grid_scan

March 15, 2021

1 Grid scan and time series at the beamline

1.1 Load the name space of the beamtime

[1]:
```
# load the beamtime name space
%run -i 999-load2.py
```

```
/Users/sst/anaconda3/envs/test_xpdstack/lib/python3.8/site-
packages/databroker/v1.py:1602: UserWarning: Failed to load config. Falling back
to v0.Exception was: Unable to handle metadatastore.module
'databroker.headersource.sqlite'
  warnings.warn(
```

```
No config file could be found in the following locations:
/Users/sst/.config/acq
/Users/sst/anaconda3/envs/test_xpdstack/etc/acq
/etc/acq
Loading from packaged simulation configuration
INFO: Initializing the XPD data acquisition environment …
INFO: area detector has been configured to new acquisition time (time per frame)
= 0.1s
INFO: Reload beamtime objects:

ScanPlans:
0: ct_5
1: ct_0.1
2: ct_1
3: ct_10
4: ct_30
5: ct_60
6: Tramp_5_300_310_3

Samples:
0: Ni

{'Verification time': '2021-03-15 20:17:04', 'Verified by': 'st'}
```

```
Is this configuration correct? y/n:  y
Please input your initials:  st
```

```
INFO: beamtime object has been linked

INFO: Initialized glbl, bt, xrun.
INFO: Publish data to localhost port 5567 with prefix 'raw'.
INFO: Changed home to /Users/sst/acqsim/xpdUser
OK, ready to go.  To continue, follow the steps in the xpdAcqdocumentation at
http://xpdacq.github.io/xpdacq
```

1.2 Import the packages we need

[2]:
```python
import scanplans.planhelper as pth
import bluesky.plan_stubs as bps
import bluesky.plans as bp
import matplotlib.pyplot as plt
```

Here, I use some fake motors and a fake two dimensional detector.

[3]:
```python
# fake devices
from ophyd.sim import hw
HW = hw()
MOTORX = HW.motor1
MOTORY = HW.motor2
MOTORPHI = HW.motor3
DETECTOR = xpd_configuration['area_det']
```

1.3 Set the exposure time

[4]:
```python
plan = pth.configure_area_det(DETECTOR, 0.1, 0.1)
xrun({}, plan)
```

```
INFO: requested exposure time = 0.1 - > computed exposure time= 0.1
```

[4]: ()

