Results System ID

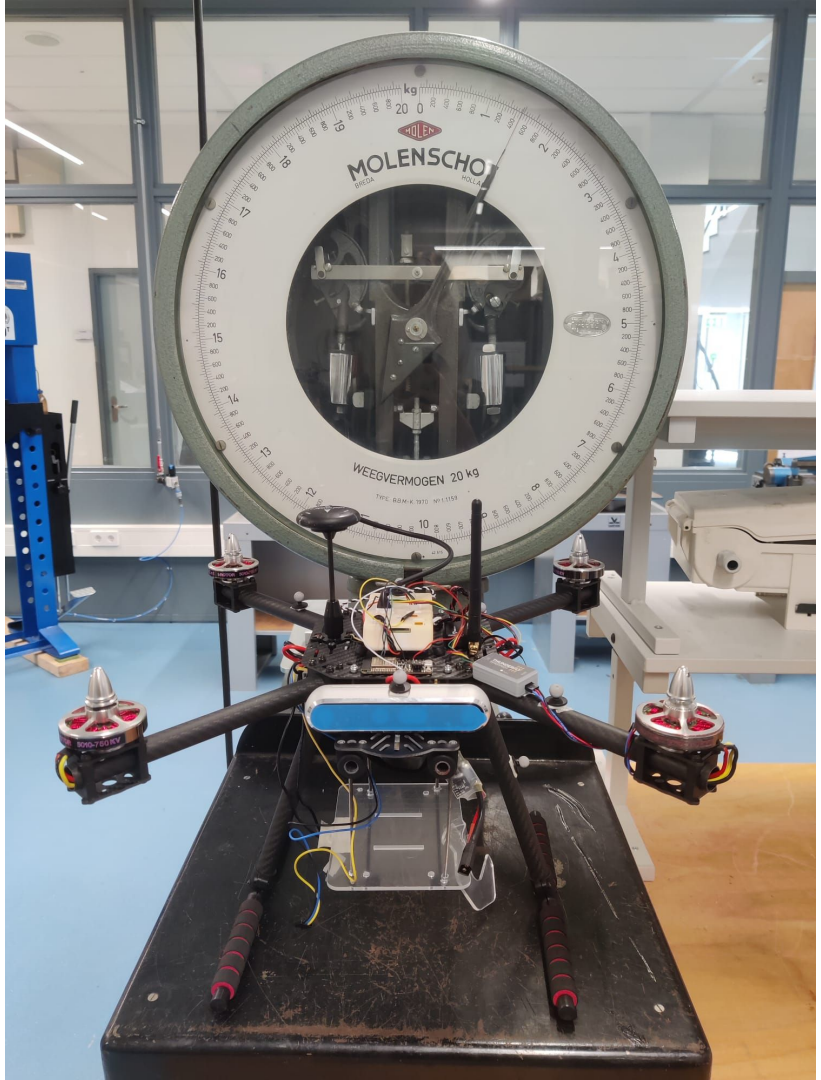
Hover thrust

Setup

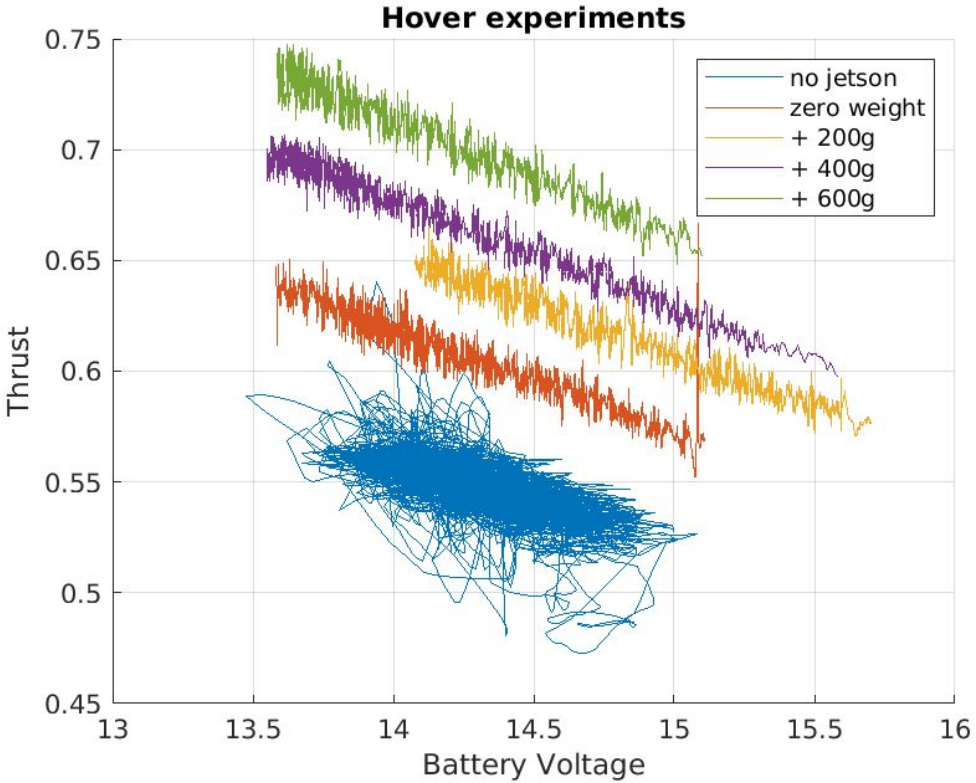
m_drone = 2.190kg

m_jetson = 0.310kg

m_calib = 0.200kg (3x)



