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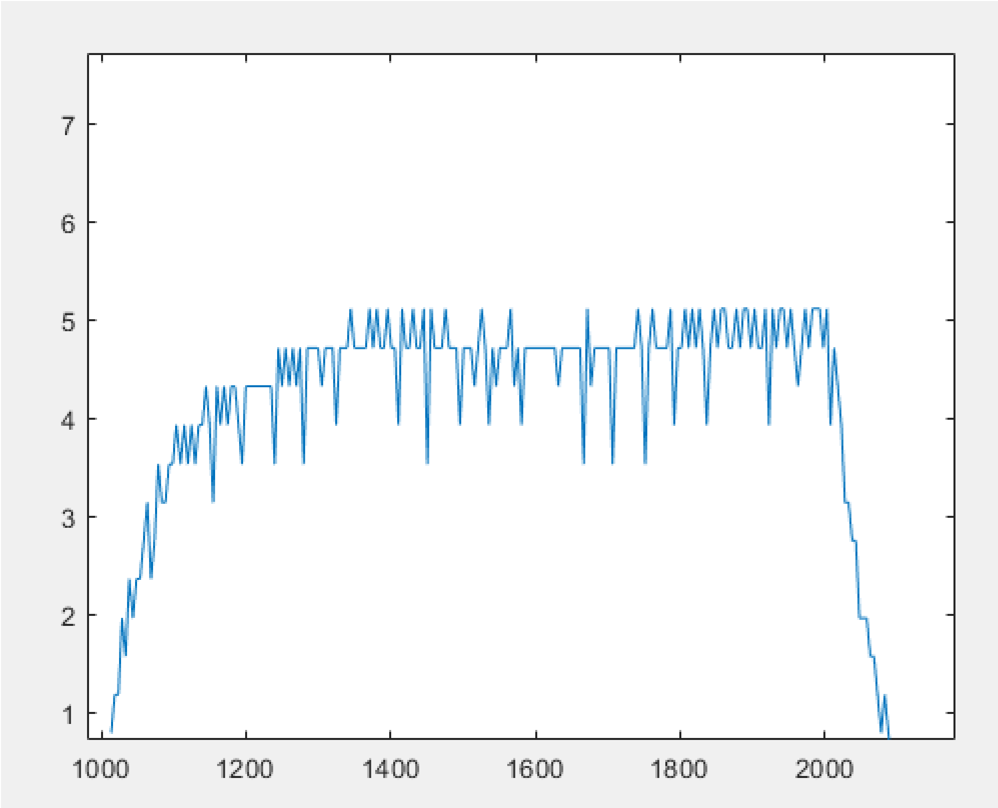
The design methods of the control system started with the derivation of the transfer function of the plant of the ultimate control system, which in the case of this project was the motor. In order to determine that, a step response experiment of just the running motor was performed.



Using this experimental data, the second order transfer function of the motor can be approximated using the general form of $\frac{K\sigma}{s+\sigma}$, where the values of K and σ could be found based off of the data. From the derived transfer function, a simulation can be generated to confirm that the modeled transfer function is accurate.

