ActuatorSelection_Test3_2

October 27, 2021

1 Benefit of Multiplicative (MPL) Models over Nominal (Nom) Models of Systems

Testing actuator selection and feedback of Nominal and MPL models on simulations of True system

Py Packages

[1]:
```
import numpy as np
from copy import deepcopy as dc
# %matplotlib widget

from functionfile_system_definition import sys_from_file, system_display_matrix
from functionfile_system_mplcost import simulation_nom_vs_mpl,␣
 ↪plot_simulation_nom_vs_mpl_1, plot_simulation_nom_vs_mpl_2,␣
 ↪actuator_comparison
```

1.1 Code

[2]:
```
test_set = 'System Model 1'
S_True = sys_from_file(test_set + ' True')
S_MPL = sys_from_file(test_set + ' MPL')
S_Nom = sys_from_file(test_set + ' Nominal')
```

```
System read from file @ system_model/System Model 1 True.pickle

System read from file @ system_model/System Model 1 MPL.pickle

System read from file @ system_model/System Model 1 Nominal.pickle
```

[3]:
```
ret_sim = simulation_nom_vs_mpl(S_Nom, S_MPL, S_True)
```

1.2 Output

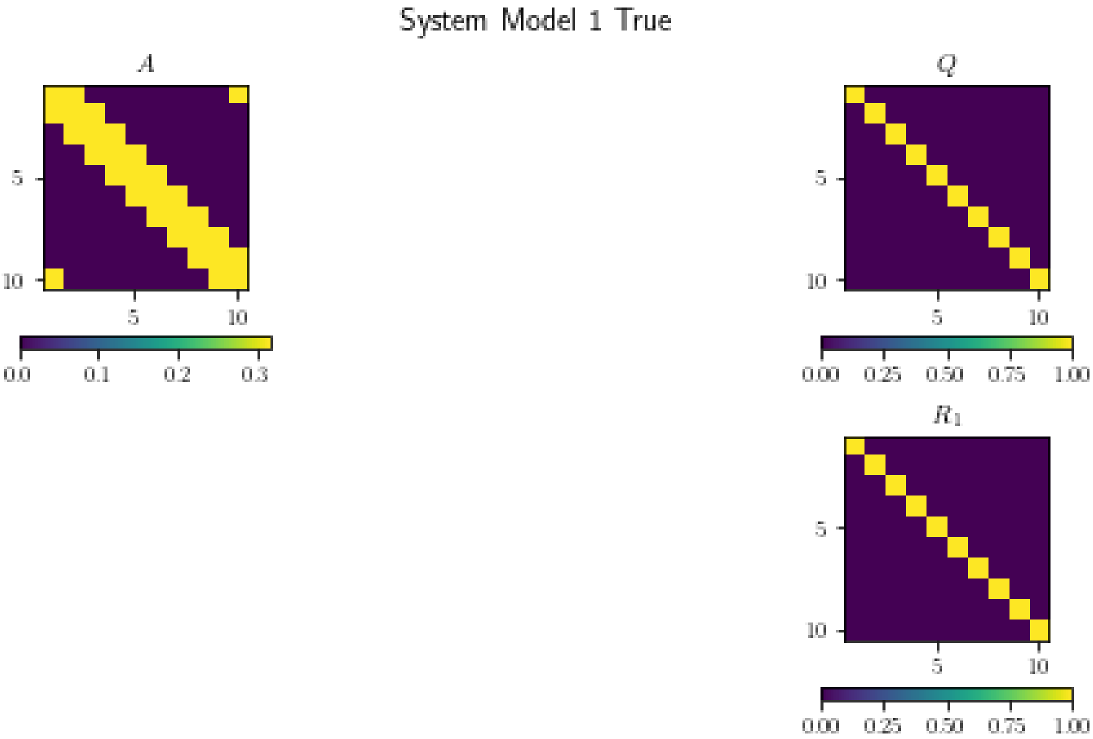
System Models

True System

[4]:

```
print('max(abs(eigvals(A)))= %.4f' % (np.max(np.abs(np.linalg.
 ↪eigvals(S_True['A'])))))
system_display_matrix(S_True)
```

