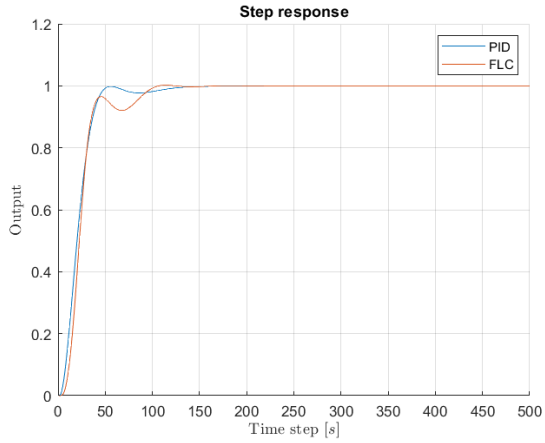
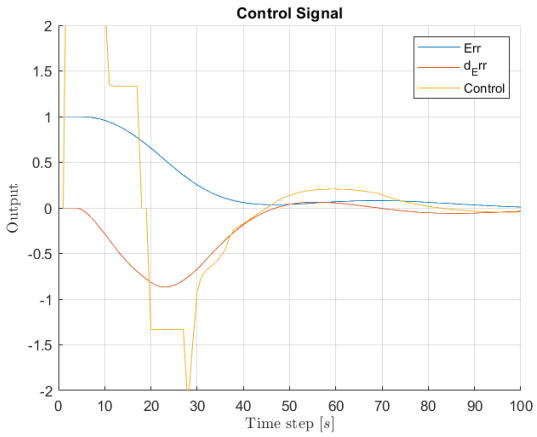
# HW 1 – Intelligent Control Theory

In this homework we were given the task of designing a fuzzy logic controller that could control the given system to have a rising time of less than 20s, 5% overshoot and a 2% settling time of 70s. To archive this goal we were given a simple systemsimulation with an included fuzzy logic controller to modify. This controller consisted of a set of fuzzy rules to respond to a given big, medium, small or no error or change in error and was to be compared to a PID-Controller.

## The initial system



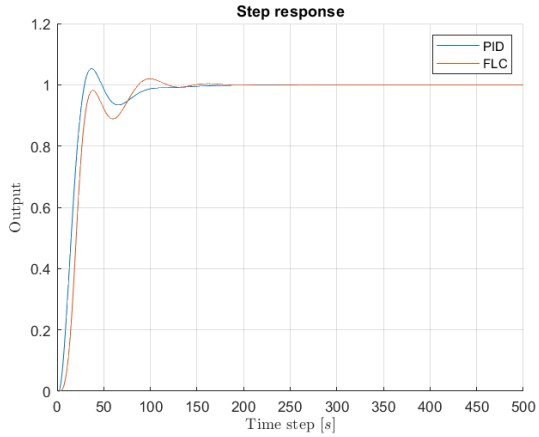

The initial PID controller had zero overshoot, a rising time of 28 seconds and a settling time of 96 seconds. The initial FL controller had 0.22 % overshoot, a rising time of 24 seconds and a settling time of 93 seconds.

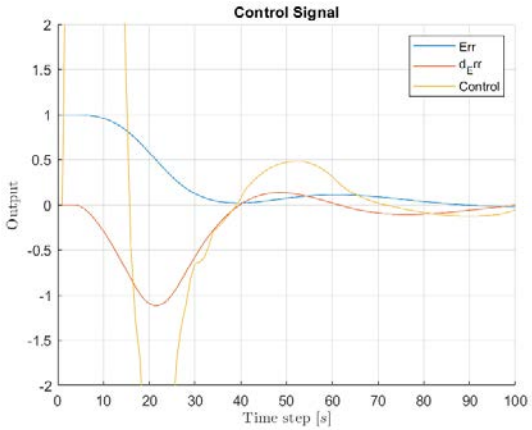
## The changes

By tweaking some parameters of the PID controller I managed to stay in the 5% overshoot envelope (with an overshoot of 4.74%), reduced the rising time to 18 seconds by increasing the p-value and reduced the settling time to 93 seconds.

To improve the Fuzzy controller I expanded the ruleset to include more cases, tweaked the ranges for big positive and big negative, to get a more aggressive response without sacrificing fine control and tweaked the general parameters.

## The results




As can be seen on the graphs both controllers have a stronger initial response, while still settling faster than with the initial system. Especially in the control signal of the Fuzzy controller you can see the stronger control response, with a fast start and fast braking upon closing to the target value.

With these changes I managed to get the rising time of the Fuzzy Controller down to 18 seconds with an overshoot of 1.96% and a settling time of 82 seconds. I was not able to reach the desired goal of a 70s settling time.

## Outlook

In order to improve further on the system one could improve the fuzzy controller by extending the fuzzy logic to include for example higher order derivatives of the system, to allow for finer response control.