1.4 Grid scan

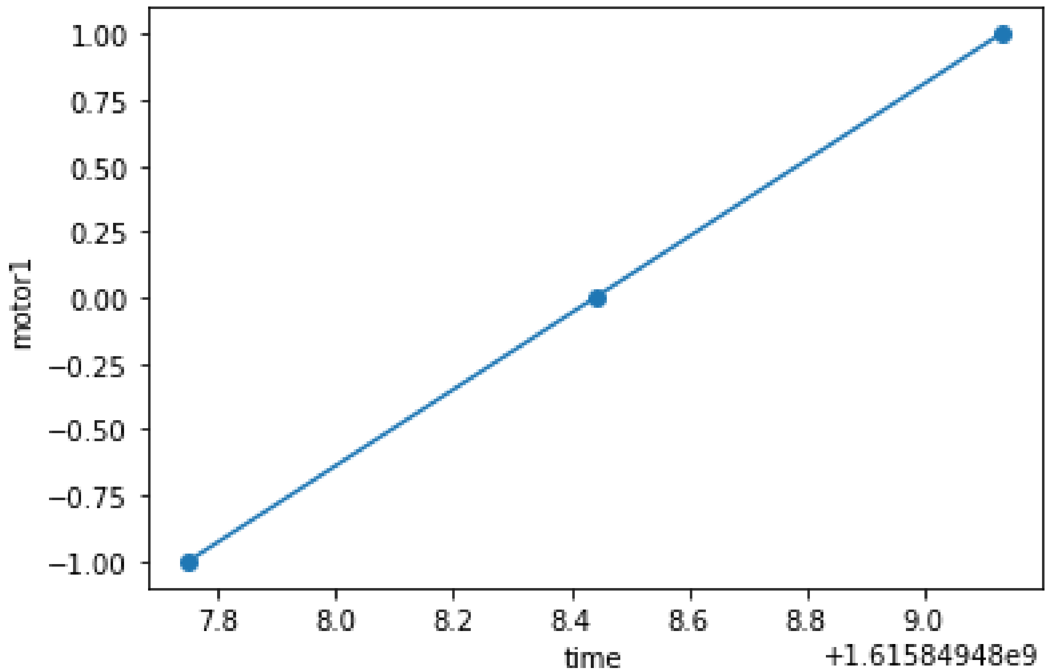
1.4.1 A one dimensional scan

[5]:
```
plan5 = pth.xpdacq_grid_scan([DETECTOR], MOTORX, -1, 1, 3)
uids5 = xrun(0, plan5)
```

```
INFO: closing shutter…
INFO: taking dark frame…
INFO: This scan will append calibration parameters recorded in
/Users/sst/acqsim/xpdUser/config_base/xpdAcq_calib_info.poni
INFO: Current filter status
INFO: flt1 : In
INFO: flt2 : Out
INFO: flt3 : Out
INFO: flt4 : Out
dark frame complete, update dark dict
opening shutter…
INFO: This scan will append calibration parameters recorded in
/Users/sst/acqsim/xpdUser/config_base/xpdAcq_calib_info.poni
INFO: Current filter status
INFO: flt1 : In
INFO: flt2 : Out
INFO: flt3 : Out
INFO: flt4 : Out
```

1.4.2 Visualize the motor position and images in a scan

[6]:
```
data = db[uids5[-1]].primary.read()
data["motor1"].plot(x="time", marker="o")
plt.show()
```



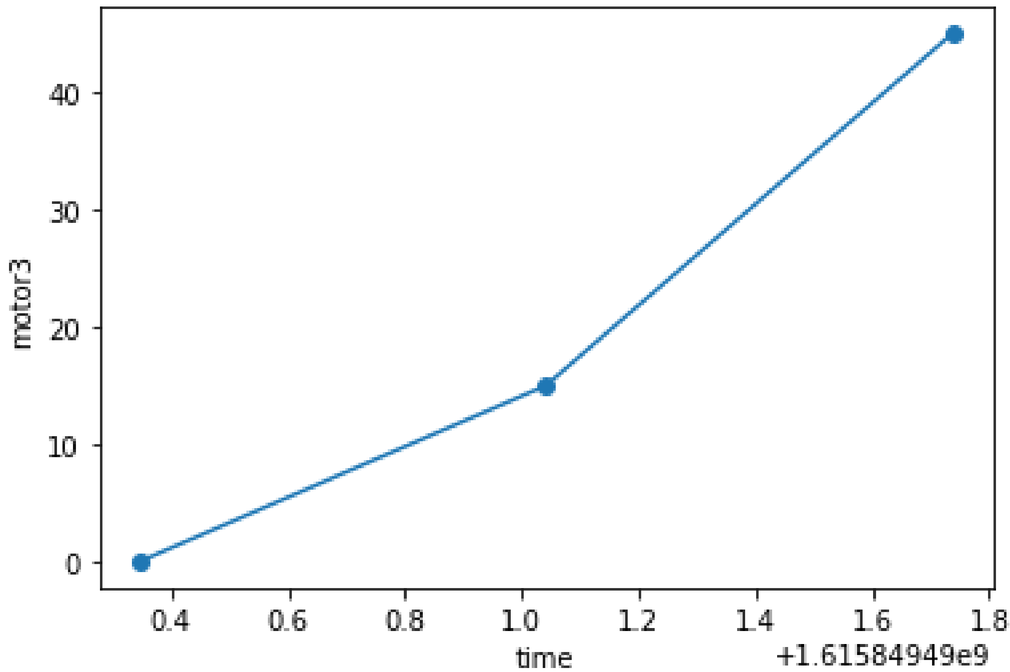
1.4.3 A one dimensional grid list scan

[7]:
```
plan7 = pth.xpdacq_list_grid_scan([DETECTOR], MOTORPHI, [0, 15, 45])
uids7 = xrun(0, plan7)
```

```
INFO: This scan will append calibration parameters recorded in
/Users/sst/acqsim/xpdUser/config_base/xpdAcq_calib_info.poni
INFO: Current filter status
INFO: flt1 : In
INFO: flt2 : Out
INFO: flt3 : Out
INFO: flt4 : Out
```

1.4.4 Visualize the position of the motor

[8]:
```
data = db[uids7[-1]].primary.read()
data["motor3"].plot(x="time", marker="o")
plt.show()
```



