

MNPoolWithDescendingCommand

Julius C. F. Schulz

January 29, 2017

This notebook is a simulation of 5000 ms of 400 independent descending commands following a gamma distribution with mean of 12 ms and order 10 and the Soleus muscle (800 motoneurons). Each descending command connects to approximately 30 % of the motor units.

Input #1

```
import sys
sys.path.insert(0, '..')
import time
import matplotlib.pyplot as plt
%matplotlib inline
import numpy as np

from Configuration import Configuration
from MotorUnitPool import MotorUnitPool
from NeuralTract import NeuralTract
from SynapsesFactory import SynapsesFactory
```

Input #2

```
conf = Configuration('confMNPoolWithDescendingCommand.rmto')
conf.simDuration_ms = 5000 # Here I change simulation duration without changing the Configur
```

Input #3

```
pools = dict()
pools[0] = MotorUnitPool(conf, 'SOL')
pools[1] = NeuralTract(conf, 'CMExt')
Syn = SynapsesFactory(conf, pools)
del Syn
```

Output #3

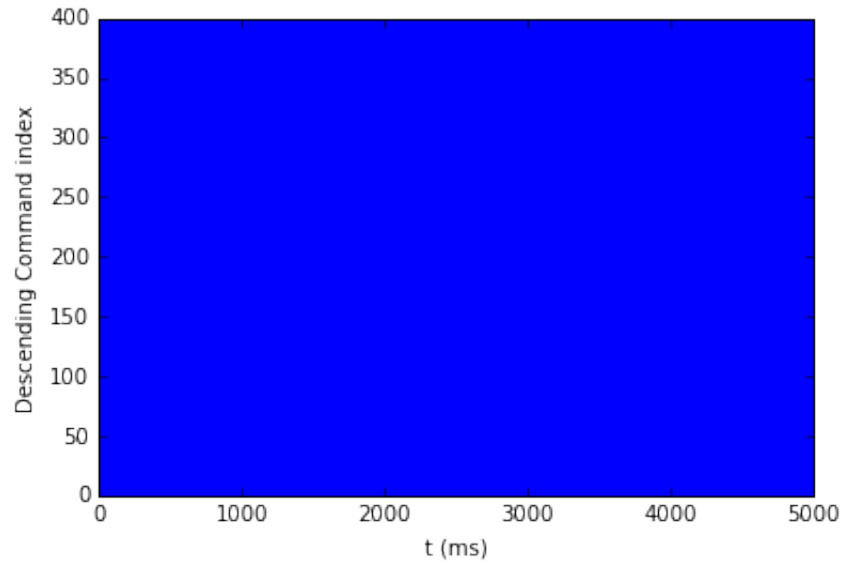
```
Motor Unit Pool SOL built
Descending Command CMExt built
All the 95788 synapses were built
```

Input #4

```
t = np.arange(0.0, conf.simDuration_ms, conf.timeStep_ms)
```

Input #5

```
dendV = np.zeros_like(t)
somaV = np.zeros_like(t)
```



Spike times of all descending commands along the 10000 ms of simulation.

```
tic = time.clock()
for i in xrange(0, len(t)-1):
    pools[1].atualizePool(t[i])
    pools[0].atualizeMotorUnitPool(t[i])
    dendV[i] = pools[0].unit[2].v_mV[0]
    somaV[i] = pools[0].unit[2].v_mV[1]
toc = time.clock()
print str(toc - tic) + ' seconds'
```

Output #5

10435.49023 seconds

The spike times of all descending commands along the 5000 ms of simulation is shown in Fig. ??.

Input #6

```
pools[0].listSpikes()
pools[1].listSpikes()
```

Input #7

```
plt.figure()
plt.plot(pools[1].poolTerminalSpikes[:, 0],
         pools[1].poolTerminalSpikes[:, 1]+1, '.')

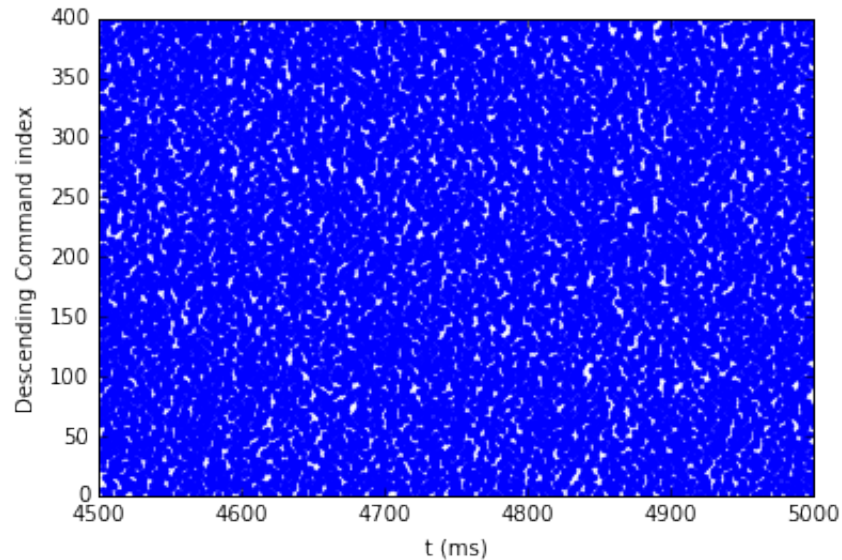
plt.xlabel('t (ms)')
plt.ylabel('Descending Command index')
```