Raw data



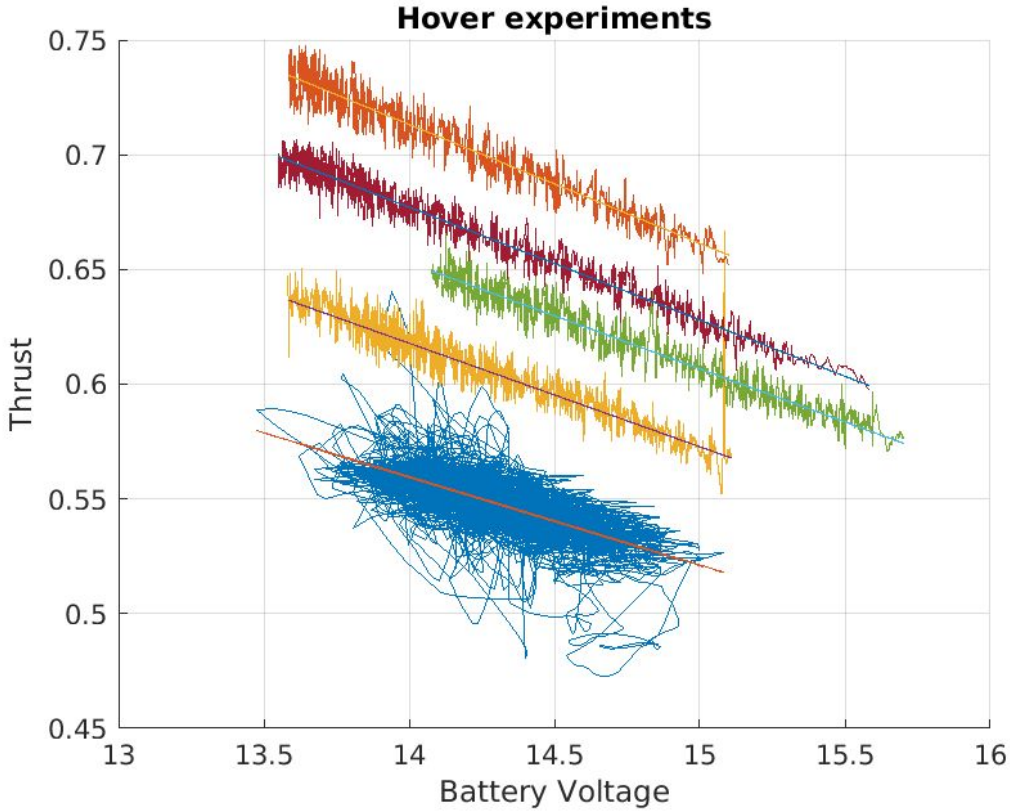
mass_array = [1.88,2.19,2.39,2.59,2.79]
→
acc_array = [8.42, 9.81, 10.70, 11.60, 12.49]

acc_array = [mass_array-m_drone]*g/m_drone+ g;