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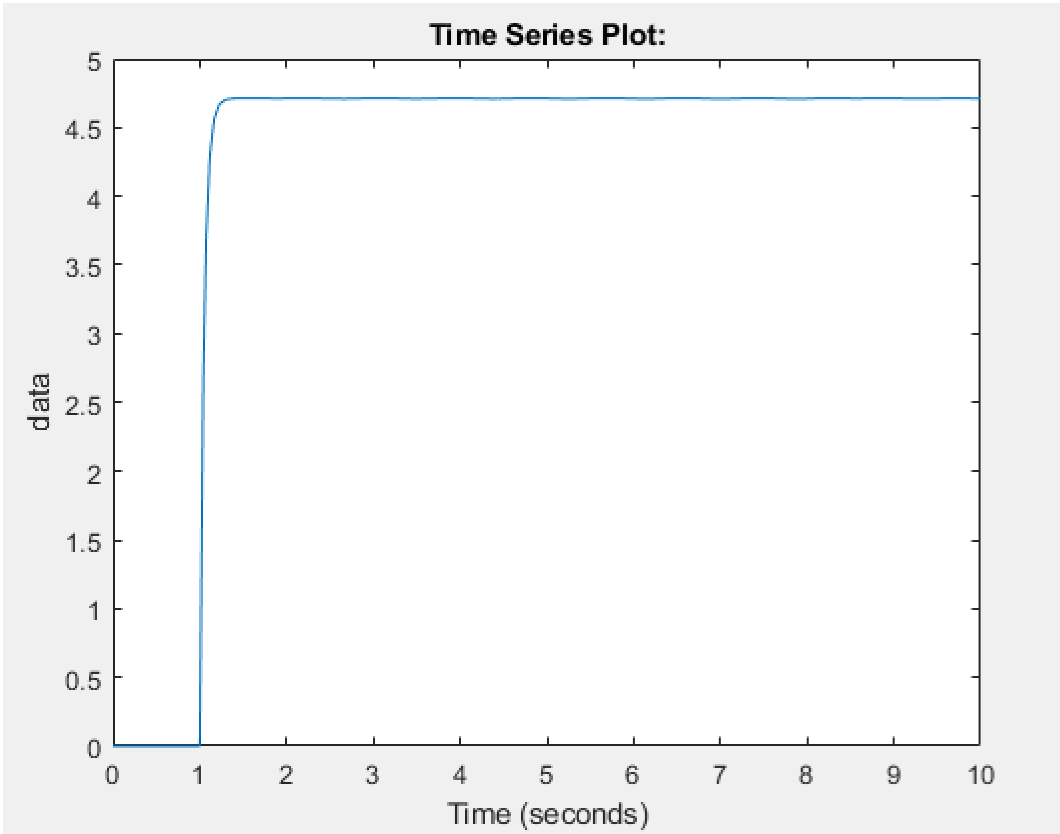
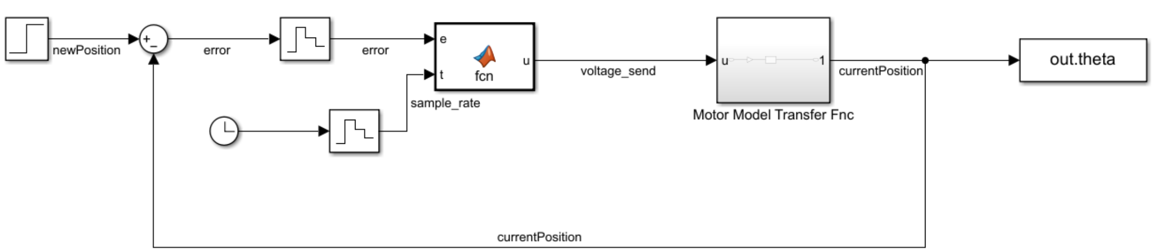


Knowing that the plant model is accurate, the controller can be determined with a new model. Using Simulink to design a generic model to find the proportional and integral gains for a PI controller.



Using this model and the PI tuner functionality of Simulink, values for K_P and K_I were found, and then used to create a simulation of the corresponding step response model of the entire control system.

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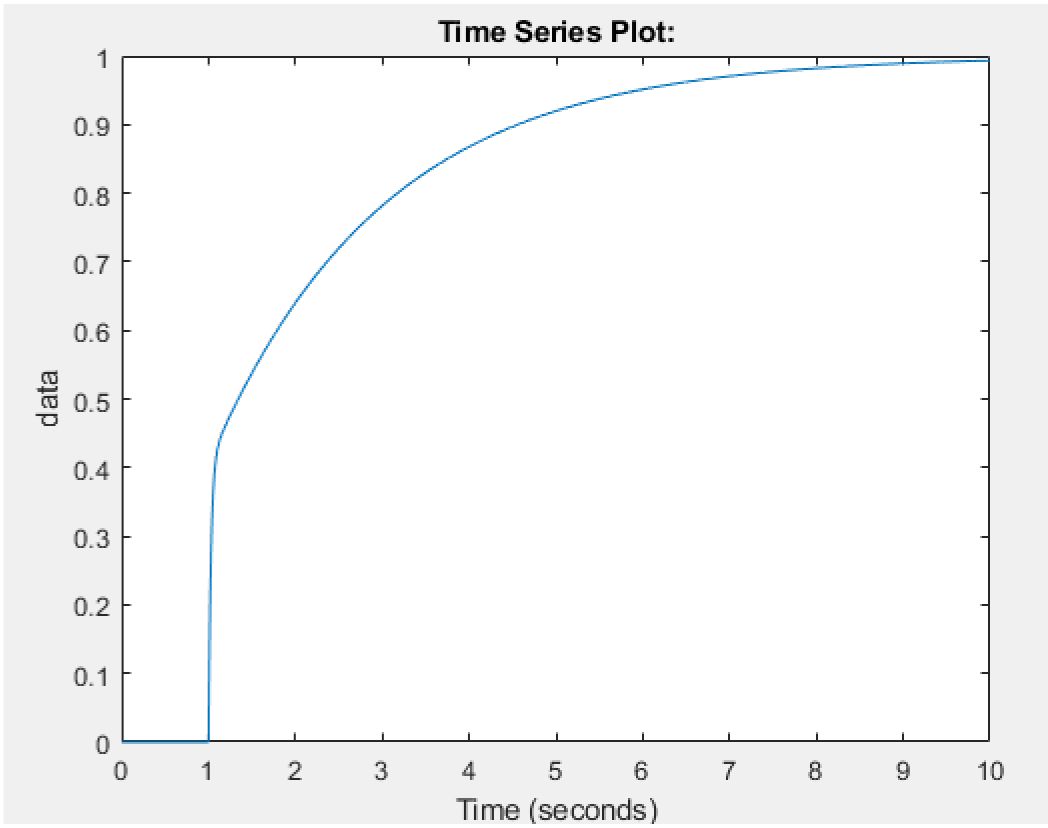

