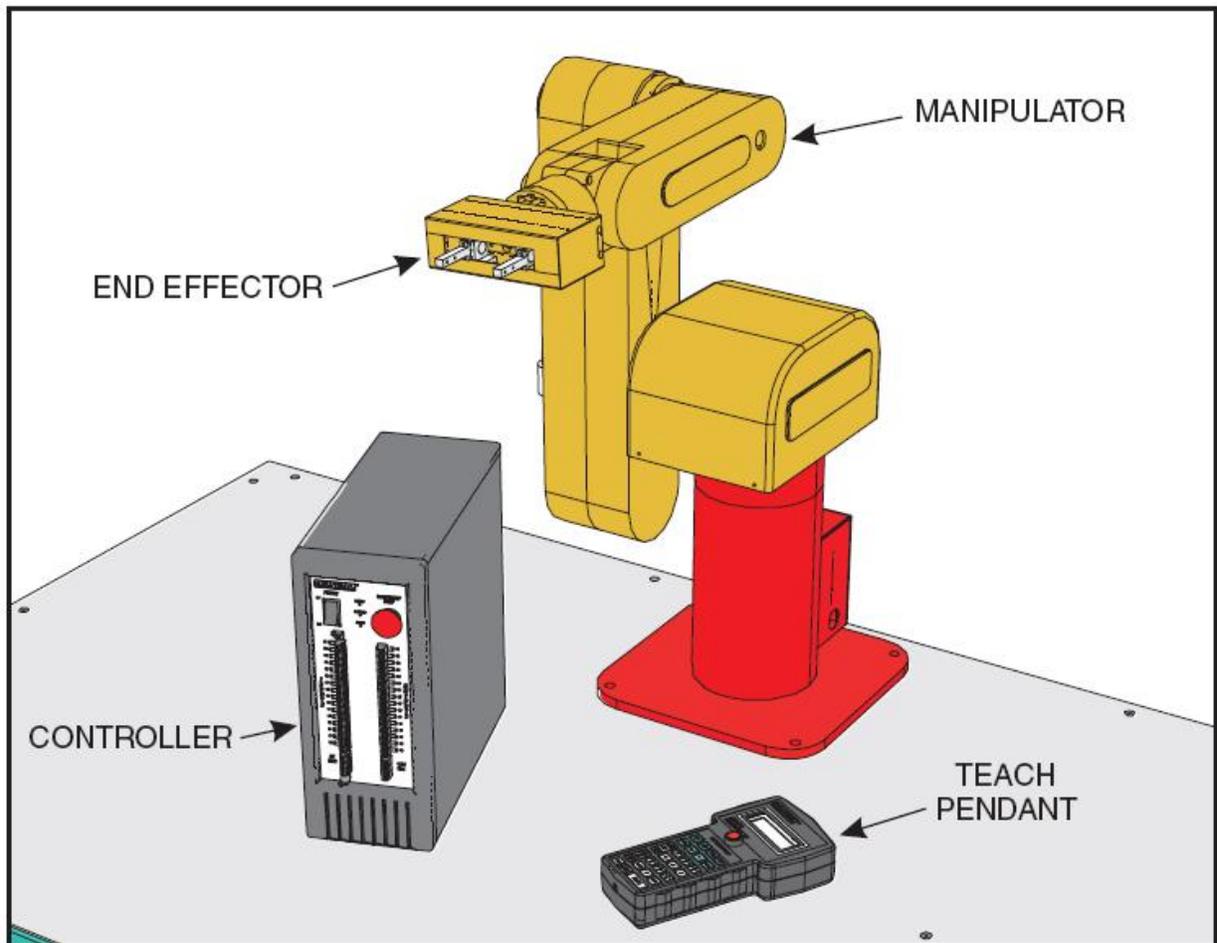


Figure 2: Axis Five Basic Component of Robot

Your first task in the lab is to identify each element of robot. You will be mainly using Teach pendant for moving the robot from one point to different point. The Teach pendant is a handheld device that allows robot operator to perform certain tasks on the robot.