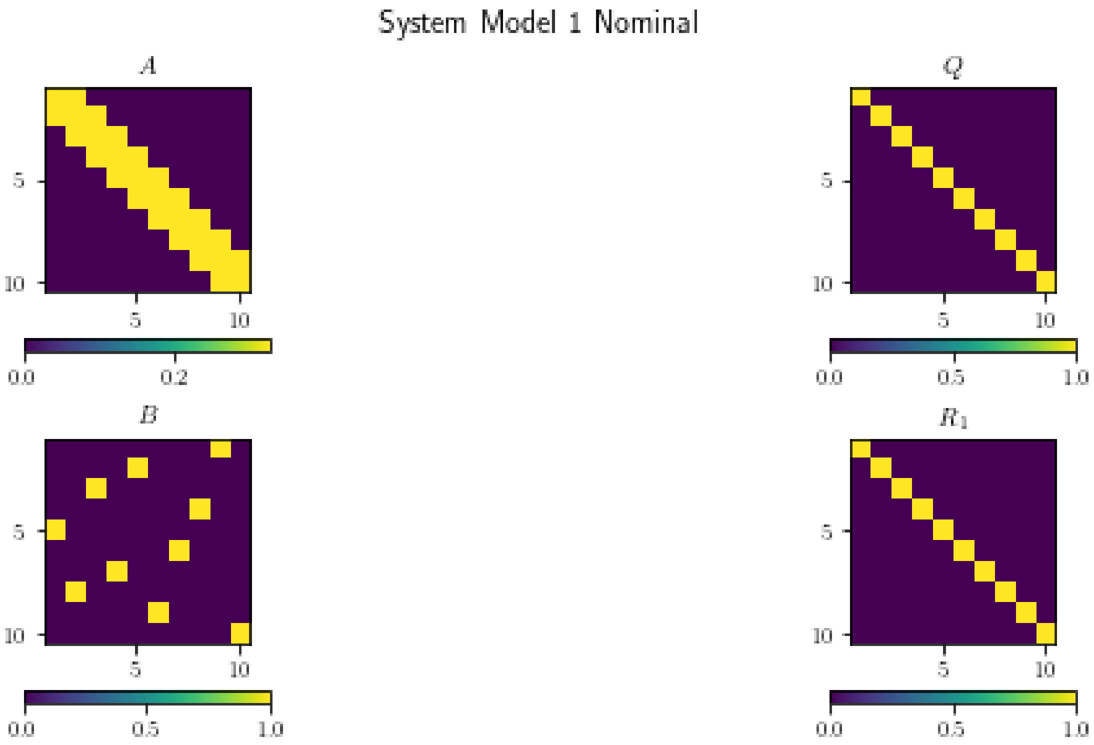
```
max(abs(eigvals(A)))= 0.9500
```



Nominal Model

```
[5]: print('max(abs(eigvals(A)))= %.4f' % (np.max(np.abs(np.linalg.
 ↪eigvals(ret_sim['system_nom']['A'])))))
system_display_matrix(ret_sim['system_nom'])
```

