ActuatorSelection_Test3_2

November 5, 2021

1 Benefit of Multiplicative Models of Systems

Testing actuator selection and feedback of MPL models on simulations of True system - Comparison to Nominal Model - Comparison of MPL models

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_model_comparison,␣
↪plot_simulation_comparison1, plot_simulation_comparison2,␣
↪actuator_comparison, cost_comparison_print
```

1.1 Code

[2]:
```
test_set = 'System Model 7'
S_True = sys_from_file(test_set + ' C')
S_MPL = sys_from_file(test_set + ' B')
S_Nom = sys_from_file(test_set + ' A')
```

```
System read from file @ system_model/System Model 7 C.pickle

System read from file @ system_model/System Model 7 B.pickle

System read from file @ system_model/System Model 7 A.pickle
```

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

```
====> Breaking current simulation at t= 53 as cumulative cost magnitude exceed
1e+08
====> Breaking current simulation at t= 63 as cumulative cost magnitude exceed
1e+08
====> Breaking current simulation at t= 81 as cumulative cost magnitude exceed
1e+08
====> Breaking current simulation at t= 67 as cumulative cost magnitude exceed
1e+08
```

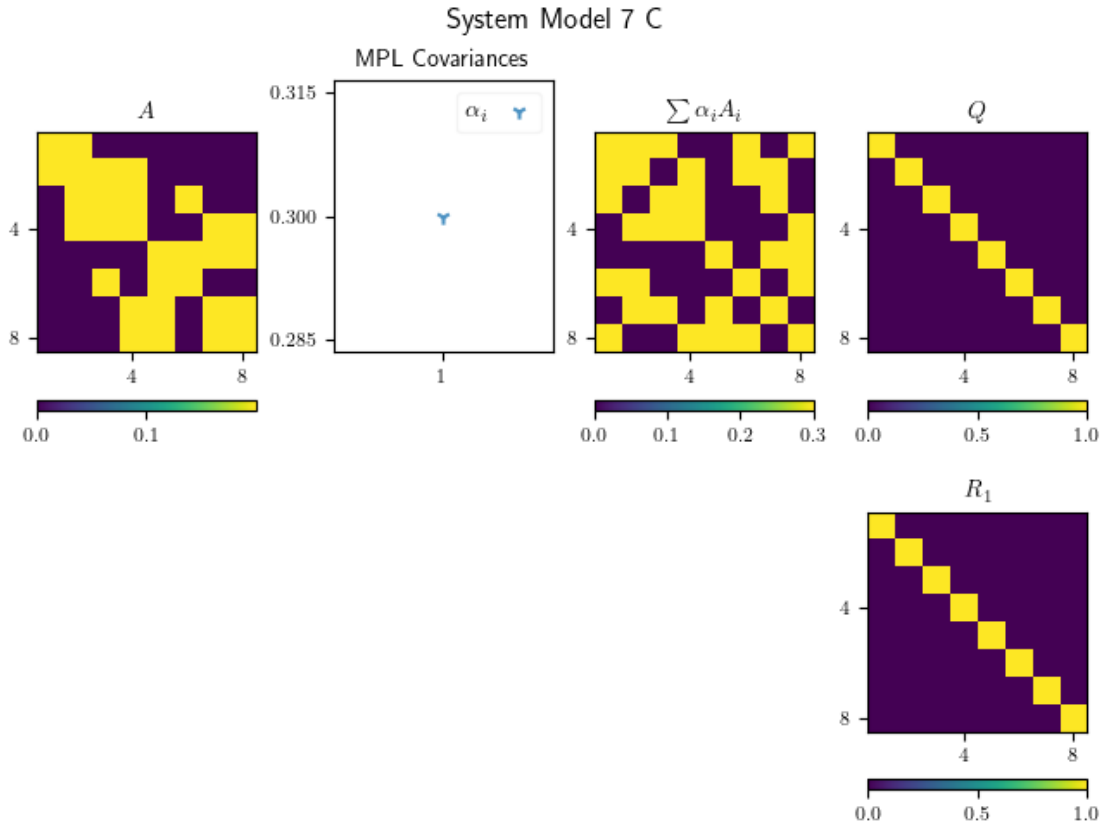
1.2 Output

System Models

System C - True System

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

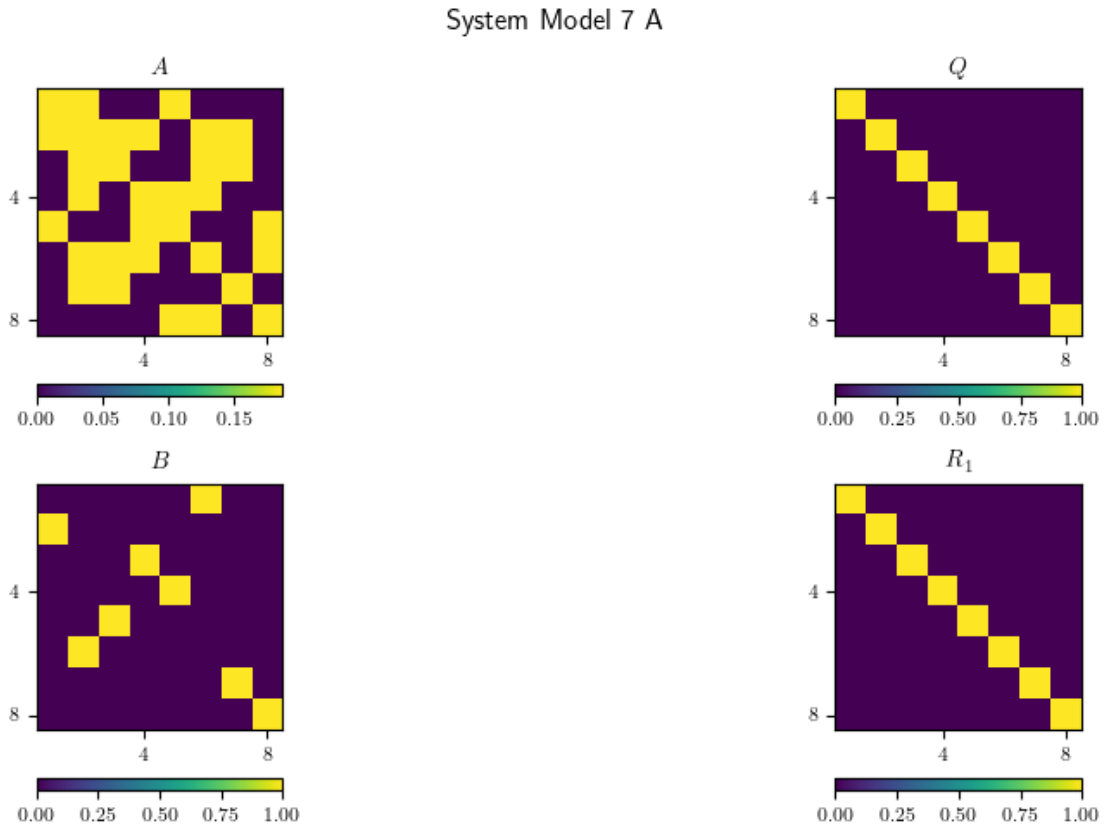
```
max(abs(eigvals(A)))= 0.8000
```



System A

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

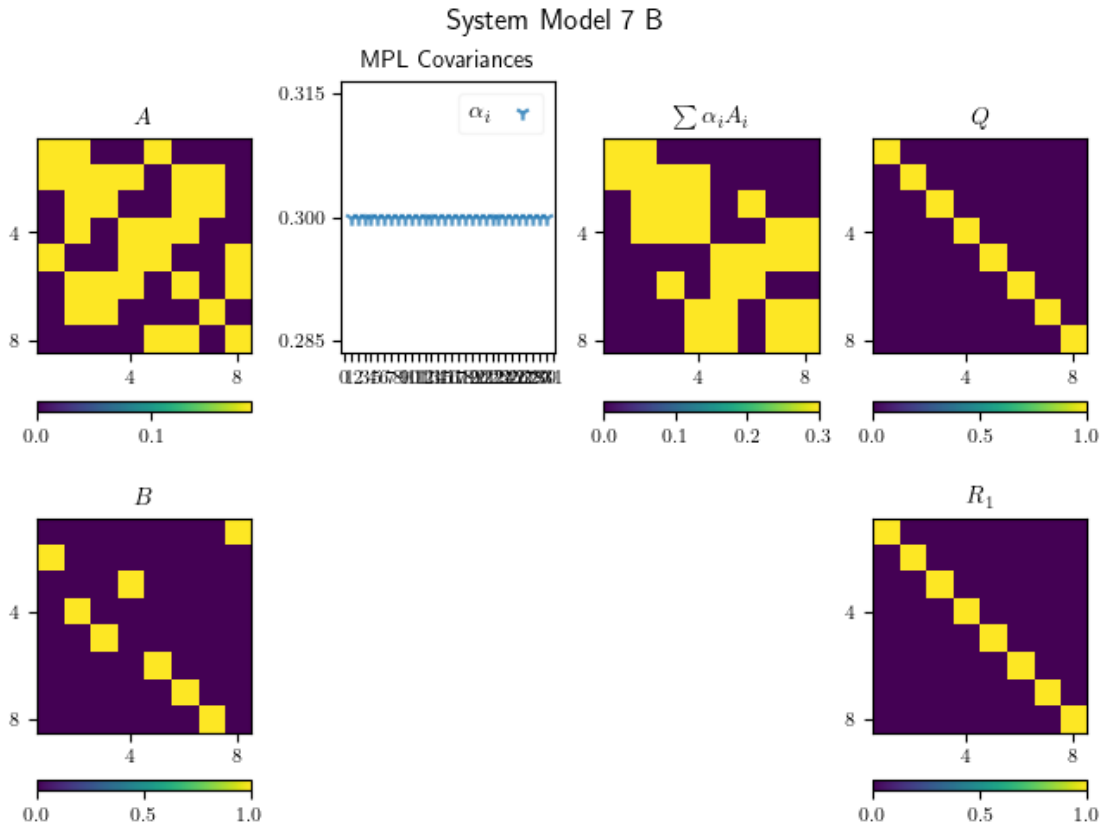
```
max(abs(eigvals(A)))= 0.8000
```



System B

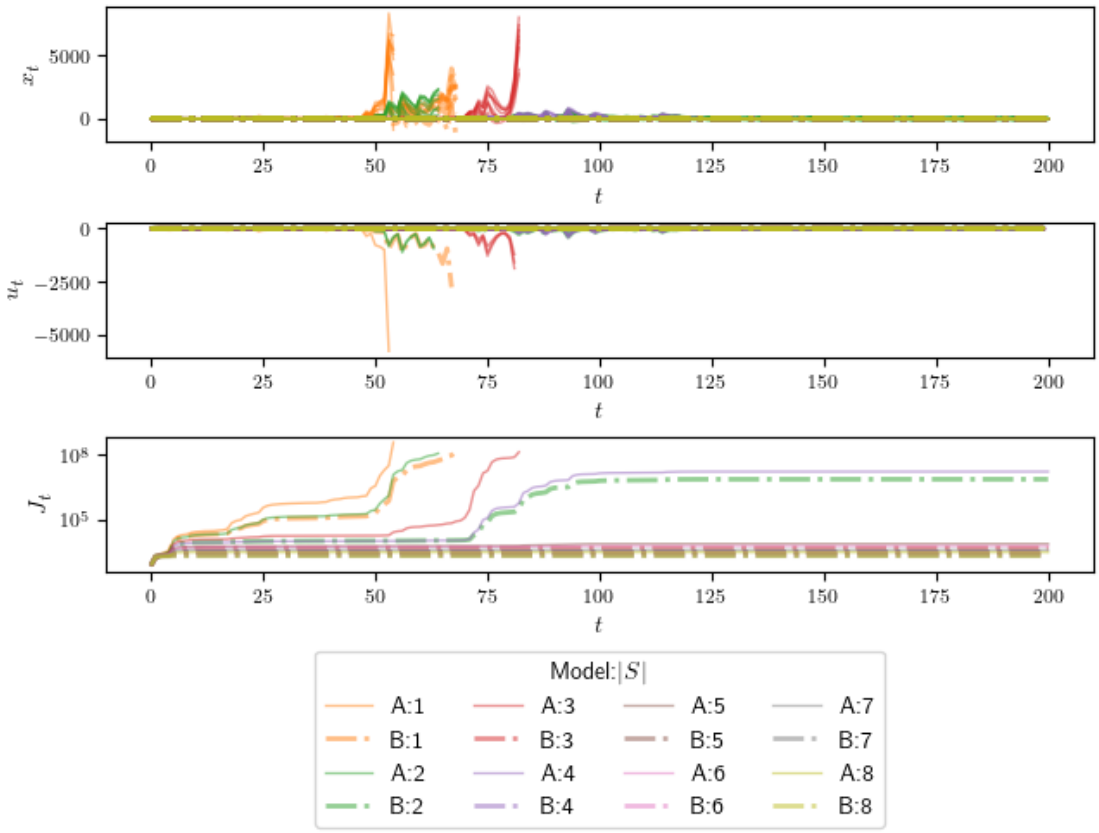
[6]:
```
print('max(abs(eigvals(A)))= %.4f' % (np.max(np.abs(np.linalg.
 ↪eigvals(ret_sim['system_B']['A'])))))
system_display_matrix(ret_sim['system_B'])
```

