BPL_TEST2_Fedbatch script with FMPy

The key library FMPy is installed.

After the installation a small application BPL_TEST2_Fedbatch is loaded and run. You can continue with this example if you like.

```
!lsb_release -a # Actual VM Ubuntu version used by Google
```

```
No LSB modules are available.
Distributor ID: Ubuntu
Description:    Ubuntu 22.04.4 LTS
Release:        22.04
Codename:       jammy
```

```
!python --version
```

```
Python 3.12.12
```

```
!uv pip install fmpy # Install the key package
```

```
Using Python 3.12.12 environment at: /usr
Resolved 19 packages in 975ms
Prepared 3 packages in 2.66s
Uninstalled 2 packages in 428ms
Installed 3 packages in 322ms
 - cmake==3.31.6
 + cmake==4.1.2
 + fmpy==0.3.26
 - numpy==2.0.2
 + numpy==2.3.5
```

BPL_TEST2_Fedbatch setup

Now specific installation and the run simulations. Start with connecting to Github. Then upload the two files:

- FMU - BPL_TEST2_Fedbatch_linux_om_me.fmu
- Setup-file - BPL_TEST2_Fedbatch_fmpy_explore.py

```
%%bash
git clone https://github.com/janpeter19/BPL_TEST2_Fedbatch
```

```
Cloning into 'BPL_TEST2_Fedbatch'...
```

```
%cd BPL_TEST2_Fedbatch
```

```
/content/BPL_TEST2_Fedbatch
```

```
run -i BPL_TEST2_Fedbatch_fmpy_explore.py
```

```
Linux - run FMU pre-compiled OpenModelica

Model for the process has been setup. Key commands:
 - par()       - change of parameters and initial values
 - init()      - change initial values only
 - simu()      - simulate and plot
 - newplot()   - make a new plot
 - show()      - show plot from previous simulation
 - disp()      - display parameters and initial values from the last s
 - describe()  - describe culture, broth, parameters, variables with v

Note that both disp() and describe() takes values from the last simula
and the command process_diagram() brings up the main configuration

Brief information about a command by help(), eg help(simu)
Key system information is listed with the command system_info()
```

```
%matplotlib inline
plt.rcParams['figure.figsize'] = [25/2.54, 20/2.54]
```

```
import warnings
warnings.filterwarnings("ignore")
```

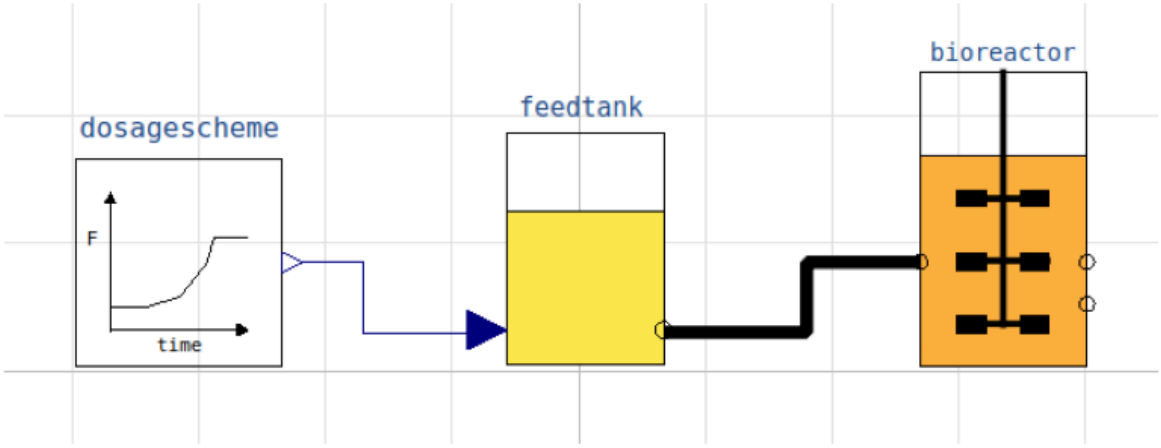
BPL_TEST2_Fedbatch - demo

```
describe('culture'); print(); #describe('liquidphase')
```