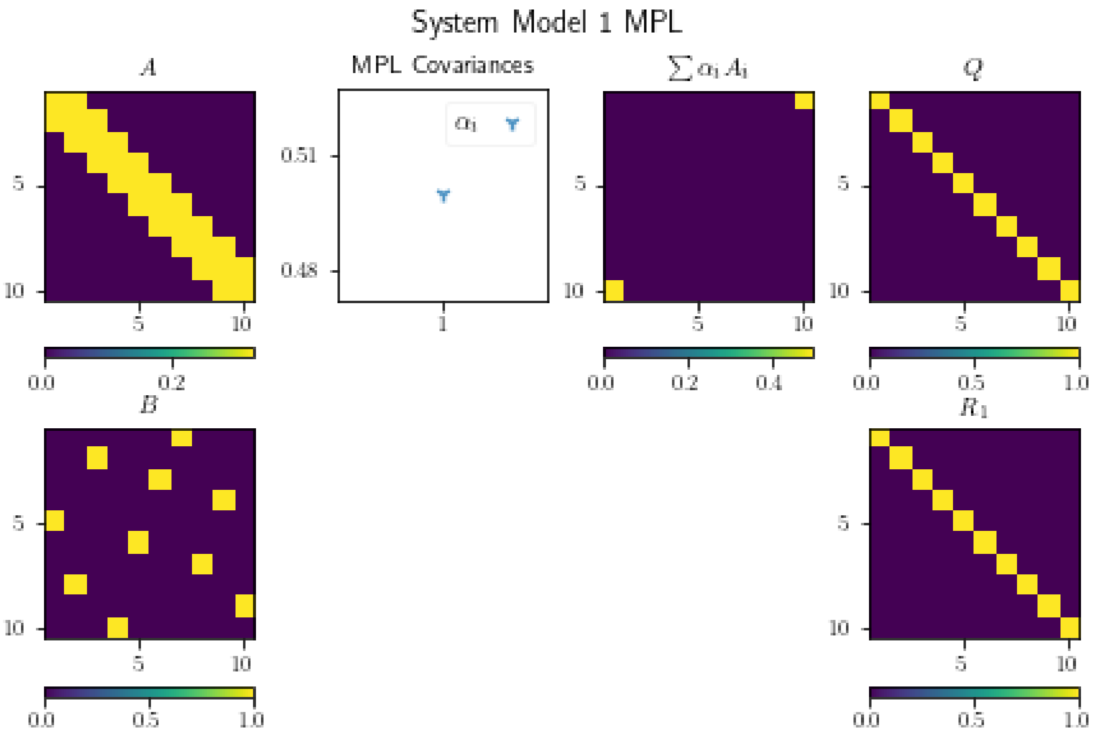
```
max(abs(eigvals(A)))= 0.9500
```



Multiplicative Noise Model

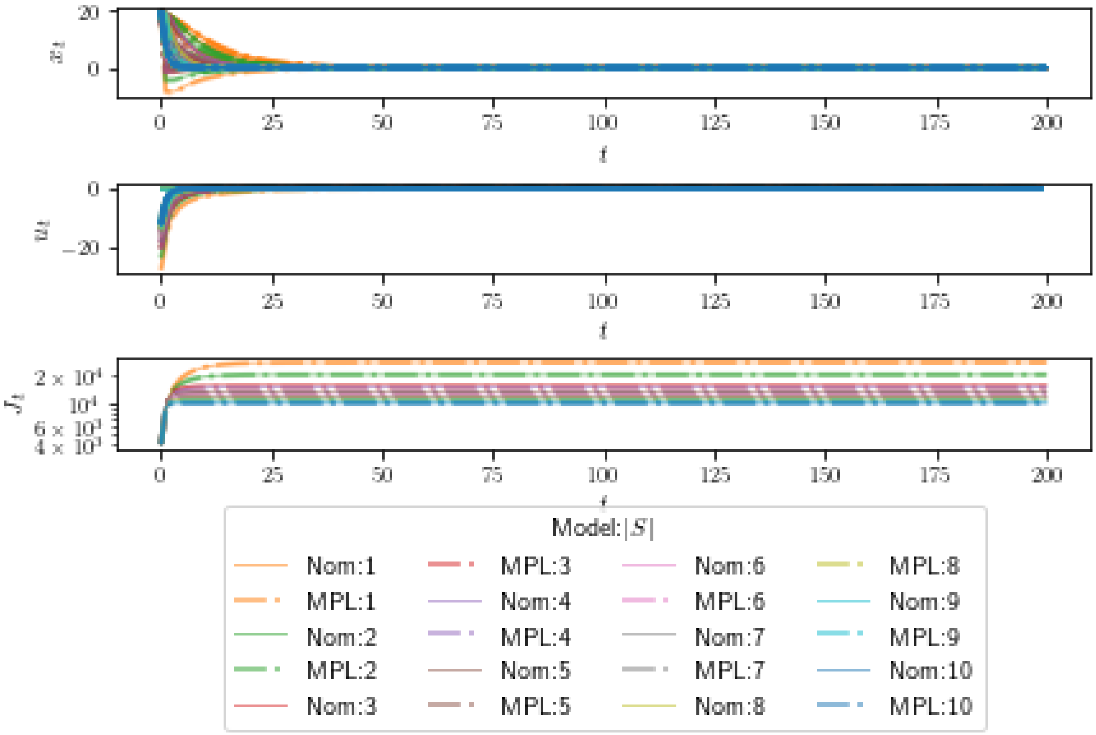
[6]:
```
print('max(abs(eigvals(A)))= %.4f' % (np.max(np.abs(np.linalg.
 ↪eigvals(ret_sim['system_mpl']['A'])))))
system_display_matrix(ret_sim['system_mpl'])
```

```
max(abs(eigvals(A)))= 0.9500
```



