Demonstrations system identification lecture 1

<u>LinearStep.mdl</u>
2^{nd} order system: $1/(0.25s^2+0.33s^2 + 1)$
Goal: System response with and without noise

- excluding noise
- including noise (random generator, variance = 0.001)

Conclusions:

1. System dynamics can not easily be recognized from step response
2. Additional noise makes it even more difficult to recognize the step response

<u>AverageMultipleSteps.m</u>
2^{nd} order system: $1/(0.25s^2+0.33s^2 + 1)$
Goal: Removal of noise by averaging of a number of realizations
Program call: AverageMultipleSteps(NrSteps)
Conclusion:

1. With a larger number of repetitions the noise can be removed. It decreases the perturbation on the step response.
2. Very many repetitions are needed for complete annihilation of the noise.

<u>LinearWhiteNoise.mdl</u>
2^{nd} order system: $1/(0.25s^2+0.33s^2 + 1)$
Goal: Demonstrate the effect of a stochastic input signal
Remark: Input signal is filtered by low-pass filter (Butterworth) with cut-off frequency of 30 Hz (3^{rd} order), because the sample frequency of the simulation is 100 Hz. Filter settings are found by

```
[A,B]=butter(3,30,'s')
```

in which 's' results in a continuous filter, 3 is the order of the filter, and 30 is the desired filter frequency.

Simulation results in u(t) and y(t), which can be used to demonstrate further data processing.

<u>Cumulative distribution function ('Verdelingsfunctie')</u>

```
Yu = normcdf(Xu,mean(u),std(u))
```

in which Xu = -5:0.1:5 (values of u(t) for which the cumulative distribution function is calucated).

<u>Probability distribution function ('Verdelingsdichtheidsfunctie')</u>

```
Pu = normpdf(Xu,mean(u),std(u))
```

in which Xu = -5:0.1:5 (values of u(t) for which the probability distribution function is calucated).

demonstration of results:

- plot(Xu,Pu,'b',Xu,Yu,'r')

or:

- hist(u,Xu)
  plot(Xu,Pu*90,'b')

<u>Disttool</u>

```
Disttool
```

Demonstration of cumulative distribution function and probability distribution function

<u>Normplot</u>

```
Normplot(u)
```

Demonstration how precise a normal distribution is achieved.