Output #7

Out[7]: <matplotlib.text.Text at 0x7f2b628a4550>

The spike times of all descending commands along the last 500 ms of simulation is shown in Fig. ??.

Input #8



Spike times of all descending commands along the last 500 ms of simulation.

```
plt.figure()
plt.plot(pools[1].poolTerminalSpikes[pools[1].poolTerminalSpikes[:, 0]>4500, 0],
         pools[1].poolTerminalSpikes[pools[1].poolTerminalSpikes[:, 0]>4500, 1]+1, '.')
plt.xlabel('t (ms)')
plt.ylabel('Descending Command index')
```

Output #8

Out[8]: <matplotlib.text.Text at 0x7f2b62a6d2d0>

The spike times of the MNs along the 5000 ms of simulation is shown in Fig. ??.

Input #9

```
plt.figure()
plt.plot(pools[0].poolTerminalSpikes[:, 0],
         pools[0].poolTerminalSpikes[:, 1]+1, '.')
plt.xlabel('t (ms)')
plt.ylabel('Motor Unit index')
```

Output #9

Out[9]: <matplotlib.text.Text at 0x7f2b60b28210>

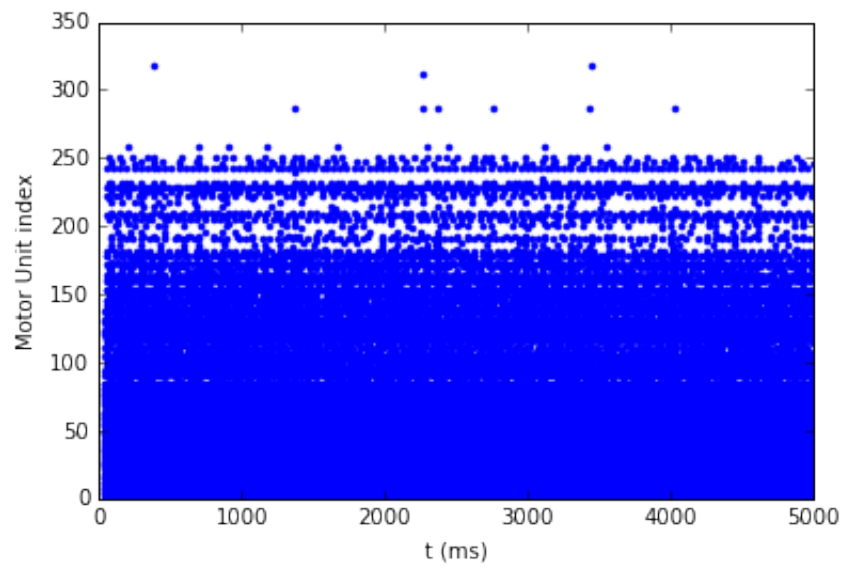
The spike times of the MNs along the last 500 ms of simulation is shown in Fig. ??.