Simulation - Trajectory, Control Input and Costs

[7]:
```
plot_simulation_nom_vs_mpl_1(ret_sim)
```

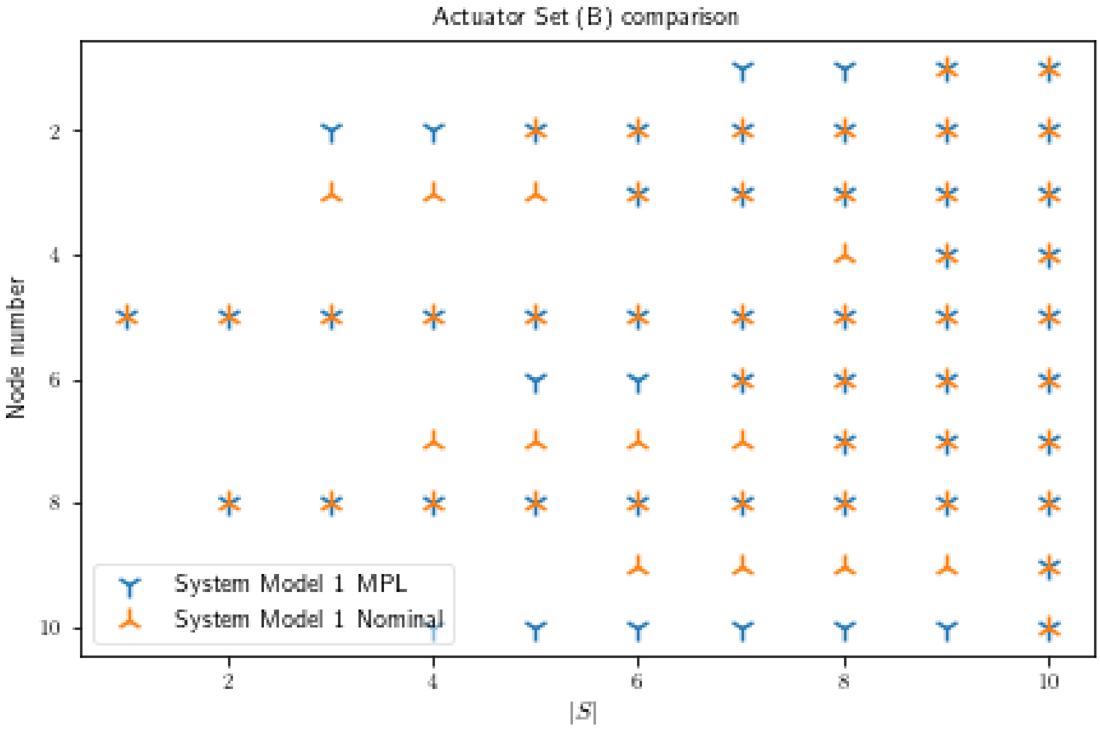


Actuator set comparison

[8]:

```
actuator_comparison(ret_sim['system_mpl'], ret_sim['system_nom']);
```

```
Control sets are different
```