Battery-HoverThrust-relation

Linear relation

$T_h = a^* U + b$



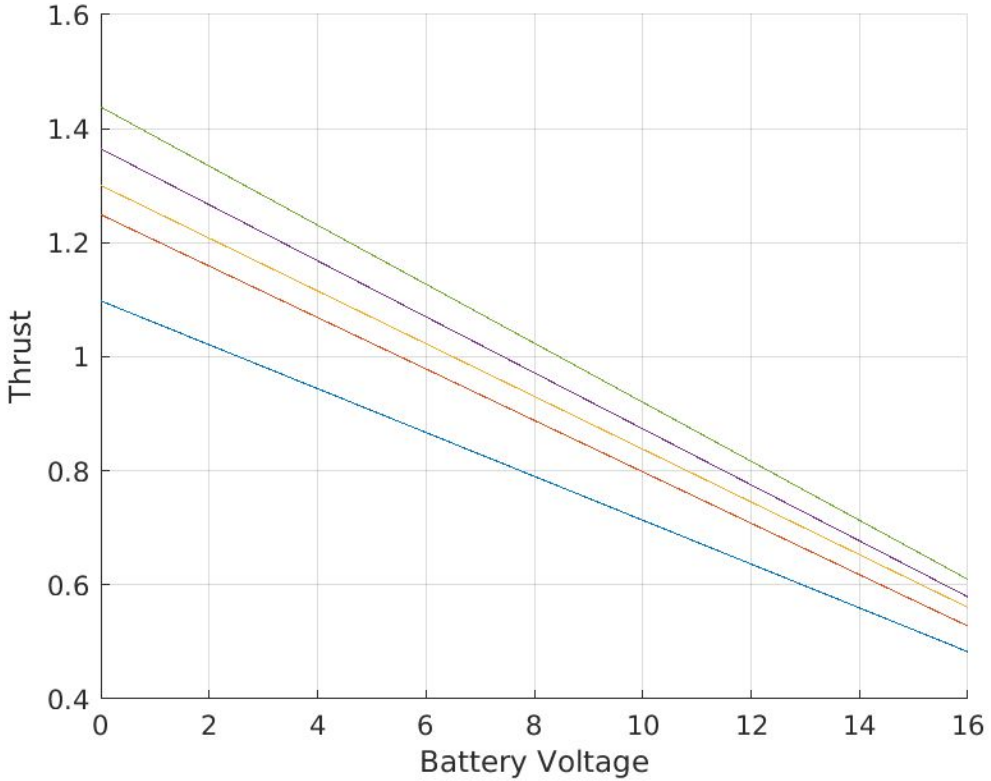
Battery-HoverThrust-Fitted Curves

Different weight/acceleration influences both a and b

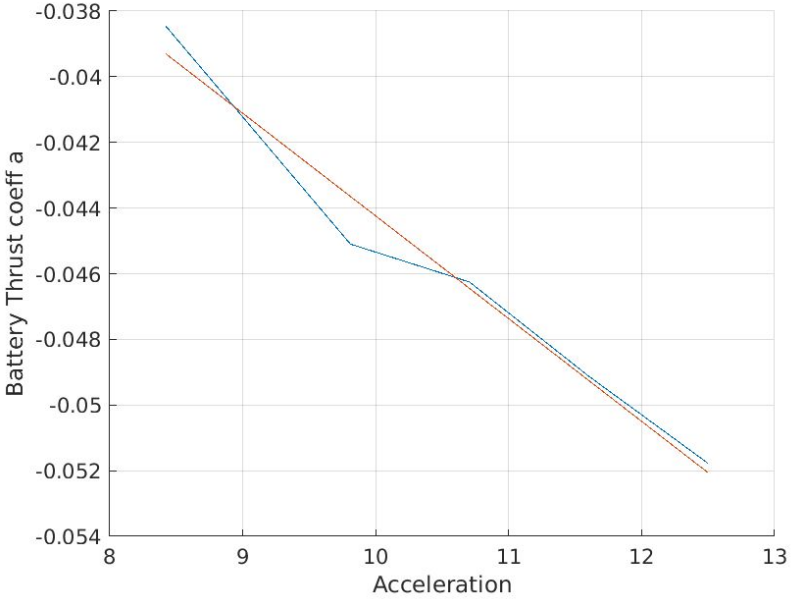
→

a_array[a_nJ,a_0,a_200,a_400,a_600]

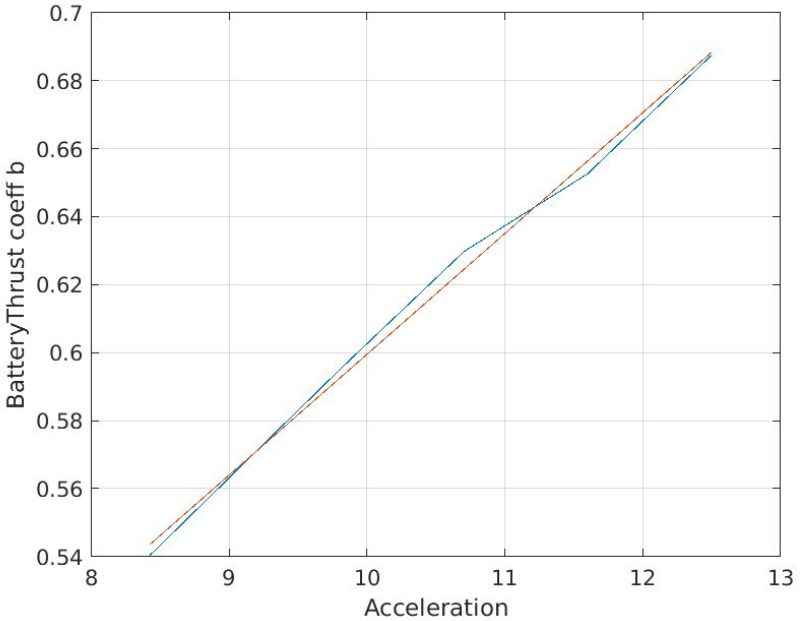
b_array[b_nJ,b_0,b_200,b_400,b_600] → picked at med voltage ~14.5