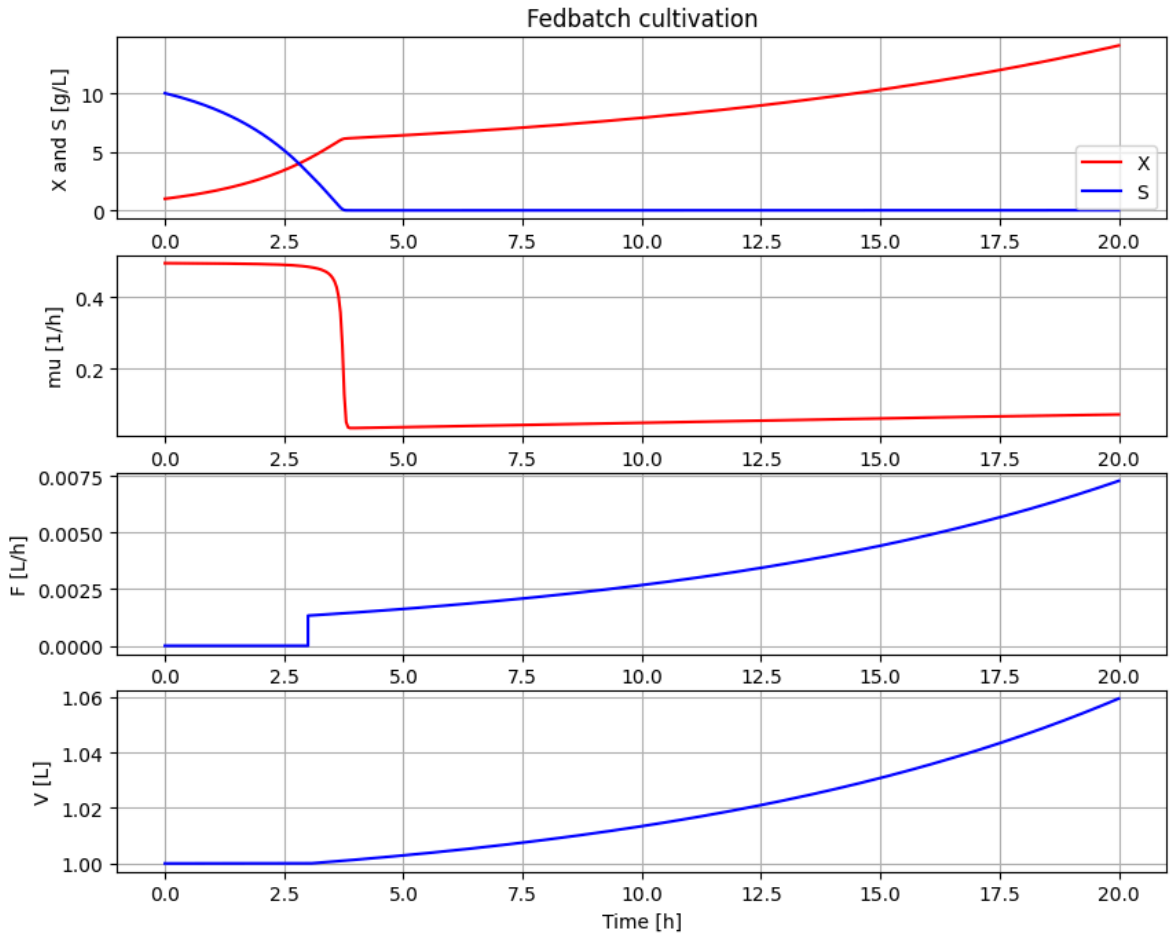
```
Simplified text book model - only substrate S and cell concentration X
```

```
process_diagram()
```

```
No processDiagram.png file in the FMU, but try the file on disk.
```




```
# Simulation with default values of the process
newplot(plotType='TimeSeries')
simu(20)
```




```
# Let us display and then save the feedprofile
disp('dosagescheme')
```