Simulated costs

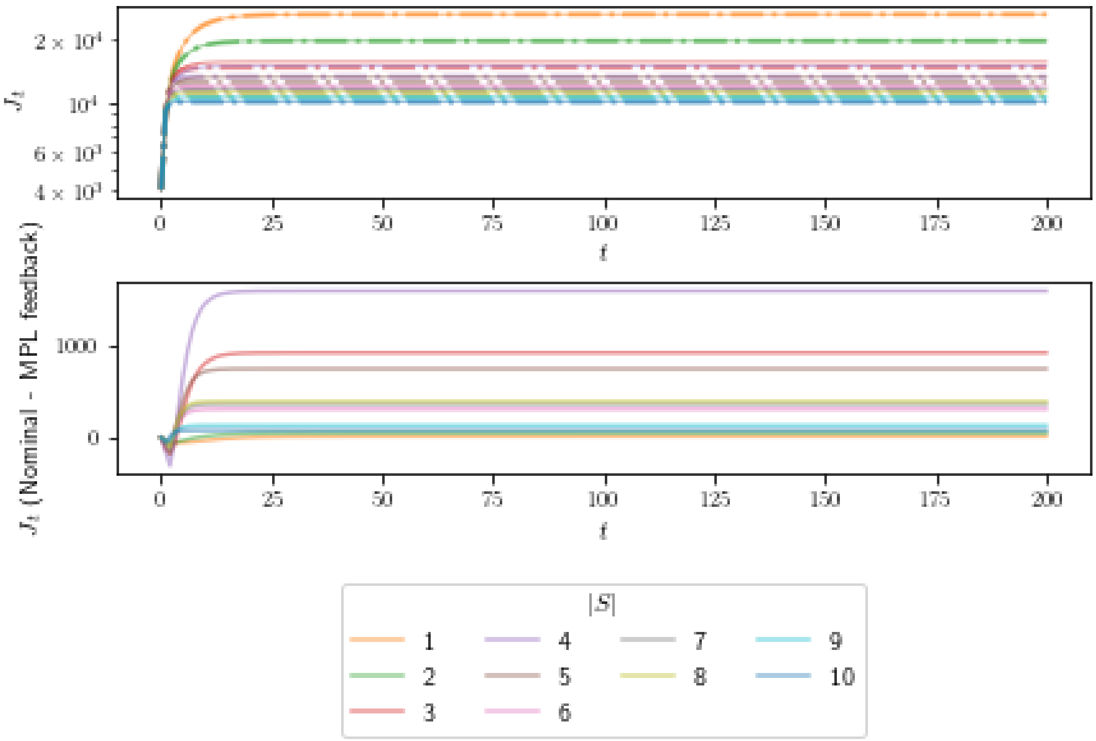
```
[9]: print('True simulation cost with <___> feedback (4decimal approx)')
     for key in ret_sim['T_Nom']['costs']:
         print ("|S|: %s | Nom: %.4f | MPL: %.4f | Diff (Nom-MPL) %.4f (%.4f %% of␣
      ↪Nom)" % (key, ret_sim['T_Nom']['costs'][key][-1],␣
      ↪ret_sim['T_MPL']['costs'][key][-1],␣
      ↪ret_sim['T_Nom']['costs'][key][-1]-ret_sim['T_MPL']['costs'][key][-1],␣
      ↪(ret_sim['T_Nom']['costs'][key][-1]-ret_sim['T_MPL']['costs'][key][-1])*100/
      ↪ret_sim['T_Nom']['costs'][key][-1]))
```

```
True simulation cost with <___> feedback (4decimal approx)
|S|: 1 | Nom: 26291.6224 | MPL: 26277.5096 | Diff (Nom-MPL) 14.1129 (0.0537 % of
Nom)
|S|: 2 | Nom: 19728.3951 | MPL: 19678.8618 | Diff (Nom-MPL) 49.5333 (0.2511 % of
Nom)
|S|: 3 | Nom: 15758.2399 | MPL: 14833.1283 | Diff (Nom-MPL) 925.1116 (5.8707 %
of Nom)
|S|: 4 | Nom: 15037.7818 | MPL: 13434.0968 | Diff (Nom-MPL) 1603.6850 (10.6644 %
of Nom)
|S|: 5 | Nom: 13415.9116 | MPL: 12664.6753 | Diff (Nom-MPL) 751.2363 (5.5996 %
of Nom)
|S|: 6 | Nom: 12206.0345 | MPL: 11895.9663 | Diff (Nom-MPL) 310.0682 (2.5403 %
of Nom)
```

```
|S|: 7 | Nom: 11791.6587 | MPL: 11431.4561 | Diff (Nom-MPL) 360.2026 (3.0547 %
of Nom)
|S|: 8 | Nom: 11410.6990 | MPL: 11018.8946 | Diff (Nom-MPL) 391.8044 (3.4337 %
of Nom)
|S|: 9 | Nom: 10753.7986 | MPL: 10624.2851 | Diff (Nom-MPL) 129.5135 (1.2044 %
of Nom)
|S|: 10 | Nom: 10298.4039 | MPL: 10220.3008 | Diff (Nom-MPL) 78.1031 (0.7584 %
of Nom)
```

[10]:

```
plot_simulation_nom_vs_mpl_2(ret_sim)
```



1.3 Run Complete

[11]:

```
print('Run Complete')
```

```
Run Complete
```