Project Progress Report

Implementation of Conventional and Neural Controllers Using Position and Velocity Feedback

Week Ending: March 26, 2000

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Objective

This week's objective was to design a minor loop compensator, adjust the proportional controller and redesign the feed forward compensator.

Progress

To design a minor loop compensator it was the goal to find a transfer function that changes our plant to a phase margin of 60°. The plant function we used to design the controller was an approximation of the plant with time delay found in a previous week.

$$Gp = \frac{5.05}{s(s/1.85+1)} = \frac{9.3425}{s(s+1.85)} \tag{1}$$

This is a second order plant in the form of:

$$Gp = \frac{{\omega_n}^2}{s(s+2\delta\,\omega_n)} \tag{2}$$

The minor loop was designed with a tach, which is in the form of Ks. Since the desired phase margin is 60° the damping ratio δ is 0.6. The closed loop transferfunction for the minor loop is:

$$H = \frac{9.3425}{s^2 + s(1.85 + 9.3425k_t) + 9.3425} \tag{3}$$

With equation (3) kt can be calculated in the following way:

$$2\delta\omega_n = 2*0.6*3.06 = 3.672 = 1.85 + 9.3425kt \Rightarrow k_T = 0.212 \quad (4)$$

Next step was to recalculate the proportional controller. To do this we had to find Gp' in closing the loop to get the changed plant transfer function.

$$Gp' = \frac{9.3425}{s(s+5.66)} \quad (5)$$

With this the new proportinal controller was found to be k=0.42.

Next step was to redesign the feedforward compensator in takink the inverse of Gp'.

$$G_{FF} = \frac{s(s/5.66+1)}{1.65*(s/60+1)^2} \quad (6)$$

To make it work we had to add a double pole at 60rad/sec which is one decade away of our zero. To make it work we switched to a second order system:

$$G_{FF} = \frac{s*0.3}{s/30+1} \quad (7)$$

The gain of 0.3 was found through simulink simulation and it worked in simulink even with a plant change of a factor of 3.

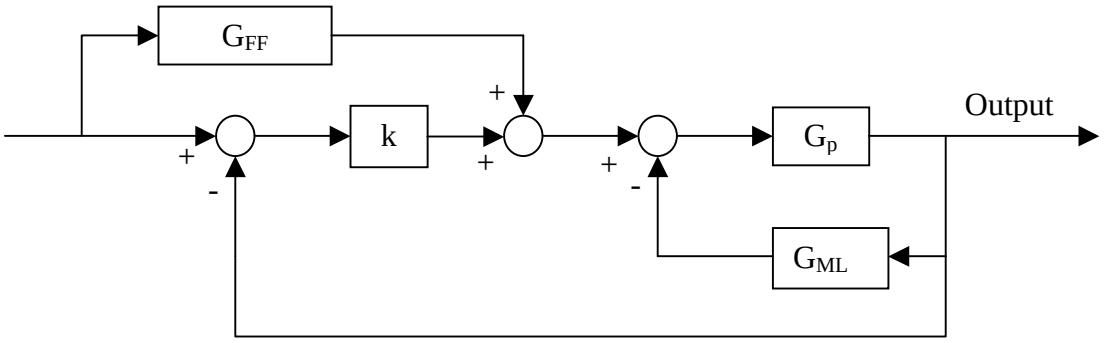

Fig.1 Overall System with Controllers

The next step will be to change the old controllers and implement all new controllers in C-Code. The problem we already observed is that the gain factors will differ from the Simulink simulation by a factor of at about ten as we saw already before. Also we expect differentiation problems in the minor loop, which can be hopefully solved by using a curve-fitting algorithm of our neural network.