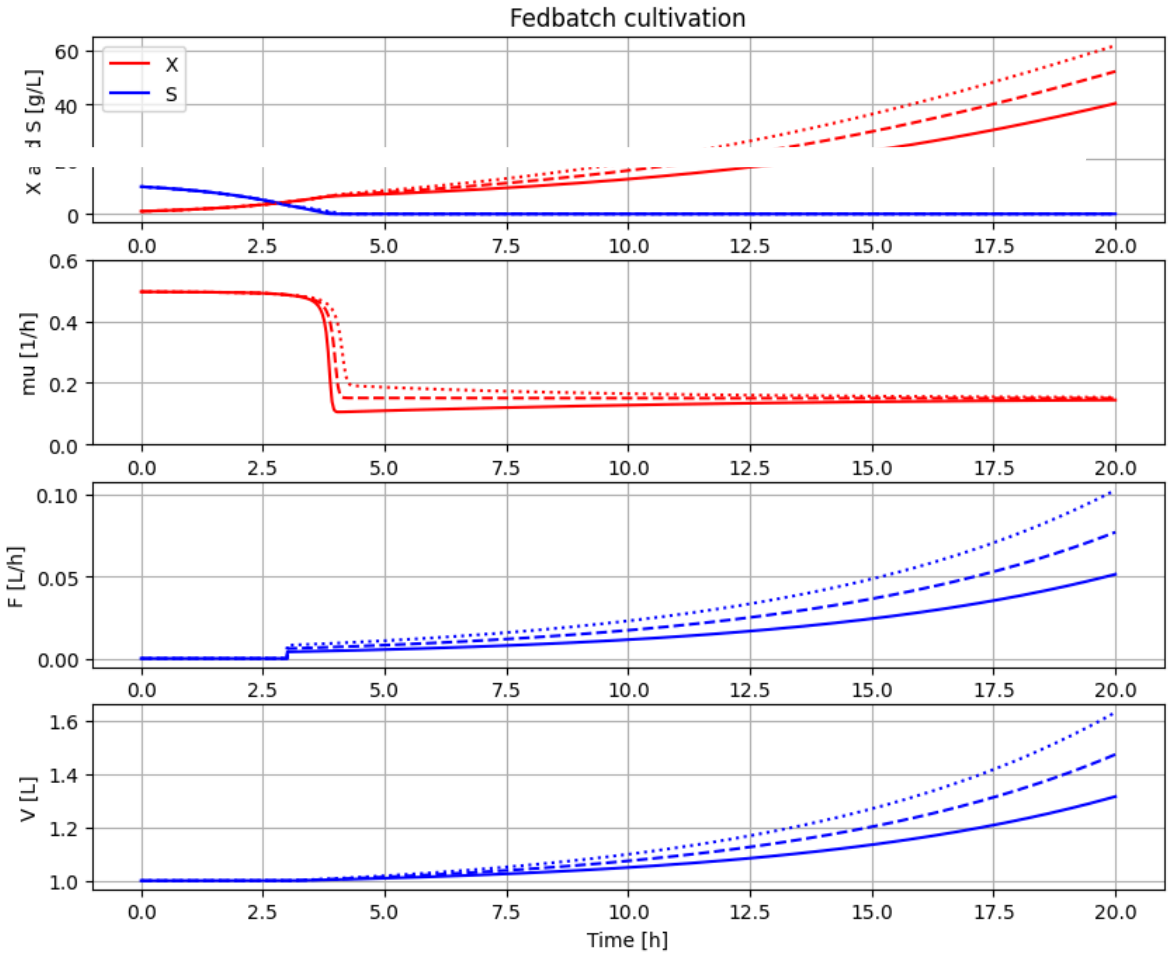
```
F_start : 0
mu_feed : 0.1
t_startExp : 3.0
F_startExp : 0.001
F_max : 0.3
```

```
feedprofile_1={'F_start':0, 'mu_feed':0.1, 't_startExp':3, 'F_startEx
```

```
# Let us develop a feedprofile with mu_feed=0.15 1/h instead
newplot(plotType='TimeSeries'); ax2.set_ylim(0,0.6)

# Choose mu_feed
par(mu_feed=0.15)
```

```
# Tune F_startExp value to get a stable culture growth rate at mu 0.1
for value in [0.004, 0.006, 0.008]:
    par(F_startExp=value)
    simu(20)
```