1.4.5 A two dimensional grid scan

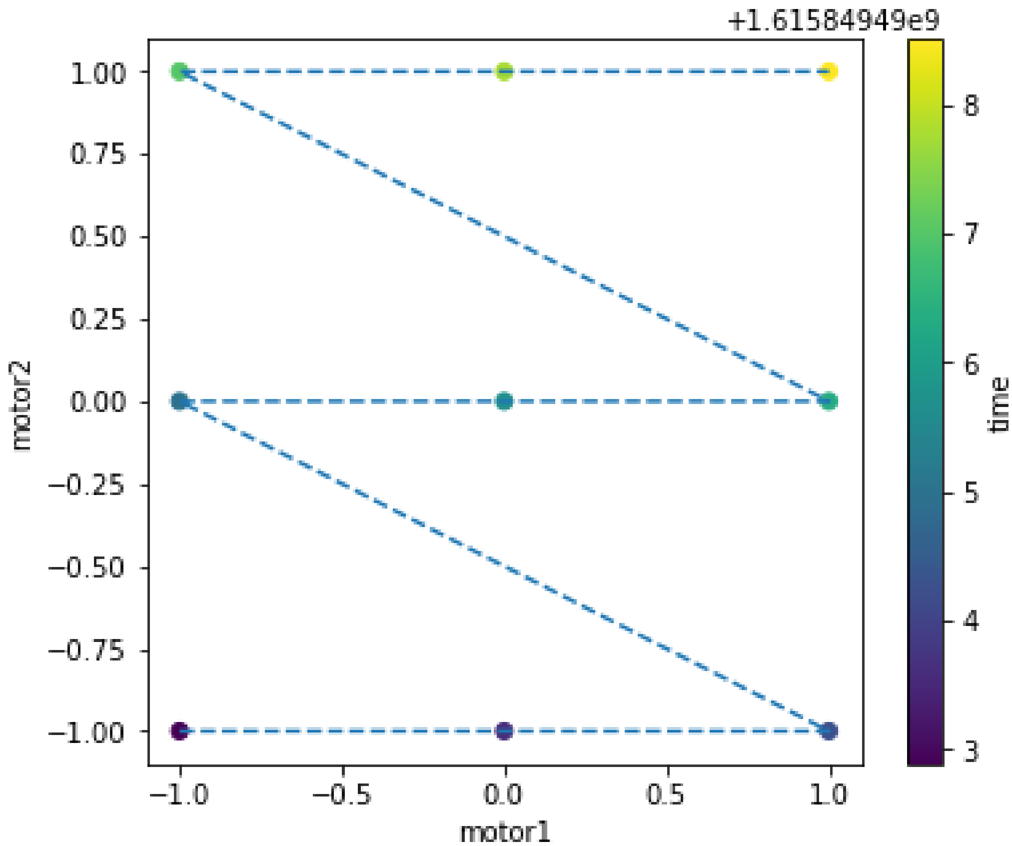
We scan the sample by moving the MOTORX and MOTORY. The MOTORX and MOTORY will move from -1 to 1 and 3 points will be measured on the grid so there are 3 * 3 images in total.

[9]:
```
plan0 = pth.xpdacq_grid_scan([DETECTOR], MOTORY, -1, 1, 3, MOTORX, -1, 1, 3)
uids0 = xrun(0, plan0)
```

```
INFO: This scan will append calibration parameters recorded in
/Users/sst/acqsim/xpdUser/config_base/xpdAcq_calib_info.poni
INFO: Current filter status
INFO: flt1 : In
INFO: flt2 : Out
INFO: flt3 : Out
INFO: flt4 : Out
```

1.4.6 Visualize the motor movement in a grid scan

[10]:
```
data = db[uids0[-1]].primary.read()
data.plot.scatter("motor1", "motor2", hue="time", size=5, aspect=1.2)
plt.plot(data["motor1"], data["motor2"], '--')
plt.show()
```



