

▼ BPL_TEST2_Batch script with FMPy ver 0.3.15

The key library FMPy ver 0.3.15 is installed.

After the installation a small application BPL_TEST2_Batch is loaded and run. You can continue with this example if you like.

```
lslsb_release -a # Actual VM Ubuntu version used by Google

No LSB modules are available.
Distributor ID: Ubuntu
Description:    Ubuntu 20.04.5 LTS
Release:        20.04
Codename:       focal

%env PYTHONPATH=

env: PYTHONPATH=

!wget https://repo.anaconda.com/miniconda/Miniconda3-py38_22.11.1-1-Linux-x86_64.sh
!chmod +x Miniconda3-py38_22.11.1-1-Linux-x86_64.sh
!bash ./Miniconda3-py38_22.11.1-1-Linux-x86_64.sh -b -f -p /usr/local
import sys
sys.path.append('/usr/local/lib/python3.8/site-packages/')

--2023-04-20 09:18:33--  https://repo.anaconda.com/miniconda/Miniconda3-py38_22.11.1-1-Linux-x86_64.sh
Resolving repo.anaconda.com (repo.anaconda.com)... 104.16.130.3, 104.16.131.3, 2606:4700::6810:8203, ...
Connecting to repo.anaconda.com (repo.anaconda.com)|104.16.130.3|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 64630241 (62M) [application/x-sh]
Saving to: 'Miniconda3-py38_22.11.1-1-Linux-x86_64.sh'

Miniconda3-py38_22. 100%[=====] 61.64M  188MB/s   in 0.3s

2023-04-20 09:18:33 (188 MB/s) - 'Miniconda3-py38_22.11.1-1-Linux-x86_64.sh' saved [64630241/64630241]

PREFIX=/usr/local
Unpacking payload ...

Installing base environment...

Downloading and Extracting Packages

Downloading and Extracting Packages

Preparing transaction: done
Executing transaction: done
installation finished.

!conda update -n base -c defaults conda --yes

Collecting package metadata (current_repodata.json): done
Solving environment: done

## Package Plan ##

environment location: /usr/local

added / updated specs:
- conda

The following packages will be downloaded:
```

package	build	
boltons-23.0.0	py38h06a4308_0	426 KB
ca-certificates-2023.01.10	h06a4308_0	120 KB
conda-23.3.1	py38h06a4308_0	960 KB
conda-package-handling-2.0.2	py38h06a4308_0	267 KB
conda-package-streaming-0.7.0	py38h06a4308_0	26 KB
cryptography-39.0.1	py38h9cele76_0	1.4 MB
jsonpatch-1.32	pyhd3eb1b0_0	15 KB
jsonpointer-2.1	pyhd3eb1b0_0	9 KB
ncurses-6.4	h6a678d5_0	914 KB
openssl-1.1.1t	h7f8727e_0	3.7 MB
packaging-23.0	py38h06a4308_0	68 KB
pyopenssl-23.0.0	py38h06a4308_0	96 KB
requests-2.28.1	py38h06a4308_1	99 KB
sqlite-3.41.2	h5eee18b_0	1.2 MB
tqdm-4.65.0	py38hb070fc8_0	131 KB
urllib3-1.26.15	py38h06a4308_0	197 KB

xz-5.2.10		h5eee18b_1	429 KB
zstandard-0.19.0		py38h5eee18b_0	474 KB

Total:			10.5 MB

The following NEW packages will be INSTALLED:

boltons	pkgs/main/linux-64::boltons-23.0.0-py38h06a4308_0
conda-package-streaming	pkgs/main/linux-64::conda-package-streaming-0.7.0-py38h06a4308_0
jsonpatch	pkgs/main/noarch::jsonpatch-1.32-pyhd3eb1b0_0
jsonpointer	pkgs/main/noarch::jsonpointer-2.1-pyhd3eb1b0_0
packaging	pkgs/main/linux-64::packaging-23.0-py38h06a4308_0
zstandard	pkgs/main/linux-64::zstandard-0.19.0-py38h5eee18b_0