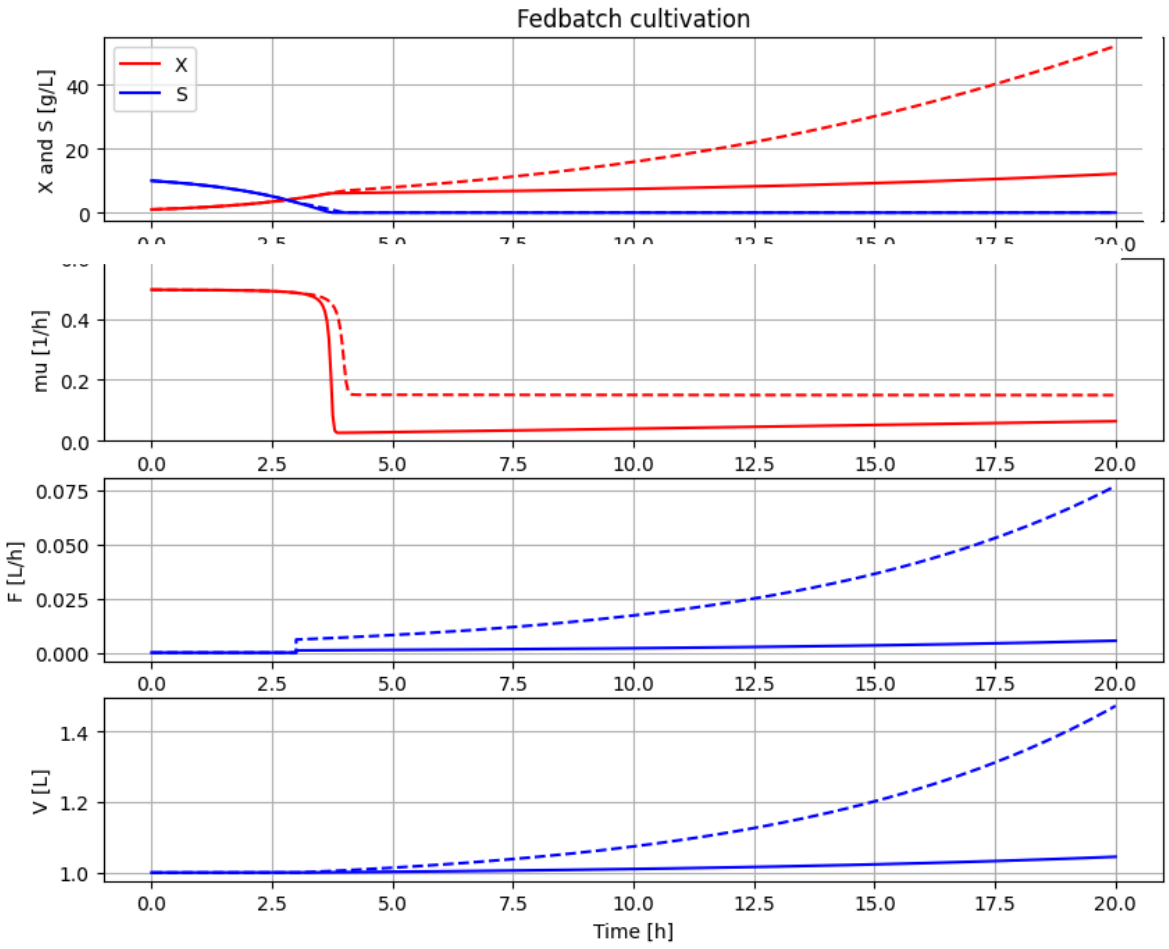



```
# We choose F_startExp = 0.008 and save the new feedprofile
feedprofile_2={'F_start':0, 'mu_feed':0.15, 't_startExp':3, 'F_startE
```

```
# Compare the result of ot the two
newplot(plotType='TimeSeries'); ax2.set_ylim(0,0.6)

for feedprofile in [feedprofile_1, feedprofile_2]:
    par(feedprofile)
    simu(20)
```

```
# Restore the original feedprofile
par(feedprofile_2)
```




```
describe('mu')
```

```
Cell specific growth rate variable : 0.15 [ 1/h ]
```

```
describe('parts')
```