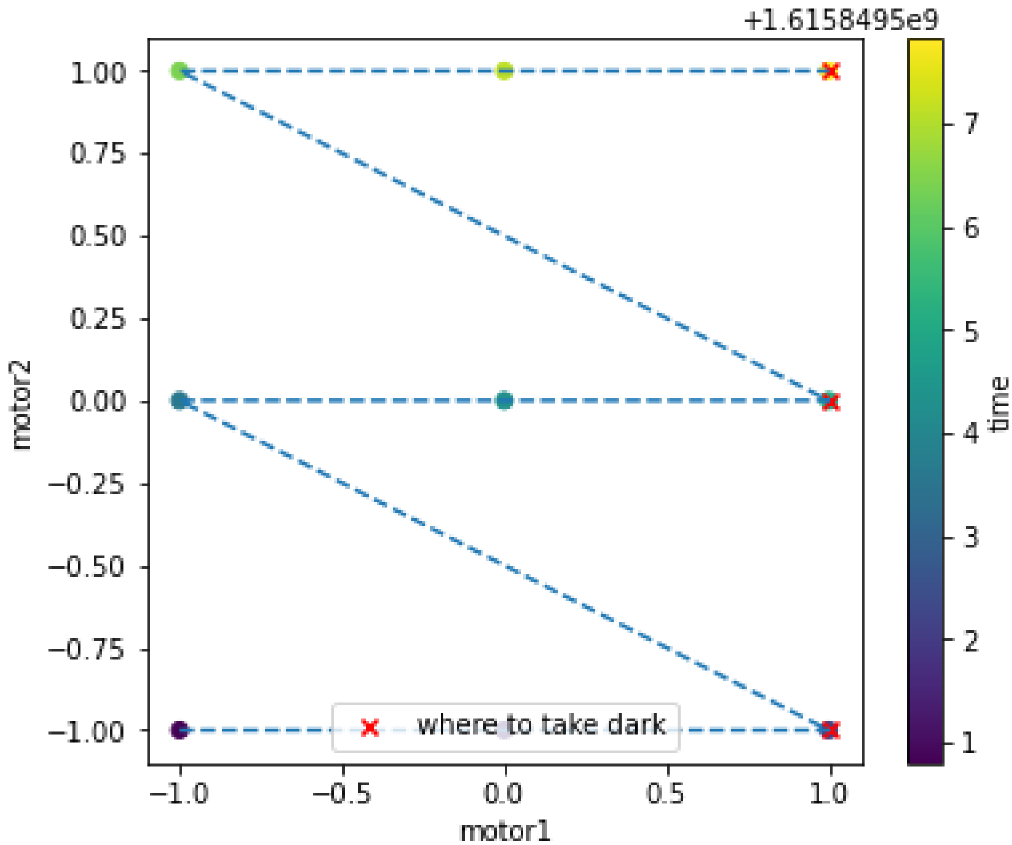
1.4.7 A two dimensional scan where a dark is taken at the point that the slow motor changes its position

[11]:
```
plan6 = pth.xpdacq_grid_scan_with_dark([DETECTOR], MOTORY, -1, 1, 3, MOTORX,␣
 ↪-1, 1, 3)
uids6 = xrun({}, plan6)
```

```
INFO: This scan will append calibration parameters recorded in
/Users/sst/acqsim/xpdUser/config_base/xpdAcq_calib_info.poni
INFO: Current filter status
INFO: flt1 : In
INFO: flt2 : Out
INFO: flt3 : Out
INFO: flt4 : Out
```

1.4.8 Visualize the motor movement and where the dark is taken

[12]:
```
data = db[uids6[-1]].primary.read()
darkData =db[uids6[-1]].dark.read()
facet = data.plot.scatter("motor1", "motor2", hue="time", size=5, aspect=1.2)
facet.axes.scatter(darkData["motor1"], darkData["motor2"], marker="x", c="r",␣
 ↪label="where to take dark")
facet.axes.legend()
plt.plot(data["motor1"], data["motor2"], '--')
plt.show()
```