Experiment:

The robot control software is facilitated with RSS interface software where you can move a virtual robot on screen using the same command that you will be using to move actual robot. The next step in the lab is to practice using the robot in predefined ways to get some experience of robot commands before handling the actual robot with student-defined commands.

Part 1.

1. Start the Pegasus Control software and enable the Pegasus RSS interface.

(Select Robot from Menu and then select interface w/simulation software in the drop down menu.)

2. Read page 32 in Manual 1 to learn how to jog a robot using virtual teach pendant. Move all 5 axes one by one and identify its concerned axis of rotation. You will need to document which axis is which in your lab report by the end of the lab. Use the image in the appendix.
3. Learn to use emergency stop (red round) button in case there is some unexpected motion of the Robot.
4. Learn the “Homing” operation of Robot. Remember, before running any program, the homing operation is necessary. The homing action brings robot in a predefined position. Read page 58 of the Manual 1 and follow the steps 1 to 5 to practice homing the robot. Explain how incorrect homing of the robot might affect subsequent behavior, both for small homing errors and for large ones.
5. Now learn how to operate robot gripper using instructions on page 67 of manual 1. The gripper has one additional sensor that the other axes do not have. Investigate this, and explain in your report.

Part 2.

Once you are done with these above steps you are ready to move to the actual robot setup. Do the following actions to prepare the robot.

1. Press the power button on the control and start robot control software on the system. Remember in case of any unexpected or violent movement of robot immediately press either emergency stop (red round button) on the controller or on the teach pendant.
2. Before doing any operation, be sure to “Home” the robot. Perform the instructions given in manual 2 on page 8 to move the robot from one point to other point. The instructions are given and explained for a virtual robot, but perform the given steps on the actual robot.
3. Learn to teach the different point to the robot and save the points.
4. Now you are experienced with the basic robot motions. It’s time to move to segment two to learn basic programming commands given in segment 2 of the second manual.
There are four main commands used to program the robot.
Pmove Point_1 : It moves the robot to the point_1 from its current position.
Grasp : It is used to grab some object by robot’s end effector.
Release: it is used to release the object from the robot’s end effector.

Delay : it is used to delay or give some pause between two consecutive commands written in the program.

Explain in your lab report: Under what types of manipulations would point-to-point programming work well? What situations would this NOT work very well? In particular, what might other control paradigms be other than point-to-point? (think about your human arm and different tasks you perform)

Part 3.

In this part you have to write a program to grab an object and place it to the desired position, all while avoiding obstructions.

Steps:

1. Place the object in the square marked on the table. The goal is to pick up the object and place it in the other larger square on the table.
2. Place some arbitrary obstruction in between the pick-up point and target point.
3. Using the teach pendant, perform the pick and place operation avoiding the obstructions in the way. Once you are sure of the path robot should take for the pick and place operation, use these points to teach a path trajectory to robot.
4. Write a program to perform the pick and place operation using the points taught to the robot in step 3.
5. Show the program to instructor and demonstrate by running it.
6. Save the program with the coordinates of all the points used in the program. Take print out and submit it.
7. Before leaving home the robot. Then close the robot control software and the switch off the power button located on the controller.

Lab Report.

For the lab report, please answer the questions above as well as the following questions. Additionally, you must label the picture on Page 2 as described below. Your report be typed, and the labels should appear as a high-resolution image within document; no hand-sketches allowed. (Hint, copy and paste the image into an editing package, edit it, then paste into your report)

- 1) Discuss how many control loops are used for the robot.
- 2) Explain which axes each control loop correspond to, and label them in your picture
- 3) What type of actuator is used in each control loop?
- 4) What type of sensor is used to measure the output of the control loop?
- 5) Which control loop might have two sensors, and why?
- 6) What would be the advantage and disadvantage of EVERY control loop using multiple sensors?
- 7) How might a robot similar to this be used in real life applications? Please give two distinct examples from different industries, and explain which type of control loops would be most appropriate: position, velocity, or force control?

Be sure to label the components in the picture as necessary such that the sensor(s), actuator(s), and control loop(s) are clearly indicated in your diagram.