Fit coefficients to acceleration



a = c_a*acc + d_a



b = c_b*acc + d_b

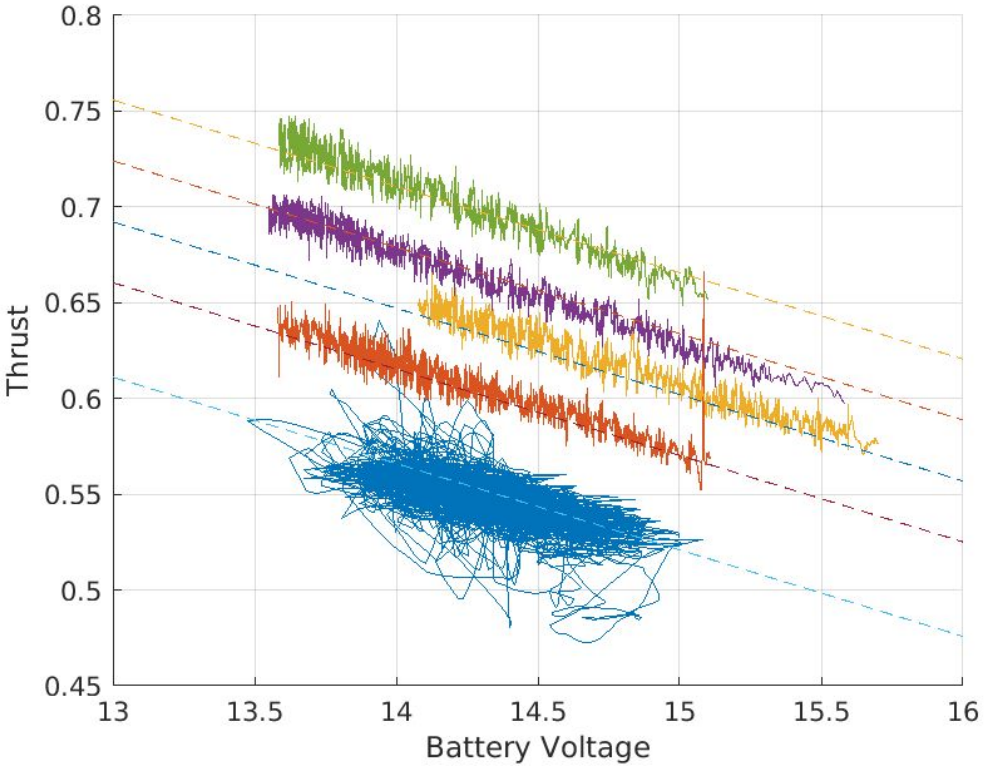
Two models: 1) Assuming constant a

$T_h = a*U + b$

→

$T_h = a*U + c_b*acc + d_b$

NRMSE = 247.8



Two models: 1) Assuming linear a

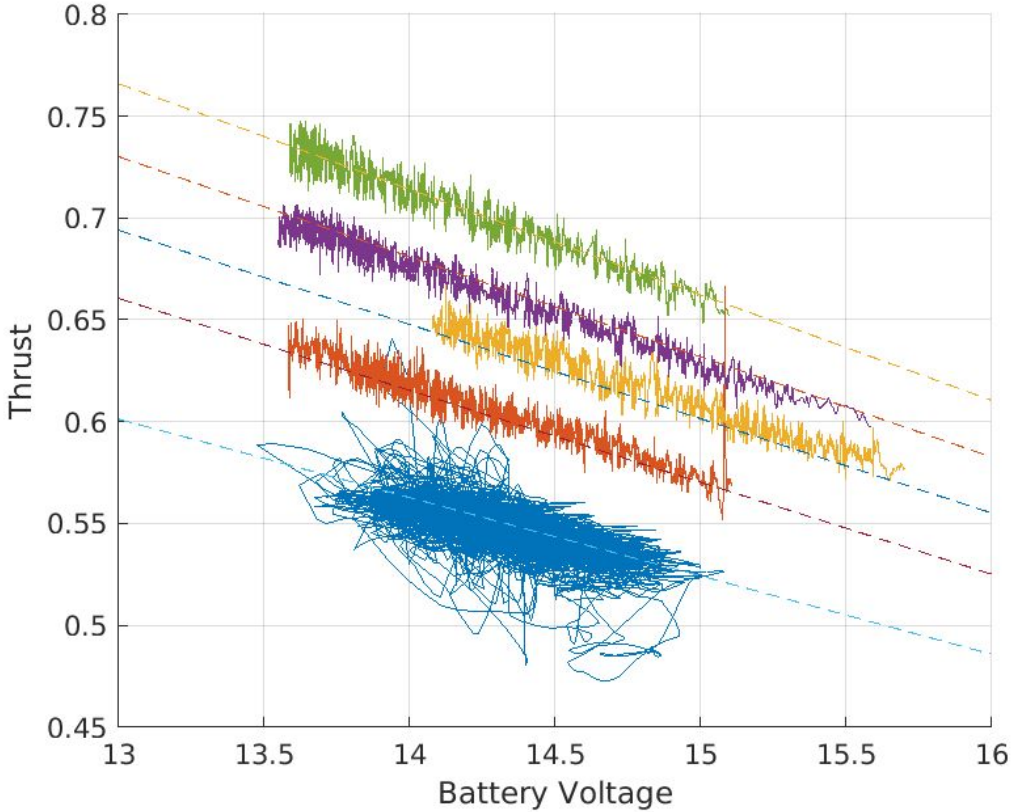
$T_h = a*U + b$

→

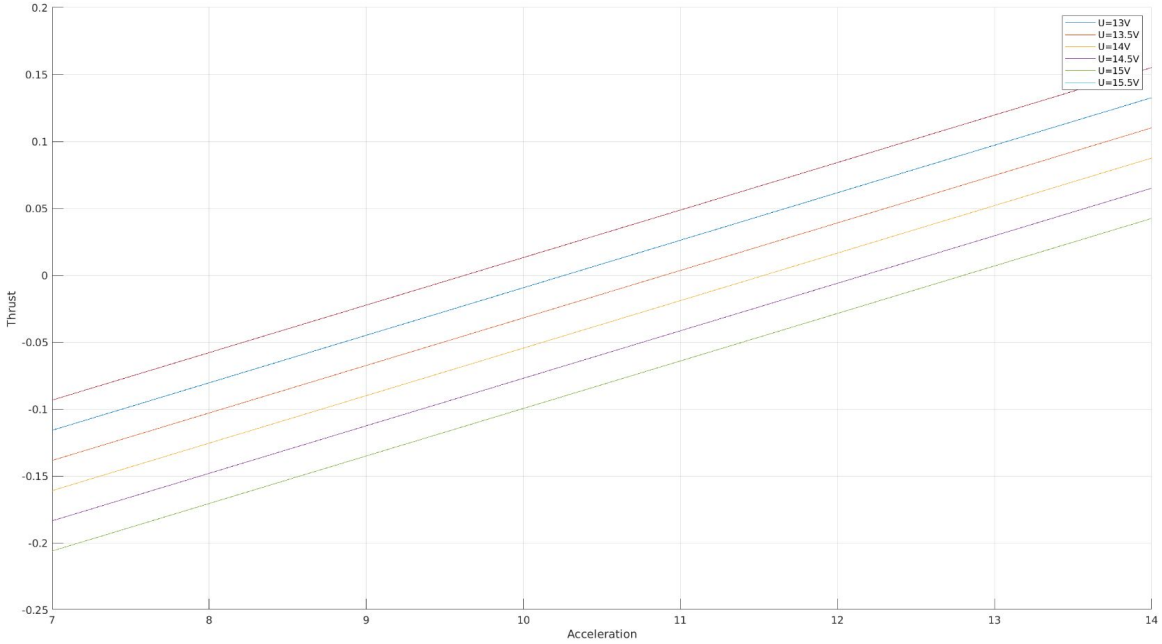
$T_h = (c_a + c_b*acc)*U + c_b*acc + d_b$