1.4.9 A two dimensional snake scan

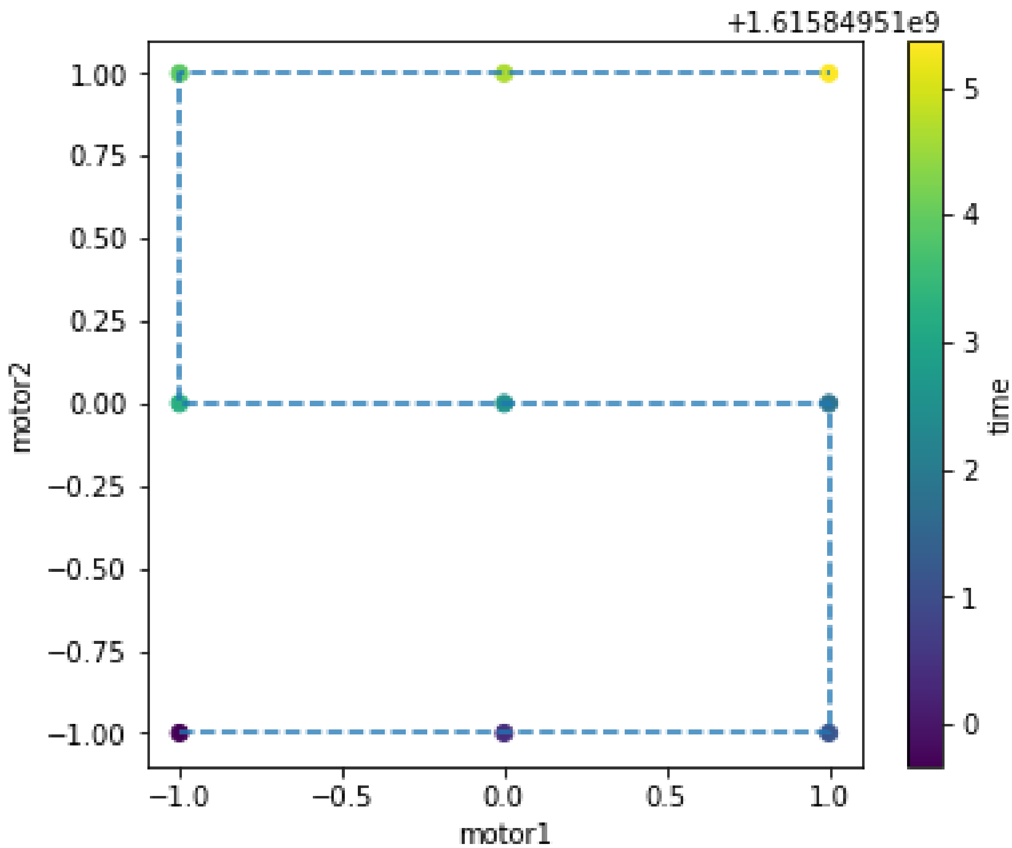
[13]:
```
plan1 = pth.xpdacq_grid_scan([DETECTOR], MOTORY, -1, 1, 3, MOTORX, -1, 1, 3,␣
 ↪snake_axes=True)
uids1 = xrun(0, plan1)
```

```
INFO: This scan will append calibration parameters recorded in
/Users/sst/acqsim/xpdUser/config_base/xpdAcq_calib_info.poni
```

```
INFO: Current filter status
INFO: flt1 : In
INFO: flt2 : Out
INFO: flt3 : Out
INFO: flt4 : Out
```

1.4.10 Visualize the motor movement in a snake scan

[14]:
```
data = db[uids1[-1]].primary.read()
data.plot.scatter("motor1", "motor2", hue="time", size=5, aspect=1.2)
plt.plot(data["motor1"], data["motor2"], '--')
plt.show()
```