The following packages will be UPDATED:

ca-certificates	2022.10.11-h06a4308_0 --> 2023.01.10-h06a4308_0
conda	22.11.1-py38h06a4308_4 --> 23.3.1-py38h06a4308_0
conda-package-handling	1.9.0-py38h5eee18b_1 --> 2.0.2-py38h06a4308_0
cryptography	38.0.1-py38h9ce1e76_0 --> 39.0.1-py38h9ce1e76_0
ncurses	6.3-h5eee18b_3 --> 6.4-h6a678d5_0
openssl	1.1.1s-h7f8727e_0 --> 1.1.1t-h7f8727e_0
pyopenssl	pkgs/main/noarch::pyopenssl-22.0.0-py~ --> pkgs/main/linux-64::pyopenssl-23.0.0-py38h06a4308_0
requests	2.28.1-py38h06a4308_0 --> 2.28.1-py38h06a4308_1
sqlite	3.40.0-h5082296_0 --> 3.41.2-h5eee18b_0
tqdm	4.64.1-py38h06a4308_0 --> 4.65.0-py38hb070fc8_0
urllib3	1.26.13-py38h06a4308_0 --> 1.26.15-py38h06a4308_0

```
!conda --version
!python --version
```

```
conda 23.3.1
Python 3.8.15
```

```
!conda install -c conda-forge fmpy --yes # Install the key package
```

```
Preparing transaction: done  
Verifying transaction: done  
Executing transaction: done
```

```
!conda install matplotlib --yes
```

```
fonttools-4.25.0      | 632 KB      | : 100% 1.0/1 [00:00<00:00, 1.85it/s]
```

```
Preparing transaction: done  
Verifying transaction: done  
Executing transaction: done
```

```
#!conda install scipy --yes
```

```
#!conda install xlrd --yes
```

```
#!conda install openpyxl --yes
```

▼ BPL_TEST2_Batch setup

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

- FMU - BPL_TEST2_Batch_linux_om_me.fmu
- Setup-file - BPL_TEST2_Batch_fmpy_explore.py

```

%%bash
git clone https://github.com/janpeter19/BPL_TEST2_Batch

    Cloning into 'BPL_TEST2_Batch'...

%cd BPL_TEST2_Batch

    /content/BPL_TEST2_Batch

run -i BPL_TEST2_Batch_fmpy_explore.py

Linux - run FMU pre-compiled OpenModelica 1.21.x

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

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_Batch - demo

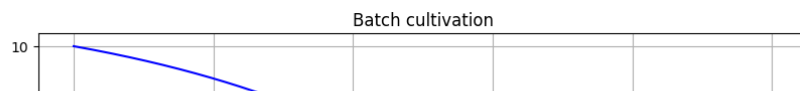
```

describe('culture'); print(); #describe('liquidphase')                                # Pump schedule parameter

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

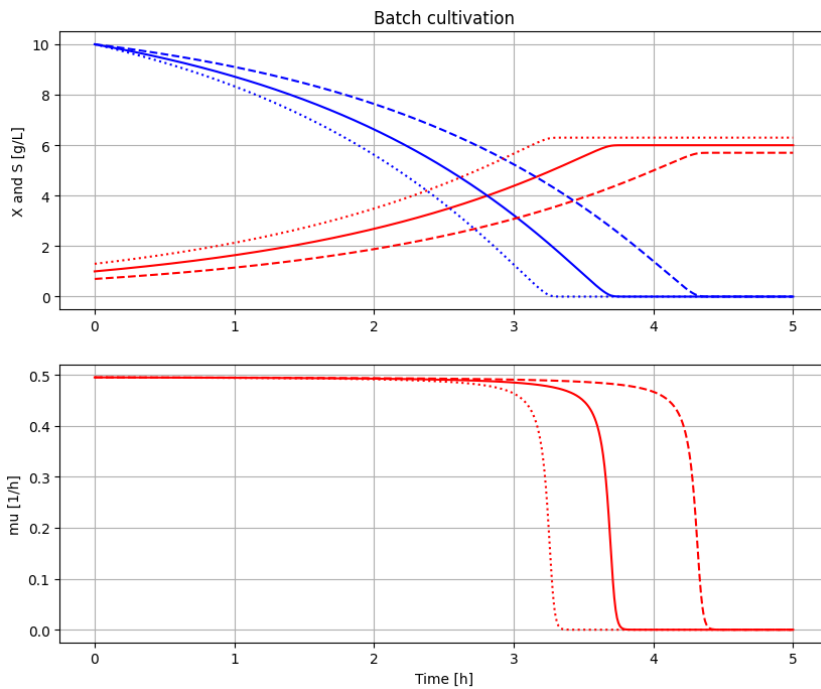
# Simulation with default values of the process
newplot(plotType='TimeSeries')
simu()

```



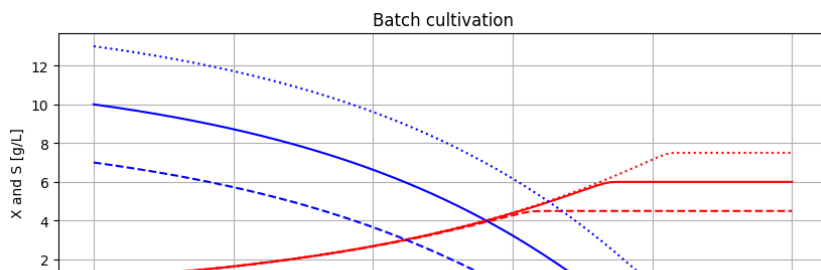
```
# Simulation were initial value of biomass VX_0 is varied
newplot(plotType='TimeSeries')
for value in [1.0, 0.7, 1.3]: init(VX_0=value); simu(5)

