BPL_TEST2_Fedbatch - demo

This notebook just produce the Figure 2 in the paper "Design ideas behind Bioprocess Library for Modelica", by J P Axelsson, presented in the 15th International Modelica Conference in Aachen, Germany, October 9-11, 2023.

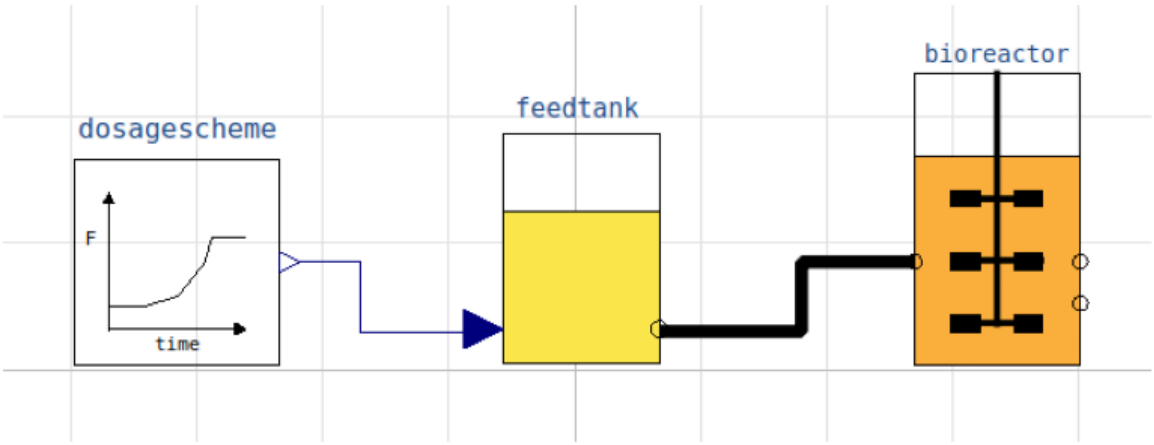
Unfortunately the Linux FMU from OpenModelica does not work and therefore Windows FMU from JModelica is used. Thus Google Colab cannot run the example.