NRMSE = 240.8

! nonlinear relation



Acceleration vs Thrust for different voltages

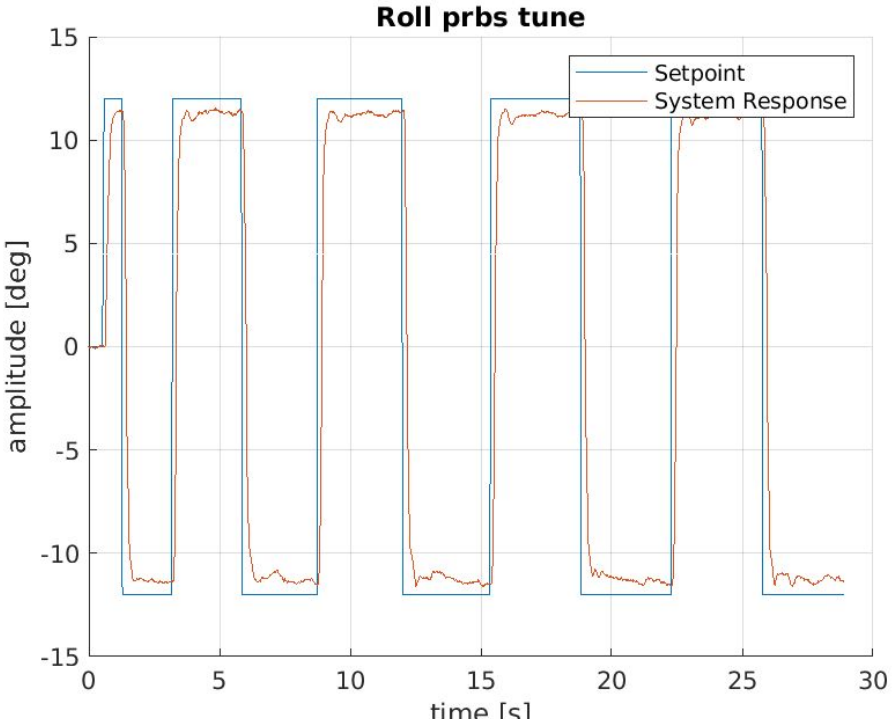


Results System ID

Roll Identification

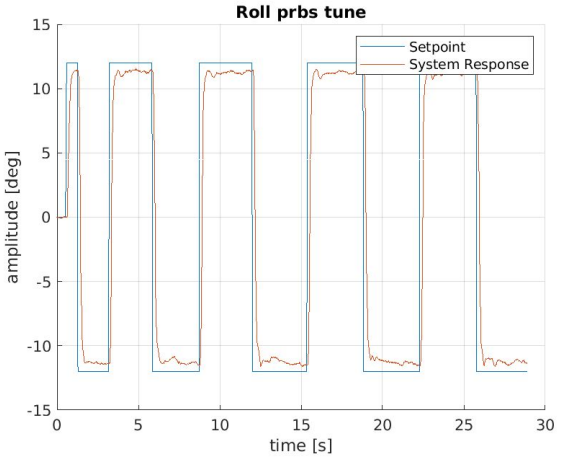
Tuning results

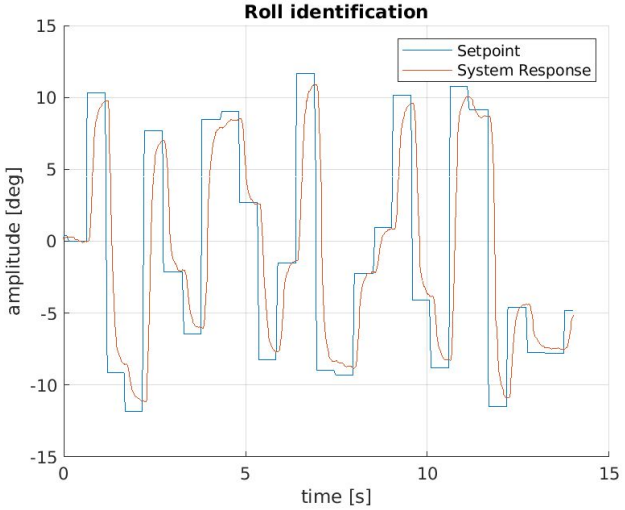
Gains: P-pos: 5.5, P-vel:0.14, I-vel: 0.5, D-vel:0.0025

