3 MATLAB: Control System Toolbox I

3.1 Creation of LTI-Models

a) Create a TF-LTI-Model `pt1` with transfer fnction

$$F_{\texttt{pt1}} = \frac{\texttt{V}}{1 + s\,\texttt{T1}}$$

with $\texttt{V} = 1$ und $\texttt{T1} = 0.01$.

b) Create a ZPK-LTI-Model `int` with the transfer function

$$F_{\texttt{int}} = \frac{1}{s\,\texttt{Ti}}$$

with $\texttt{Ti} = 0.1$.

c) Create a SS-LTI-Model `reg` with the matrices

$$\mathbf{A} = \frac{-\mathbf{1}}{\texttt{Tr}} \quad ; \quad \mathbf{B} = \frac{\texttt{Vr}}{\texttt{Tr}} \quad ; \quad \mathbf{C} = \mathbf{1} \quad ; \quad \mathbf{D} = \mathbf{0}$$

with $\texttt{Vr} = 2$ and $\texttt{Tr} = 0.005$.

d) Load all data contained in file `frddaten.txt` in the Workspace.

The first two columns of variabel textttfrddaten loaded from file `frddaten.txt` contain the real and imaginary part of frequency response, and the third column contains the corresponding frequency values

Create the frequency response vector `resp` from real and imaginary part of frequency response and the frequency vector `freq` from this data.

Create a FRD-LTI-Model `sysfrd` with `resp` and `freq` and show the Bode-diagram with command `bode(sysfrd,tf(1,[1 0.07 0.1]))`.

3.2 Discrete-time LTI-Models

a) Convert the LTI-Models created in 3.1 in discrete-time models of the same type. The name of the discrete-time models should be the same as the one of the corresponding continuous-time model with leading `d`.

Set the sampling time to 0.1 sec.

b) Create the mathematical identical transfer functions

$$\frac{2z^2 + z}{z^2 + z + 2} \quad = \quad \frac{2 + z^{-1}}{1 + z^{-1} + 2z^{-2}}$$

with `tf` command first and with `filt`-command second. What substantial difference do you find?

3.3 Working witch LTI-Models

Create the system shown in Fig. 1 using the LTI-models created in 3.1.

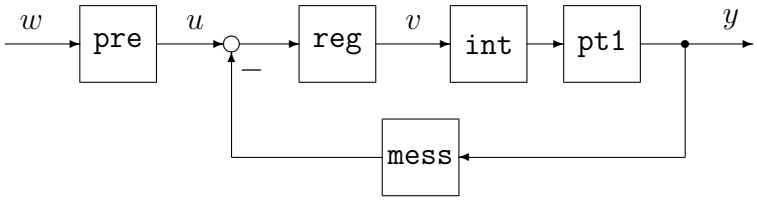

Fig. 1: Feedback control loop with pre-factor

a) Combine LTI-models `int` and `pt1` to a single LTI-model `plant`.

b) Combine LTI-models `plant` and `reg` to a single LTI-model `forward`.

c) Set measurement transfer function `mess` and pre-factor `pre` to TF-LTI-model with gain 1 each.

d) Create the feedback LTI-model `sys` (input w to output y) using LTI-models `forward`, `mess` and `pre`.

e) Show step responses of LTI-models `plant`, `forward` and `sys` with legends for plot lines.

f) Set measurement transfer function `mess` to a TF-LTI-model with

$$F_{\mathtt{mess}} = \frac{1}{1 + s\,\mathtt{Tm}}$$

with $\mathtt{V} = 1$ and $\mathtt{Tm} = 0.01$.

g) Create the feedback LTI-model `sys2` (input w to output y) using LTI-models `forward`, redefined `mess` and `pre`.

h) Show step responses of LTI-models `sys` and `sys2` with legends for plot lines.

i) Vary `Vr`, `Tr` and `Tm` and examine the effect of the changes to the step responses.