Input #10

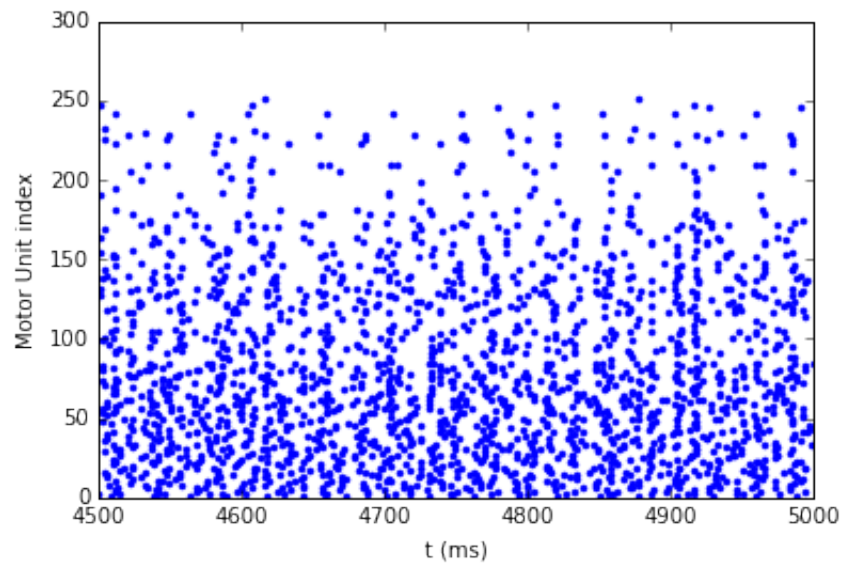
```
plt.figure()
plt.plot(pools[0].poolTerminalSpikes[pools[0].poolTerminalSpikes[:, 0]>4500, 0],
         pools[0].poolTerminalSpikes[pools[0].poolTerminalSpikes[:, 0]>4500, 1]+1, '.')
plt.xlabel('t (ms)')
plt.ylabel('Motor Unit index')
```

Output #10

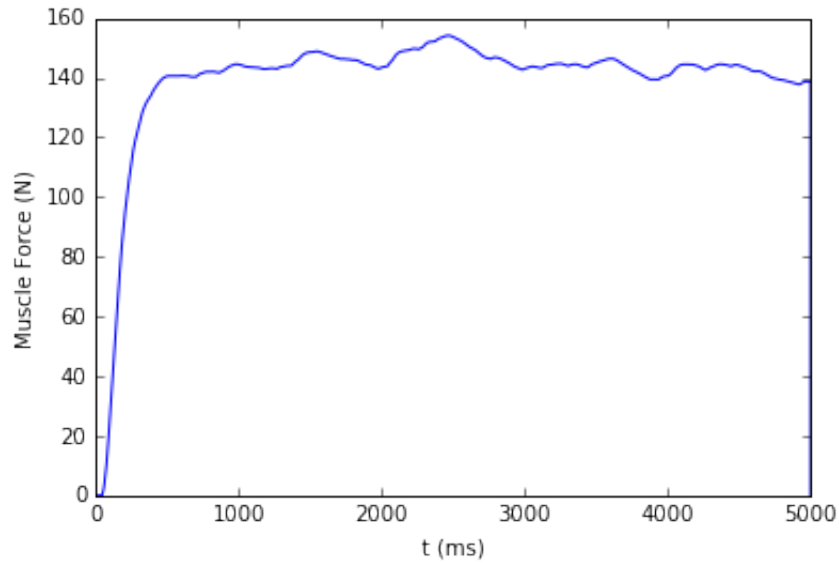
Out[10]: <matplotlib.text.Text at 0x7f2b602d9910>



Spike times of all motoneurons along the 5000 ms of simulation.



Spike times of all motoneurons along the last 500 ms of simulation.



Muscle force during the simulation

The muscle force during the simulation ??.

Input #11

```
plt.figure()
plt.plot(t, pools[0].Muscle.force, '-')
plt.xlabel('t (ms)')
plt.ylabel('Muscle Force (N)')
```

Output #11

Out[11]: <matplotlib.text.Text at 0x7f2b602d3cd0>

The membrane potential of the dendrite compartment is shown in Fig.??.

Input #12

```
plt.figure()
plt.plot(t, dendV, '-')
plt.xlabel('t (ms)')
plt.ylabel('Dendrite Membrane Potential (mV)')
```

Output #12

Out[12]: <matplotlib.text.Text at 0x7f2b60170b10>

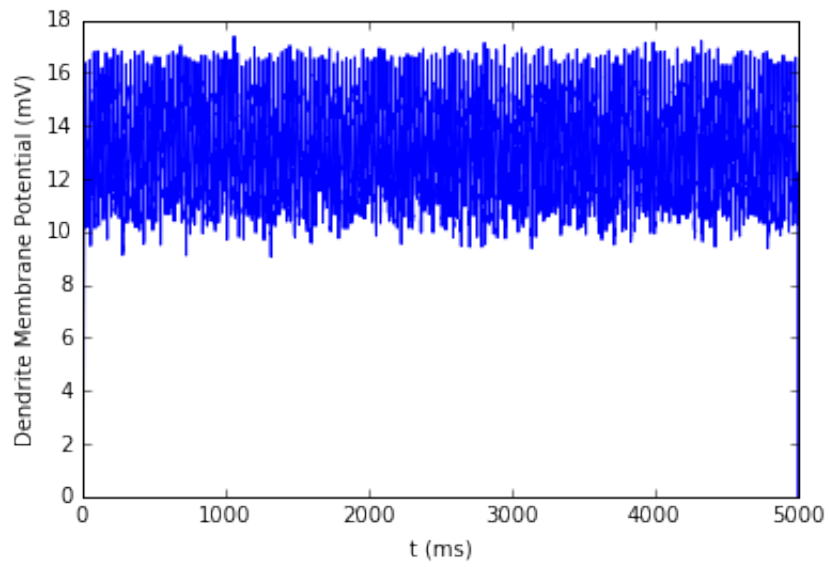
The membrane potential of the soma compartment is shown in Fig.??.