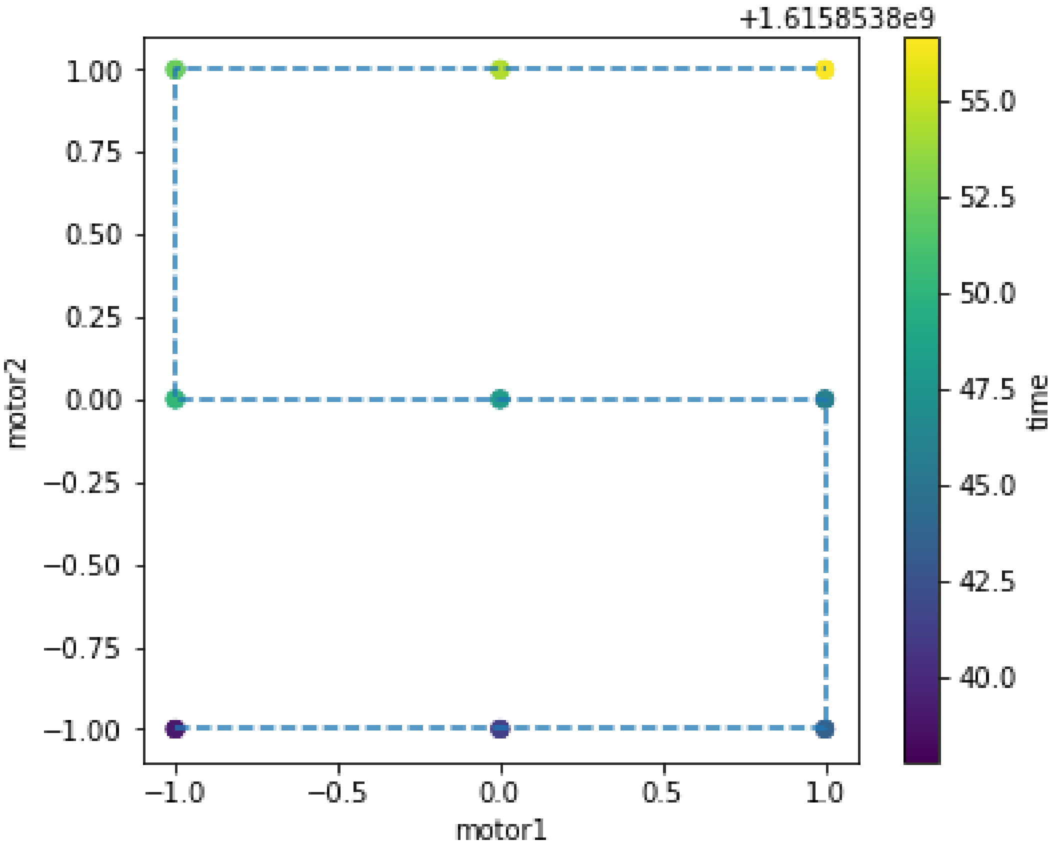
1.4.11 A three dimension scan

[4]:
```
plan2 = pth.xpdacq_grid_scan([DETECTOR], MOTORY, -1, 1, 3, MOTORX, -1, 1, 3,␣
 ↪MOTORPHI, -30, 30, 3, snake_axes=[MOTORX])
uids2 = xrun(0, plan2)
```

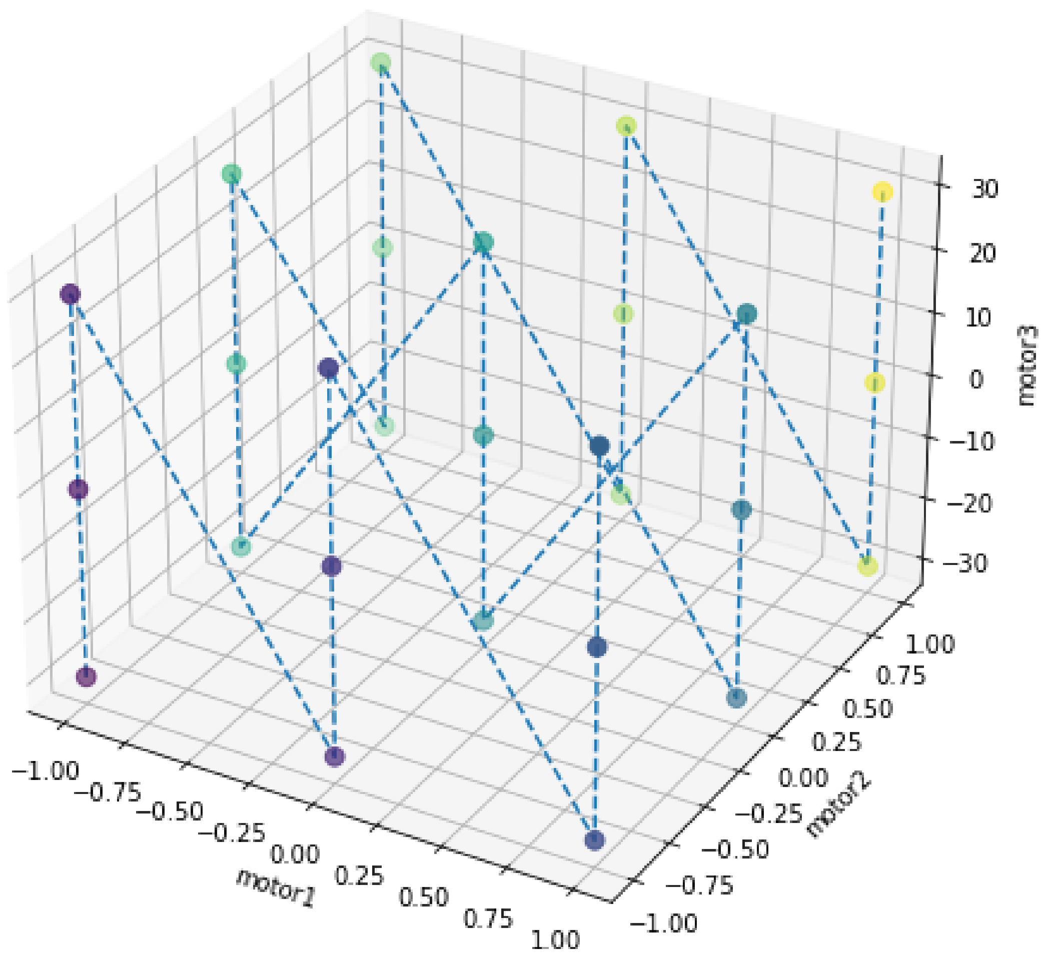
```
INFO: closing shutter…
INFO: taking dark frame…
INFO: This scan will append calibration parameters recorded in
/Users/sst/acqsim/xpdUser/config_base/xpdAcq_calib_info.poni
INFO: Current filter status
INFO: flt1 : In
INFO: flt2 : Out
INFO: flt3 : Out
INFO: flt4 : Out
dark frame complete, update dark dict
opening shutter…
INFO: This scan will append calibration parameters recorded in
/Users/sst/acqsim/xpdUser/config_base/xpdAcq_calib_info.poni
INFO: Current filter status
INFO: flt1 : In
INFO: flt2 : Out
INFO: flt3 : Out
INFO: flt4 : Out
```