In [1]:
```
run -i BPL_TEST2_Fedbatch_explore.py
```

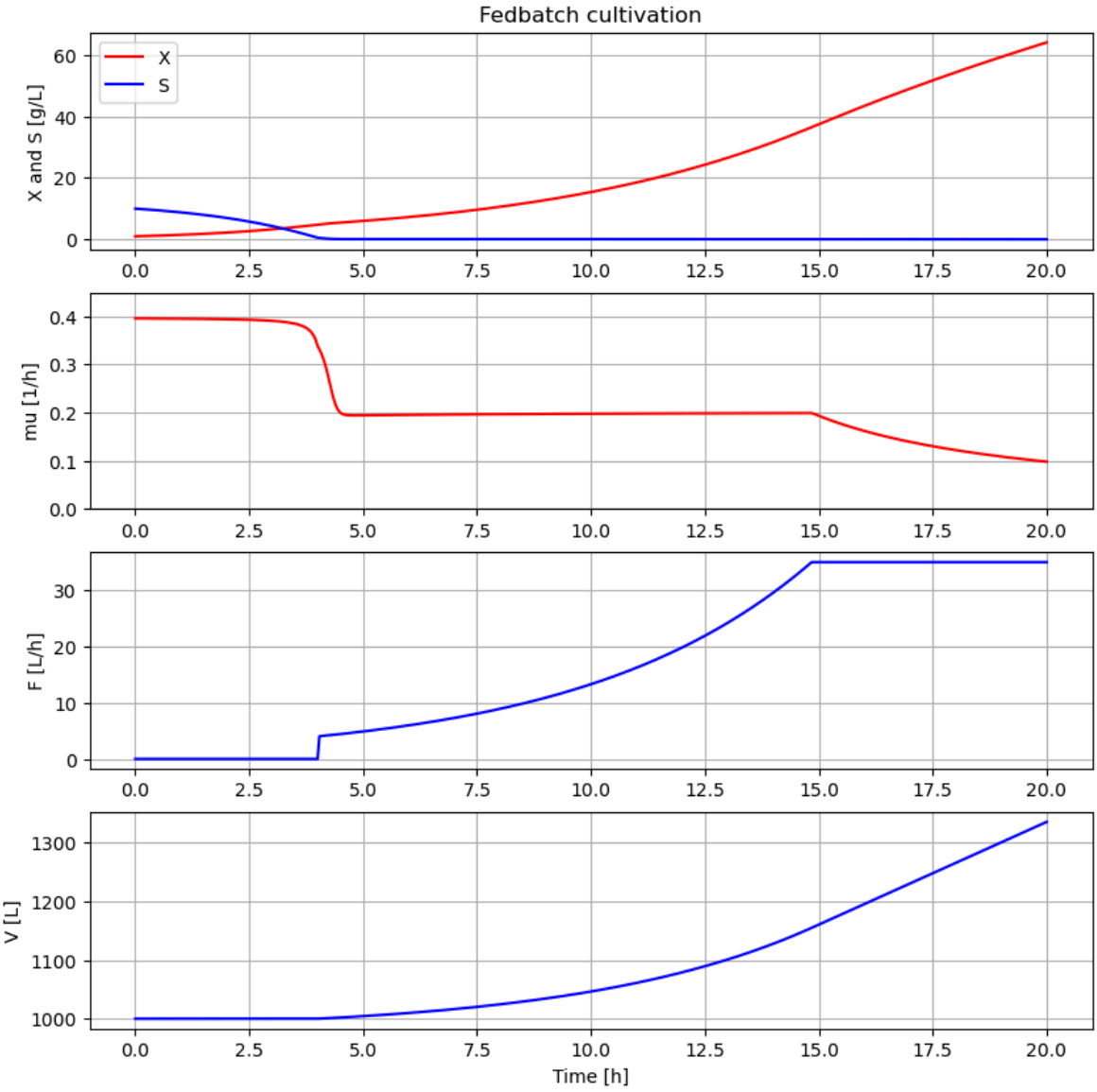
```
Windows - run FMU pre-compiled JModelica 2.14

Model for bioreactor 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 simulation
 - describe()  - describe culture, broth, parameters, variables with values/units

Note that both disp() and describe() takes values from the last simulation
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()
```

In [2]:
```
%matplotlib inline
plt.rcParams['figure.figsize'] = [25/2.54, 25/2.54]
```

In [3]:
```
process_diagram()
```



In [4]:
```
# Simulation with default values of the process
newplot(plotType='TimeSeries')
ax2.set_ylim([0, 0.45])
init(V_0=1000, VX_0=1*1e3, VS_0=10*1e3)
par(feedtank_S_in=600, Ks=0.1, Y=0.40)
par(t_start=4, F_start=4.0, mu_feed=0.2, F_max=35)
simu(20)
```



In [5]:
```
describe('mu')
```

```
Cell specific growth rate variable : 0.098 [ 1/h ]
```

In [6]:
```
describe('parts')
```

```
['bioreactor', 'bioreactor.culture', 'dosagescheme', 'feedtank', 'liquidphase',
'MSL']
```

In [7]:
```
describe('MSL')
```

```
MSL: RealInput, RealOutput
```

In [8]:
```
system_info()
```

```
System information
 -OS: Windows
 -Python: 3.12.8
 -Scipy: not installed in the notebook
 -PyFMI: 2.16.3
 -FMU by: JModelica.org
 -FMI: 2.0
 -Type: FMUModelCS2
 -Name: BPL_TEST2.Fedbatch
 -Generated: 2023-03-30T09:13:00
 -MSL: 3.2.2 build 3
 -Description: Bioprocess Library version 2.1.1
 -Interaction: FMU-explore version 0.9.8
```

In [ ]: