Discrete Control Systems Laboratory

1. Make a nonlinear model in Matlab Simulink for the seesaw system.
2. Linearize the seesaw system and make a linear state-space model for the working point zero in Matlab Simulink
3. Compare the linear model and the nonlinear model. When does the linear model become imprecise? How far can the working point be away from the initial working point (in state-space), upon which the linear system was derived from?
4. Make a state-feedback control based on the linear seesaw system. Place all poles at -1. Calculate state feedback vector k and preamplifier p. Verify the control on the linear seesaw system. Test the linear state-feedback vector k and the preamplifier p on the nonlinear seesaw system. Test it for reference value steps and disturbance torque steps.
5. Make a PI-state-feedback control based on the linear seesaw system. Place all poles at -1. Calculate the state feedback vector k based on the augmented system (5^{th} order). Verify the control on the linear seesaw system. Test the linear PI-state-feedback control for reference value steps and disturbance torque steps.
6. Make the PI-part time discrete with a sample rate 8 kHz and test the linear PI-state-feedback on the nonlinear seesaw system.
7. Make a linear full-state observer based on the linear seesaw system. Place all poles at -3. Calculate the error feedback vector h. Validate the observer on the linear seesaw system for different initial conditions. Make the parallel model time discrete (zero-order-hold) with a sample rate of 8 kHz. Test the linear full-state observer on the nonlinear seesaw system with different initial conditions.
8. Use the observed states from 7. for the controls 4. – 6. and test them on the linear and non-linear system for different initial conditions and reference value steps and disturbance torque steps.