In order to confirm that this modeled step response is correct, a step experiment was conducted with the implemented PI controller code with the motor and then compared with the simulated one.

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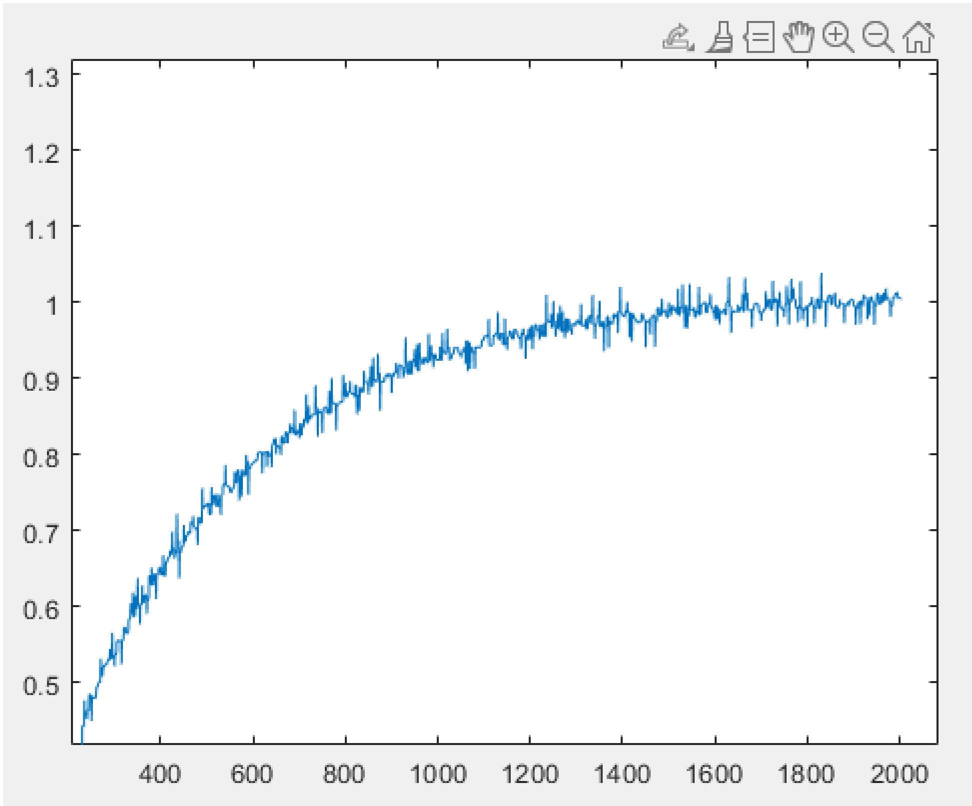

Seeing that the step response of a desired angular position of 1 radian of both the simulated and experimental situations result in similar graphs, the final values of K_I and K_P can be confirmed to be correct, additionally confirming that the implementation code of the control system is also correct.