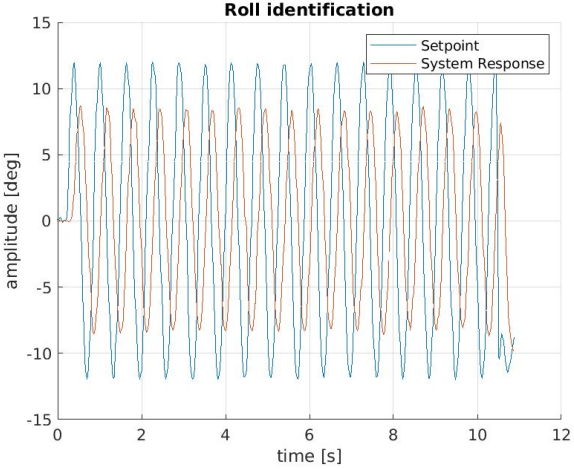


System Identification Data

- PRBS/Step signals at different frequencies
- PRBS/Step signals at different amplitdes
- Sinusoids at different frequencies



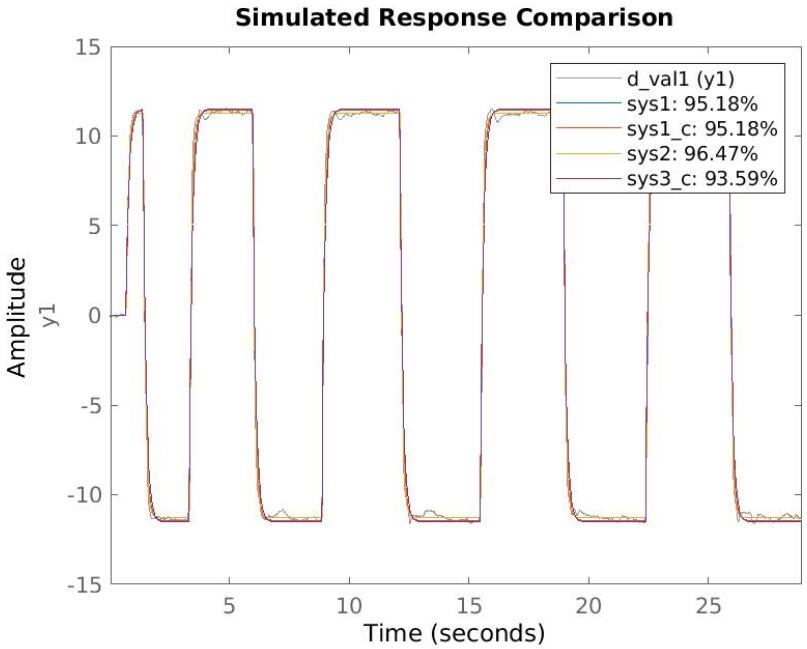


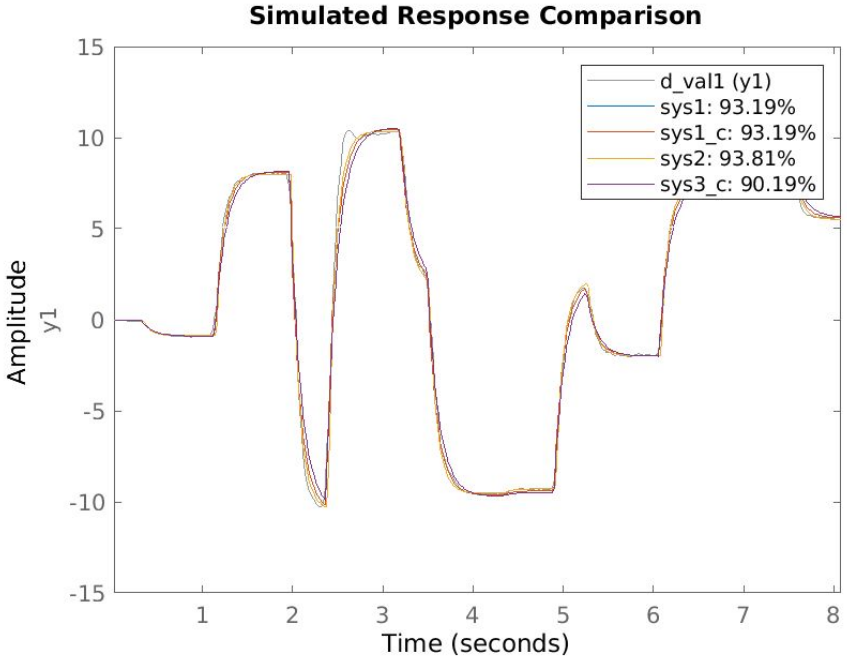


System ID Model

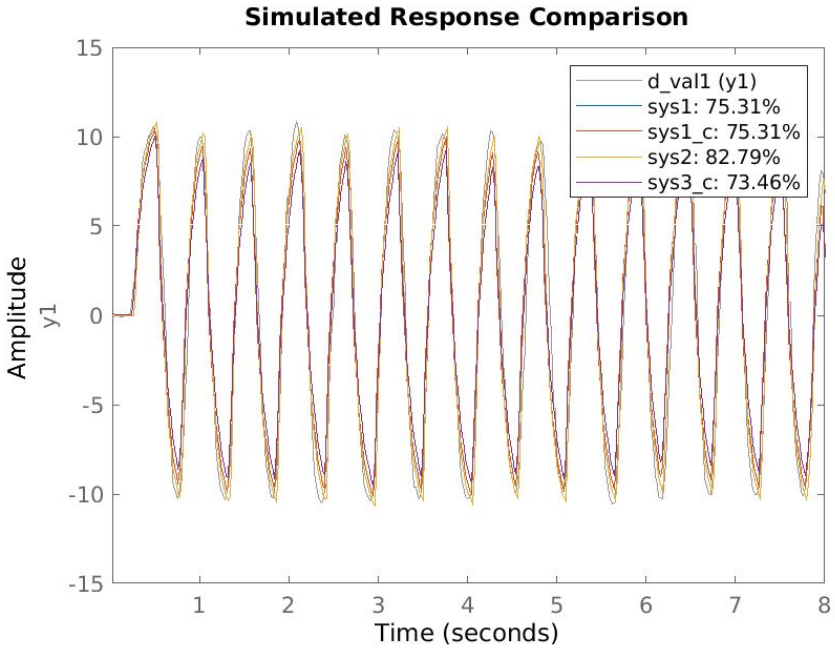
- Identify first order model with delay ~0.1s = 5*(T_s)
- phi_dot = -1/tau_phi*phi + k_phi/t_phi*phi_des
- merge different datasets for system ID
- keep some data for validation
- test different functions which all give the same model structure for first order: oe(), arx(), tfest() and translate from d2c(), if necessary