1.4.12 Visualize the motor movement

[8]:
```
data = db[uids2[-1]].primary.read()
data.plot.scatter("motor1", "motor2", hue="time", size=5, aspect=1.2)
plt.plot(data["motor1"], data["motor2"], '--')
plt.show()
```



[9]:
```
fig = plt.figure(figsize=(8, 8))
ax = plt.axes(projection='3d')
ax.plot3D(data["motor1"], data["motor2"], data["motor3"], '--')
scatter = ax.scatter3D(data["motor1"], data["motor2"], data["motor3"],␣
 ↪c=data["time"], s=60)
ax.set_xlabel('motor1')
ax.set_ylabel('motor2')
ax.set_zlabel('motor3')
plt.show()
```



1.5 Time series

1.5.1 Configure the velocity of a motor

[18]:
```
plan = bps.mv(MOTORPHI.velocity, 10)
xrun({}, plan)
```

[18]: ()

1.5.2 A helper function to calculate the time and positions in a fly scan

[19]:
```
velocity = pth.calc_velocity(start=0, end=30, exposure=10, num=2)
plan = bps.mv(MOTORPHI.velocity, velocity)
xrun({}, plan)
```

[19]:
```
()
```

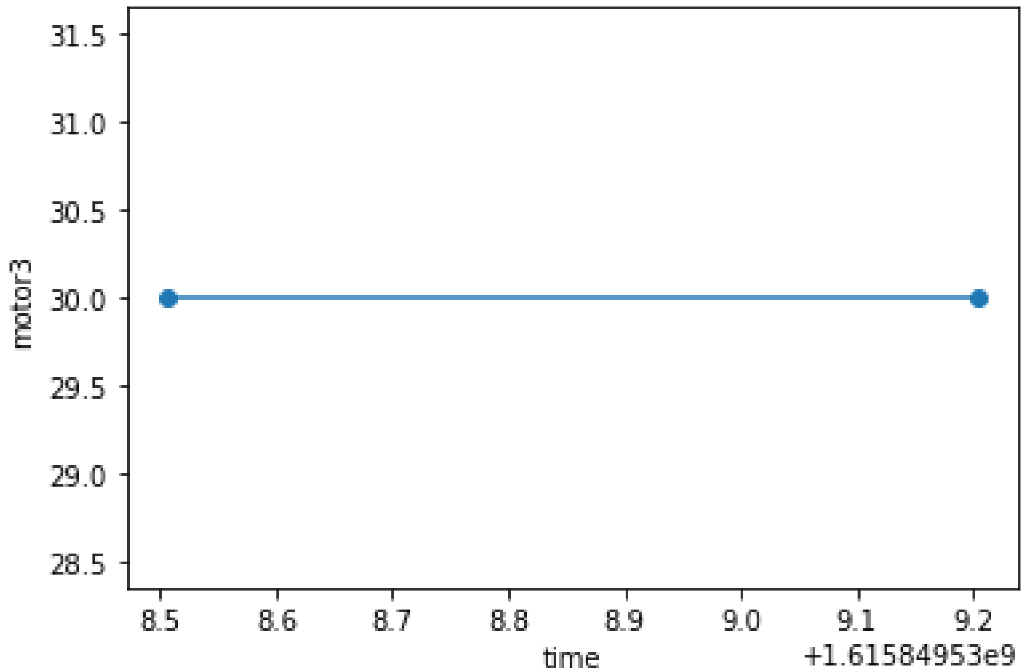
1.5.3 A time series of one detector and one motor (use ramp plan)