```
max(abs(eigvals(A)))= 0.8000
```



Simulation - Trajectory, Control Input and Costs

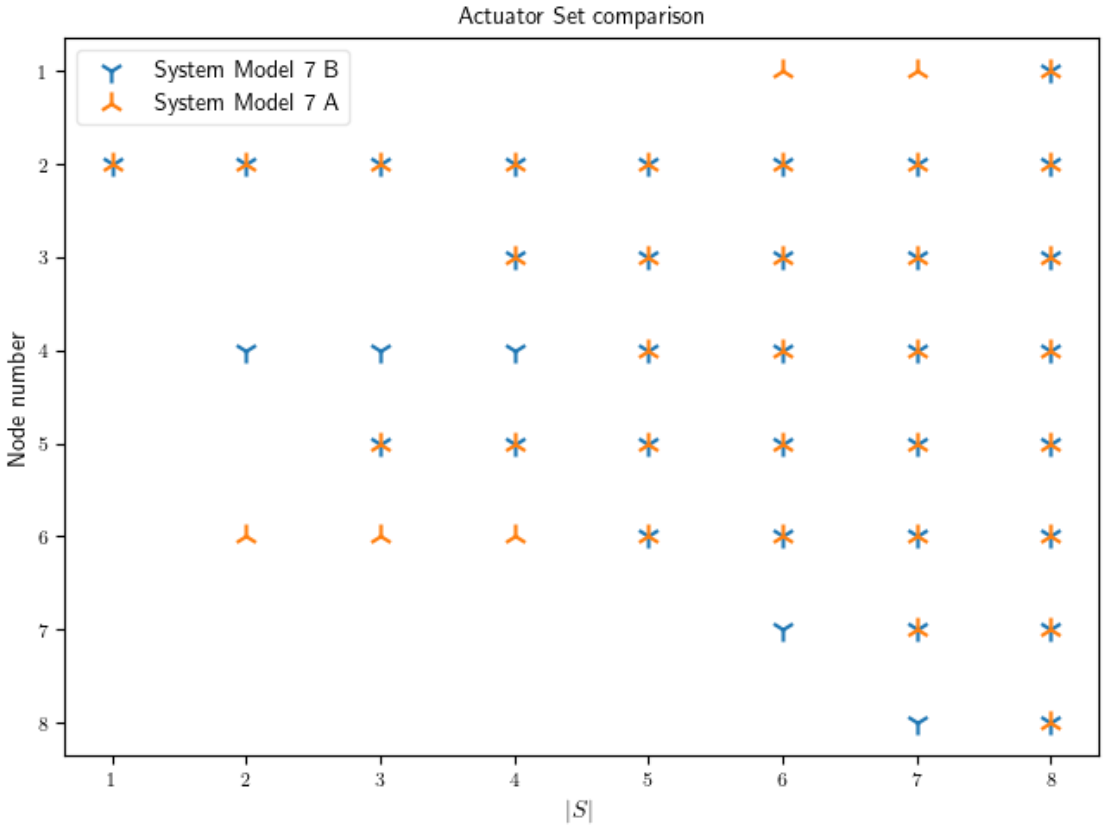
[7]:
```
plot_simulation_comparison1(ret_sim)
```



Actuator set comparison

[8]:
```
actuator_comparison(ret_sim['system_B'], ret_sim['system_A'], disptext=True,␣
↪figplt=True);
```