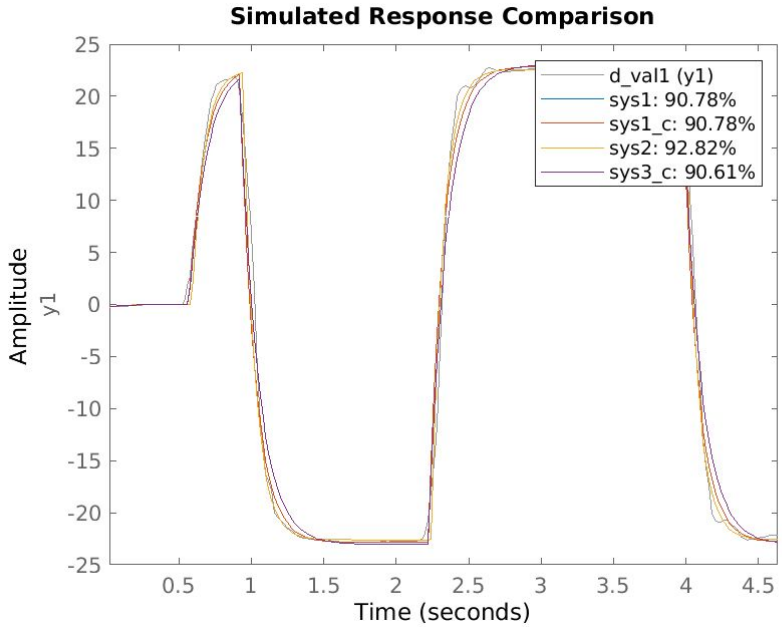
System ID results





System ID results



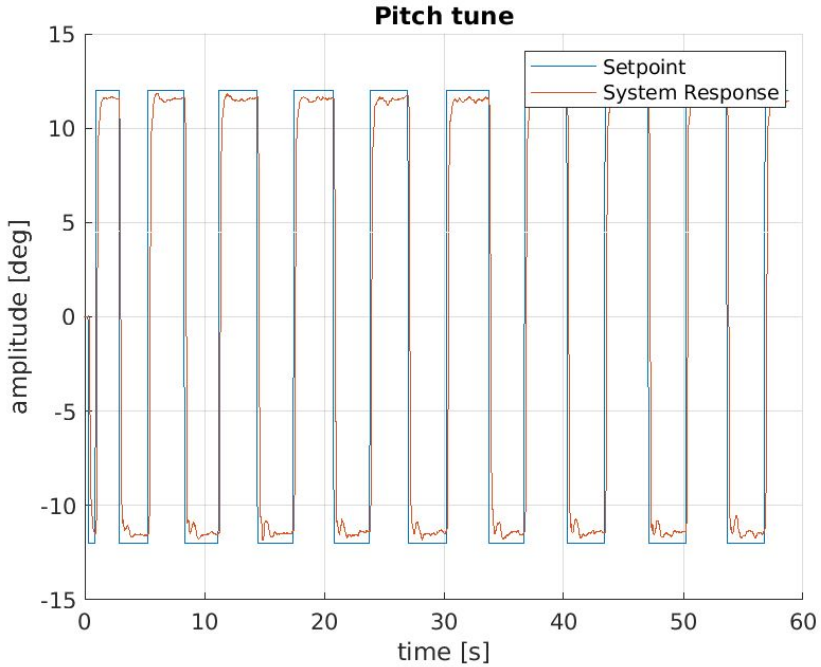


Results System ID

Pitch Identification

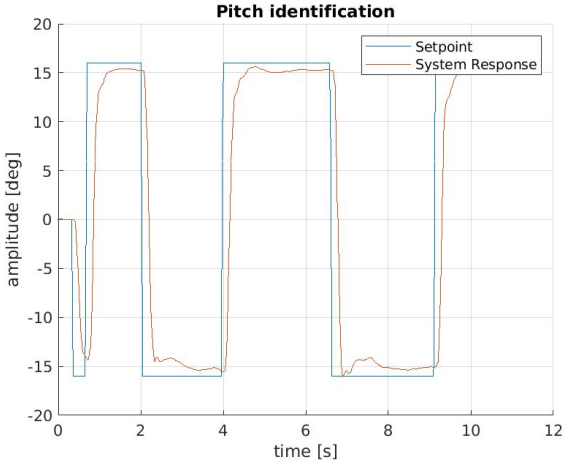
Tuning results

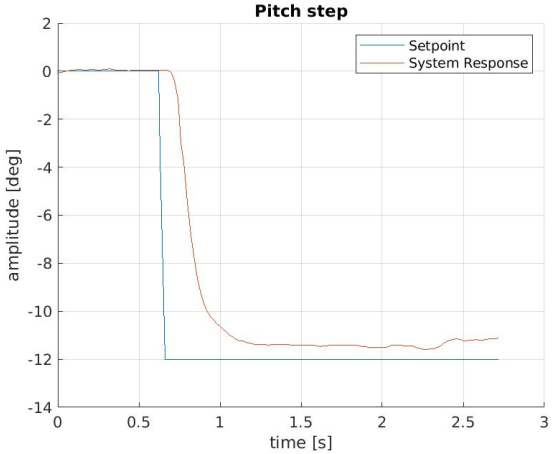
Gains: P-pos: 5.5, P-vel:0.16, I-vel: 0.5, D-vel:0.0025