# Restore default value of VX_0
init(VX_0=1.0)
```



```
# Simulation were initial value of substrate VS_0 is varied
newplot(plotType='TimeSeries')
for value in [10, 7, 13]: init(VS_0=value); simu(5)

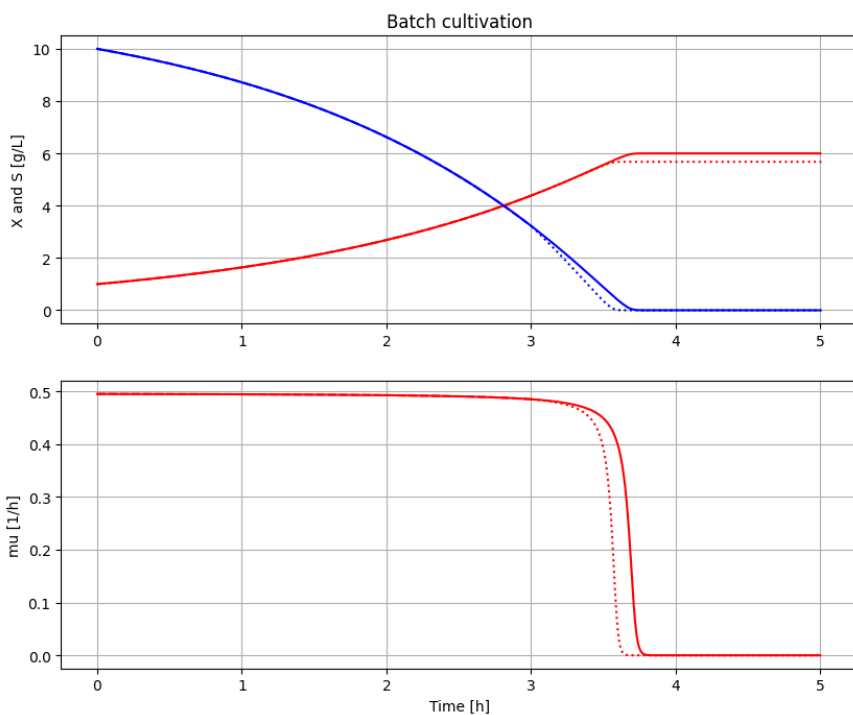
# Restore default value of VS_0
init(VS_0=10)
```



```
# Simulation where metabolism is changed after 3 hours
newplot(plotType='TimeSeries')
simu(5)
```

```
simu(3)
par(Y=0.4, qSmax=1.0/(0.4/0.5)); simu(2, 'cont')
```

```
# Restore default value of Y and qSmax
par(Y=0.5, qSmax=1.0)
```



```
disp('culture')
```

```
Y : 0.4
qSmax : 1.25
Ks : 0.1
```

```
# Growth rate variable at the end of the cultivation
describe('mu')
```

```
Cell specific growth rate variable : -0.0 [ 1/h ]
```

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

```
['bioreactor', 'bioreactor.culture']
```

```
describe('MSL')
```

```
MSL: 3.2.3 - used components: none
```

```
system_info()
```

System information

-OS: Linux
-Python: 3.9.16
-Scipy: not installed in the notebook
-FMPy: 0.3.15
-FMU by: OpenModelica Compiler OpenModelica 1.21.0
-FMI: 2.0
-Type: ME
-Name: BPL_TEST2.Batch
-Generated: 2023-04-19T18:37:26Z
-MSL: 3.2.3
-Description: Bioprocess Library version 2.1.1
-Interaction: FMU-explore for FMPy version 0.9.7

✓ 0s completed at 11:24