```
Control sets are different
```

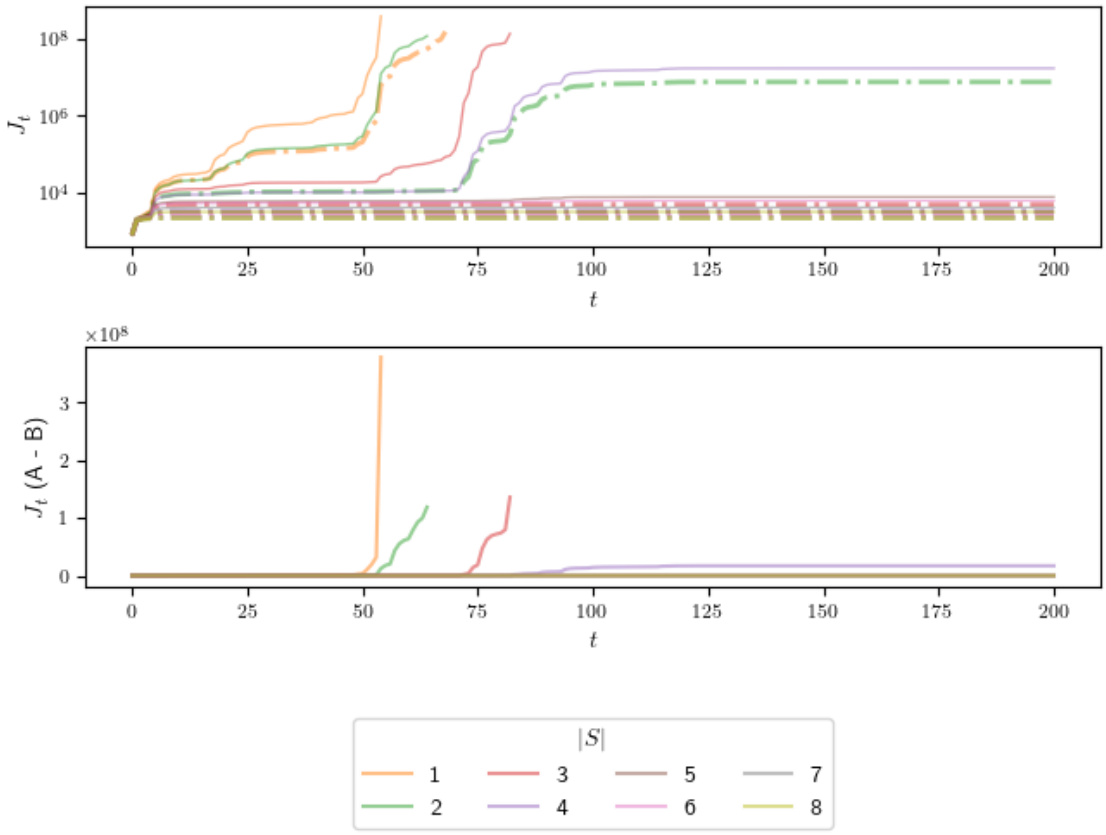


Simulated costs

[9]:
```
cost_comparison_print(ret_sim)
```

