Project Progress Report

Implementation of Conventional and Neural Controllers
Using Position and Velocity Feedback

Week Ending: April 18, 2000

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Objective

This week's objective was final testing of the minor loop controller without the neural network, find out why the neural network does not work, and comparisons of the results including minor loop without the neural network.

Progress

Testing of Minor Loop in C-Code:

The gain for the minor loop was 0.212, feed-forward was 0.3, and the p gain was 0.42. When this was ran the arm oscillated. We thought this was because of noise by looking at the output of the minor loop and seeing that it was really noisy and so we concluded to use the neural network curve fit to lower the noise level. After looking at the minor loop output again we found that it was at about 45V. This is way too much. In the outer loop feedback there is a gain of 36 for unity feedback and also to get the volts into degrees. This is not needed in the minor loop feedback because we want it in volts. So we had to divide the minor loop by 36 to get the right output. The gains changed then to 0.35 for the minor loop gain 0.02 for the feedback loop and 0.4 for the proportional controller to get the best results. Figure 1 shows the results of the minor loop feedback.
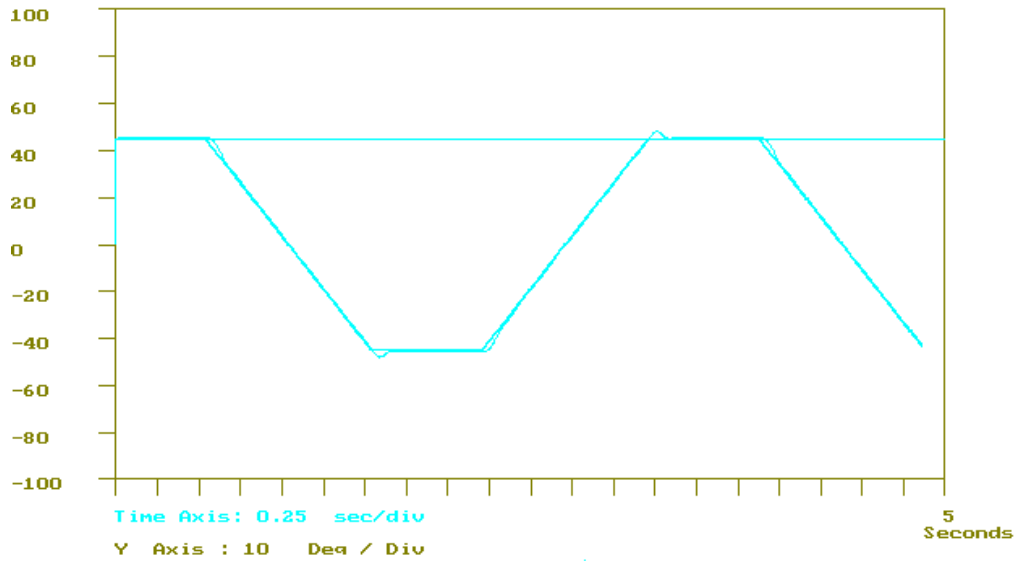
Fig.1 Minor Loop Without Ann Output

Testing of Neural Network:

The Matlab code for the neural network was converted into C-code by hand and then added to the program. We added in a separate controller listing for the neural network. Now we have a choice to use a P-controller, Feed-Forward, Minor loop without ANN, and Minor Loop with ANN. Also the output of the ANN can be graphed with the input signal to show the curve fitting. The training of the ANN is shown in Fig. 2.
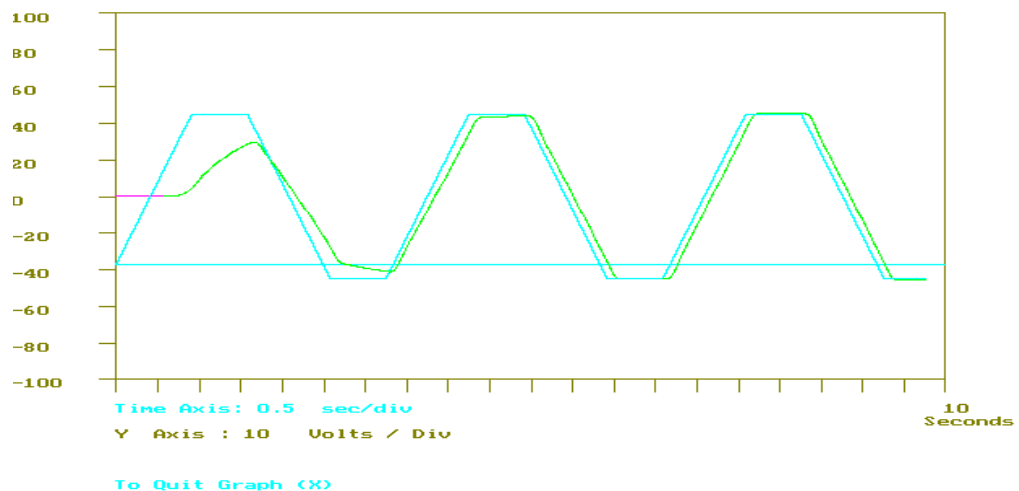