[20]:
```
# move the motor to 30, trigger and read dectector until it finishes
plan3 = pth.xpdacq_ramp_count([DETECTOR, MOTORPHI], MOTORPHI, 30)
uids3 = xrun(0, plan3)
```

```
INFO: This scan will append calibration parameters recorded in
/Users/sst/acqsim/xpdUser/config_base/xpdAcq_calib_info.poni
INFO: Current filter status
INFO: flt1 : In
INFO: flt2 : Out
INFO: flt3 : Out
INFO: flt4 : Out
```

1.5.4 Visualize the data

[21]:
```
data = db[uids3[-1]].primary.read()
data["motor3"].plot(x="time", marker='o')
plt.show()
```



1.5.5 A time series (use set and count)

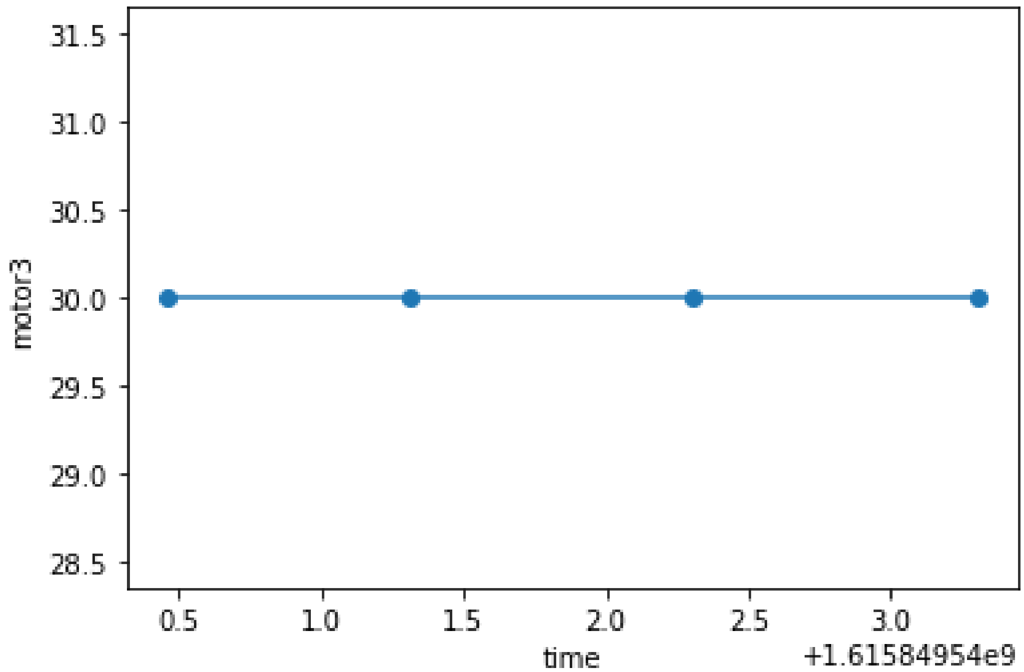
[22]:
```
# move the motor to 30 and trigger and read dectector for 4 times in total and␣
↪the period between the start of each trigger is 1 s.
plan4 = [bps.abs_set(MOTORPHI, 30, wait=False), pth.xpdacq_count([DETECTOR,␣
↪MOTORPHI], 4, 1)]
uids4 = xrun(0, plan4)
```

```
INFO: This scan will append calibration parameters recorded in
/Users/sst/acqsim/xpdUser/config_base/xpdAcq_calib_info.poni
INFO: Current filter status
INFO: flt1 : In
INFO: flt2 : Out
INFO: flt3 : Out
INFO: flt4 : Out
```

1.5.6 Time series of the motor position

[23]:
```
data = db[uids4[-1]].primary.read()
data["motor3"].plot(x="time", marker='o')
```

[23]: `[<matplotlib.lines.Line2D at 0x7ffb9a1b0a30>]`



1.6 Visualization of images

Visualize the image in an array using the jupyter widget.

[12]:
```
data = db[uids2[-1]].primary.read()


def visImage(index, **kwargs):
    data["pe1_image"][index].plot.imshow(aspect=1.2, size=5, **kwargs)
    plt.show()
```

[22]:
```
from ipywidgets import interact

interface = interact(visImage, index=(0, 26), vmax=(0., 3e4), vmin=(0., 3e4))
```

```
interactive(children=(IntSlider(value=13, description='index', max=26), FloatSlider(value=1500(
```

[ ]:
```
```