```
True system (System Model 7 C) simulation cost with A (System Model 7 A) and B
(System Model 7 B) feedback
|S|: 1 | A: nan | B: nan | Diff (A-B) nan (nan % of A)
|S|: 2 | A: nan | B: 7.5718e+06 | Diff (A-B) nan (nan % of A)
|S|: 3 | A: nan | B: 4.9342e+03 | Diff (A-B) nan (nan % of A)
|S|: 4 | A: 1.7145e+07 | B: 3.3088e+03 | Diff (A-B) 1.7141e+07 (99.98 % of A)
|S|: 5 | A: 7.7224e+03 | B: 3.0680e+03 | Diff (A-B) 4.6544e+03 (60.27 % of A)
|S|: 6 | A: 6.1543e+03 | B: 2.5394e+03 | Diff (A-B) 3.6150e+03 (58.74 % of A)
|S|: 7 | A: 4.1049e+03 | B: 2.2116e+03 | Diff (A-B) 1.8933e+03 (46.12 % of A)
|S|: 8 | A: 3.1536e+03 | B: 2.1822e+03 | Diff (A-B) 9.7141e+02 (30.80 % of A)
```

[10]:
```
plot_simulation_comparison2(ret_sim)
```



1.3 Run Complete

[11]:
```
print('Run Complete')
```

```
Run Complete
```