Fig. 2 ANN Training

This figure shows the how long it takes for the ANN to catch up with the signal (3 sec. or 600 samples).

Comparison of P-controller and Feed-forward-controller:

The P-controller shows no overshoot and bad tracking (Fig.3), while the feed-forward controller shows almost perfect tracking and a little bit of overshoot (Fig. 4).
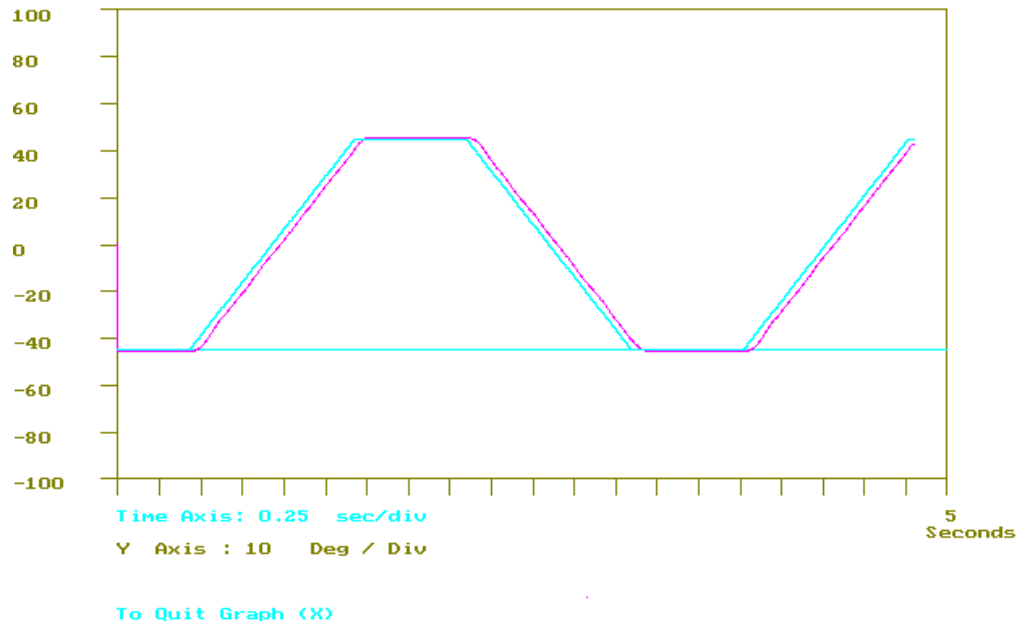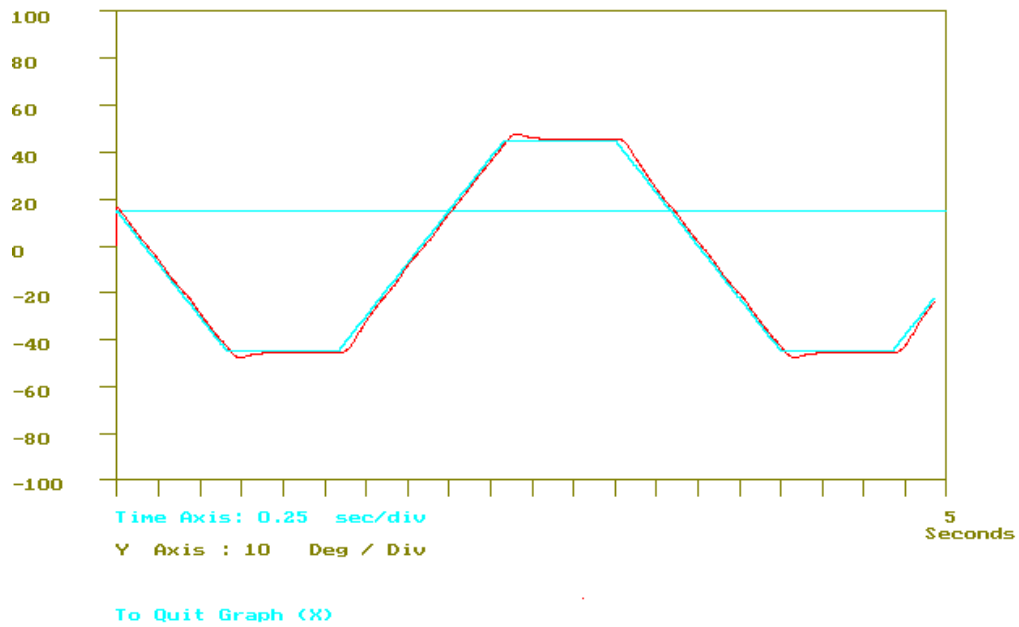