Input #13

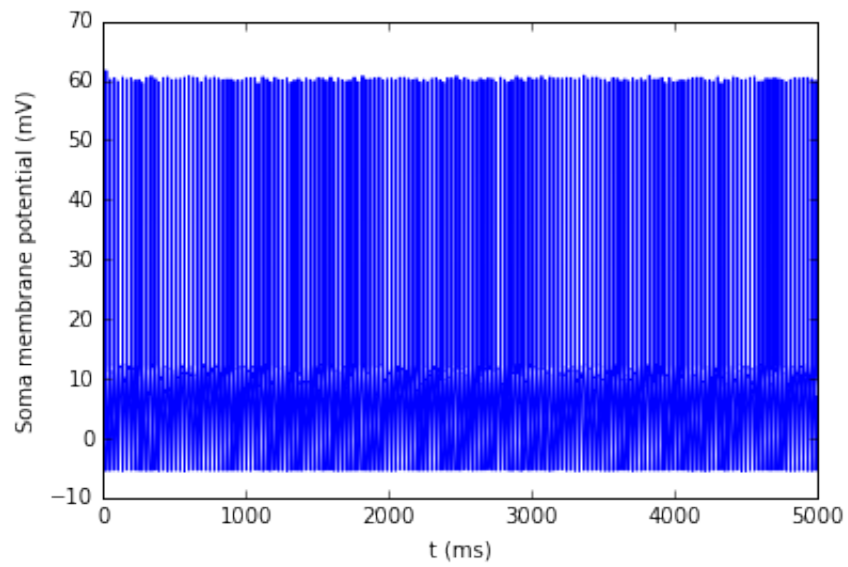
```
plt.figure()
plt.plot(t, somaV, '-')
plt.xlabel('t (ms)')
plt.ylabel('Soma membrane potential (mV)')
```

Output #13

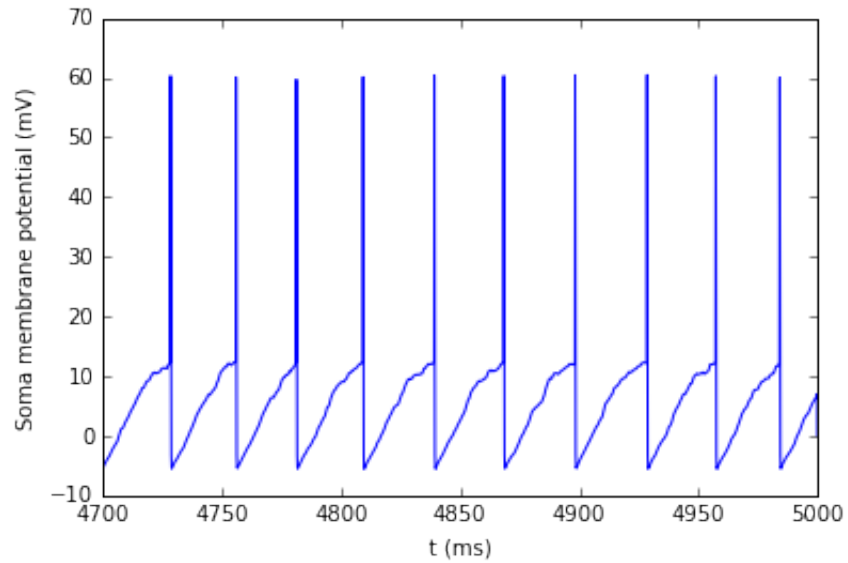
Out[13]: <matplotlib.text.Text at 0x7f2b6013f450>



The membrane potential of the dendrite compartment, in mV.



The membrane potential of the soma compartment, in mV.



The membrane potential of the soma compartment in the last 300 ms, in mV.

The membrane potential of the soma compartment in the last 300 ms is shown in Fig.??.

Input #14

```
plt.figure()
plt.plot(t[t>4700], somaV[t>4700], '-')
plt.xlabel('t (ms)')
plt.ylabel('Soma membrane potential (mV)')
```

Output #14

Out[14]: <matplotlib.text.Text at 0x7f2b5afc97d0>

Input #None