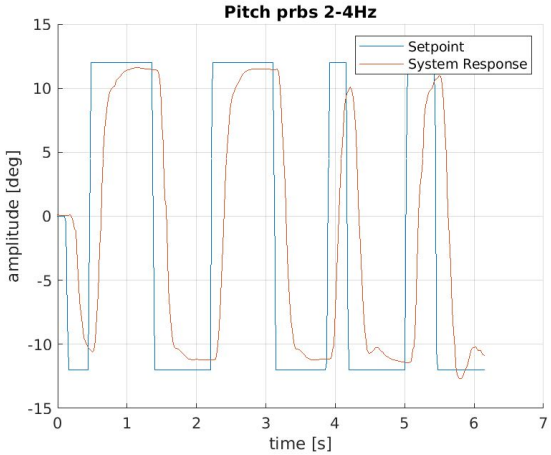


System Identification Data

- PRBS/Step signals at different frequencies
- PRBS/Step signals at different amplitdes
- Sinusoids at different frequencies



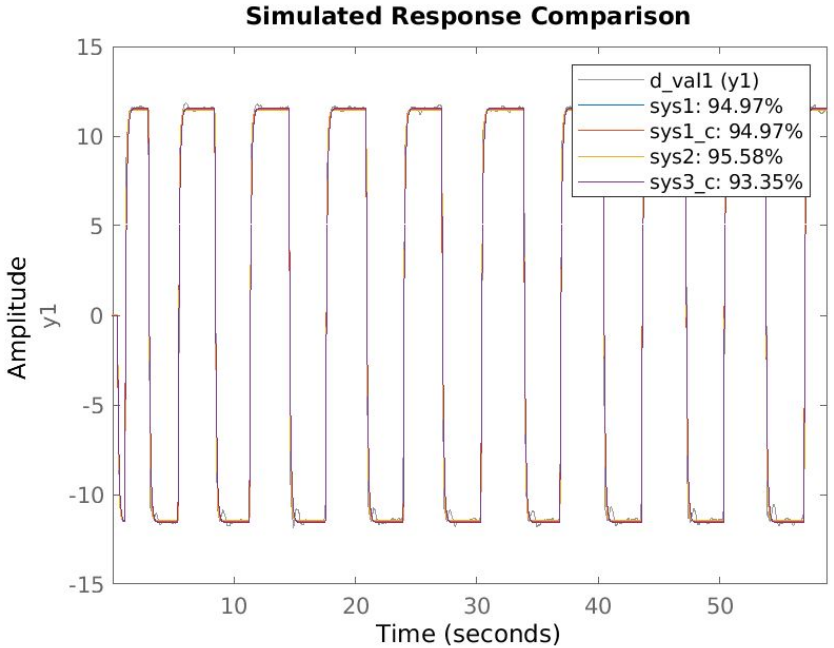


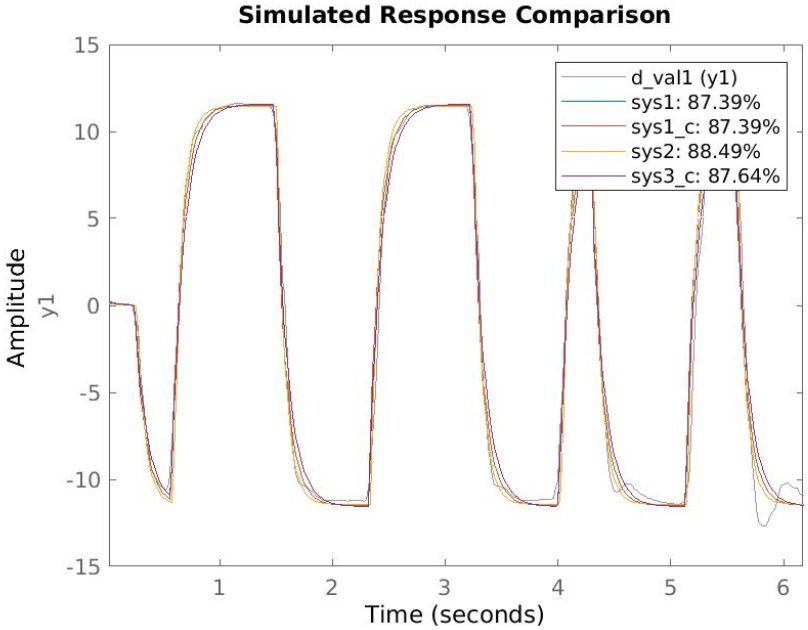


System ID Model

- Identify first order model with delay ~0.1s = 5*(T_s)
- theta_dot = -1/tau_theta*theta + k_theta/tau_theta*theta_des
- merge different datasets for system ID
- keep some data for validation
- test different functions which all give the same model structure for first order: oe(), arx(), tfest() and translate from d2c(), if necessary

System ID Results





System ID Results