Fig.3 P-Controller output

Fig.4 Feed-Forward Controller output

Problems with ANN:
If the training was obtained the neural network output did not follow the plant output exactly. (Fig. 5)
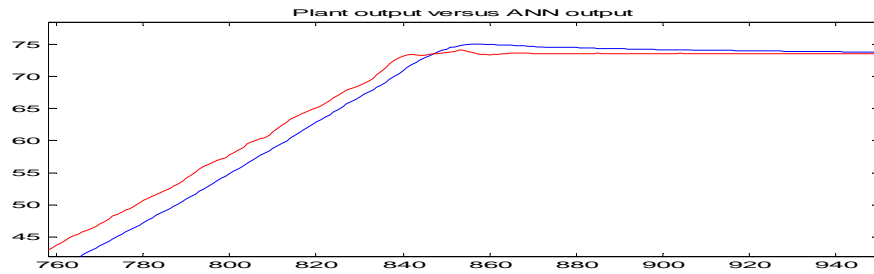

Fig.5 Plant versus ANN output

It is clearly seen that the ANN does not follow the curve exactly. It smoothens it but it looks like it is delayed. The problem is the curve-fitting algorithm. If we would have more data points and target points it would make an approximation seen in Fig.6.
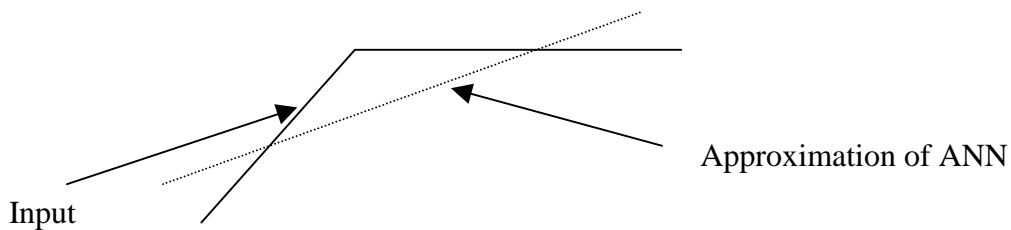

Fig.6 Function Approximation with ANN

This was the reason why we saw a gap between the input and the ANN output. The ANN tends to pull the feedback loop in one direction whereas the minor loop tries to reach the other direction, which results in an oscillation (Fig.7).
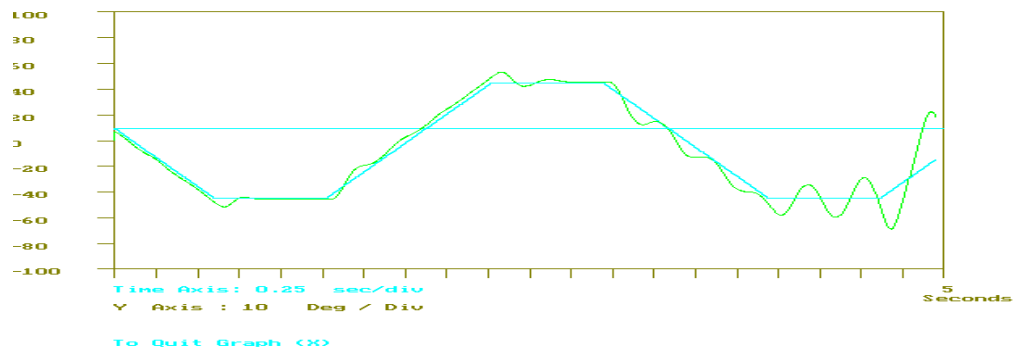

Fig.7 Minor Loop Controller with ANN

The solution will be to train the ANN during the slopes and the flat parts of the curve differently and get two sets of weights to obtain a better curve fitting.