Calibrating the Function Plane's Servo Motor   Linear Functions

Computer Controlled Machines

An example of a computer controlled machine is a CNC machine. CNC (computer numerical control) machines are machines that operate a lathe or a mill and renders obsolete processes that used to be performed by hand, at a slow pace and with high risk to the operator's life and limb. These machines are controlled by a computer software program. Now, all the CNC operator has to do is input coordinate values into the computer and the program guides the cutting mechanism to complete the task.

Industrial Remote Control
© Zhanglianxun| Dreamstime.com

In a similar way you can use software such as Labview to operate a servo motor. Servo motors like the one below are often used to position objects such as the rudder on a radio-controlled model airplane. They are also used in industrial applications and in robotics. Servo motors have 3 wires, one connected to a

positive voltage, one for ground, and the third to control the motion. This third wire is used by the computer to send "pulses" to the servo. A "pulse" is a voltage applied across the control wire for a certain time period, usually between .0009 to .0021 milliseconds. Each position that the servo's arm can move to has a unique pulse associated with it. When the computer sends a pulse there is a little circuit board in the box of the motor that turns the arm to the position associated with that pulse. For example a.0018 millisecond pulse is repeatedly sent by the computer across the control wire to the servo. The servo turns the arm to the position sent by the .0018 millisecond pulse. If the computer then sends a .0013 millisecond pulse, the servo will move the arm to another position, one that is associated with the .0013 millisecond pulse. Operating the servo by inputting a pulse width is not very convenient or practical. We'll want to create a function where the user can use to input an angle position, one that is associated with our paper template.

Task: The servo motor is controlled by a function in LabView, 'w=f1(x)', where 'w' is the pulse width. You will find a function that you can use to control the servo motor by inputting an angle associated with the 50° to -50° on the template instead of a pulse width 'w'.
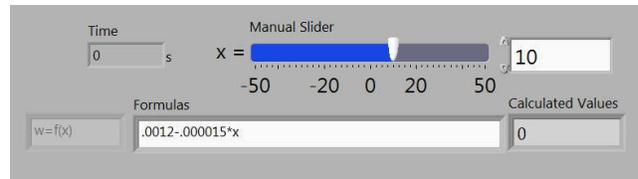

Additional Materials: 50° to -50° paper overlay.

Math Machines Program:

Function Plane Plus

Calibrating the Servo Motor

As was mentioned, operating the servo by inputting a pulse width is not very convenient. We'll want to create a function where the user can input an angle position and then let the function output the corresponding pulse width, 'w' that is sent to the motor.

To get this function you'll have to determine what relationship there is between the angle position and the pulse width. Although there are several possibilities of how angle positions could be labeled, you are given a template that designates 0° as pointing forward and counterclockwise rotations are positive with a range of 50° to -50°.

Math Machines Program: Function Plane Plus

Activity File: ServoCTL001

Collect data to determine the relationship between pulse width and angle.

1. Enter a pulse width into the function window as seen above. You can do this by selecting 'RUN' and moving the slider anywhere between .0009 and .0021 or typing a number like .0018 in the window to the left of the slider and hitting 'Enter'. You could also replace the 'x' with .0018 and then selecting 'RUN'.

2. Record the corresponding angle positions for various pulse widths on the data chart to the right. Do this to get several points spanning the range of the degree values on the protractor 50° to -50°.

3. Let 'x' now be the angle position instead of the inputted pulse width. Use **EXCEL** or a graphing calculator to graph your data and find an algebraic function that models the relationship between these two variables.

   What is the function you will use for w=f(x)?

   _____

Angle Position	Pulse Width w

Math Machines Program: Function Plane Plus

Activity File: ServoCTL002

	Manual Slider	
Time		
0	s	X =

-50   -20   0   20   50

Formulas   Calculated Values

w=f(x)   .0012-.000015*x   0

4. Enter your function into the function window on Labview and then use either the slider or text window (immediately to the right of the slider) to input values to 'x' to move the servo.

   Comment on how your function controls the servo.

   Comment on how well your function works to control the servo.

5. To control the servo with angle position as input, what are the following?

   INDEPENDENT VARIABLE: _____

   DEPENDENT VARIABLE: _____

   DOMAIN: _____

   RANGE: _____

6. What did you discover about the relationship between the two variables w & x?

   What is the slope of your function? What does it tell you?

   What is the significance of the "**w** -intercept"?