

file: Documentation\_for\_codes.doc

Consider the observer based state feedback system shown in file **OBSF\_example.pdf**. In order to get a good understanding of the system we perform the following simulations:

1. **state\_fb.mdl** (self contained) shows the response to a finite duration pulse for both the original system (blue blocks) and the system with state feedback (green blocks and light blue gains). Since the poles of the system with state feedback are at (-20, -20) versus those of the original system (-5, -10) we see a faster response for the system with feedback.
  - a. note the gray gain which is used to compensate for the overall transfer function gain which is reduced by state feedback
2. **orig\_xfer.mdl** – block diagram of original system which can be used with the following commands to obtain the transfer function
  - `>> [AA, BB, CC, DD]=linmod('orig_xfer');`
  - `>> ss_orig = ss(AA, BB, CC, DD);`
  - `>> tf(ss_orig)`
  - 
  - Transfer function:
  - $$\frac{1}{s^2 + 15s + 50}$$
  - Note the final value of a unit step is 1/50 this corresponds to part of the gray block in item 1
3. **state\_fb\_xfer.mdl** (same as item 2 but with state feedback)
  - `>> [AA, BB, CC, DD]=linmod('state_fb_xfer');`
  - `>> ss_fb = ss(AA, BB, CC, DD);`
  - `>> tf(ss_fb)`
  - 
  - Transfer function:
  - $$\frac{1}{s^2 + 40s + 400}$$
4. **obs\_sys.mdl** – this shows the original system as well as an observer with poles placed at (-50, -50)
  - click on manual switch to select source
  - try experimenting with different IC
  - try changing the system model parameters (-15 and -50) to see how well the observer behaves – this would correspond to a plant whose model parameters may not be known exactly
5. **obs\_state\_R13.mdl** – simulation of system with observer feeding state feedback gains. You should compare performance to item 1.
6. **obs\_based\_state\_xfer.mdl** – used to compute transfer function of observer based state feedback system. Note minimum realization only shows poles of state feedback system.

- `>> [AA, BB, CC, DD]=linmod('obs_based_state_xfer');`
- `sys_total = ss(AA, BB, CC, DD);`
- `tf(sys_total)`
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- Transfer function:
- $$\frac{s^2 + 100 s + 2500}{s^4 + 140 s^3 + 6900 s^2 + 140000 s + 1e006}$$
- 
- `minreal(tf(sys_total))`
- 
- Transfer function:
- $$\frac{1}{s^2 + 40 s + 400}$$
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7. also check out file **obs\_state\_xfer.m**