probeinterface

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CONTENTS

`probeinterface` is Python package to handle probe layout, geometry and wiring to device for neuroscience experiments.

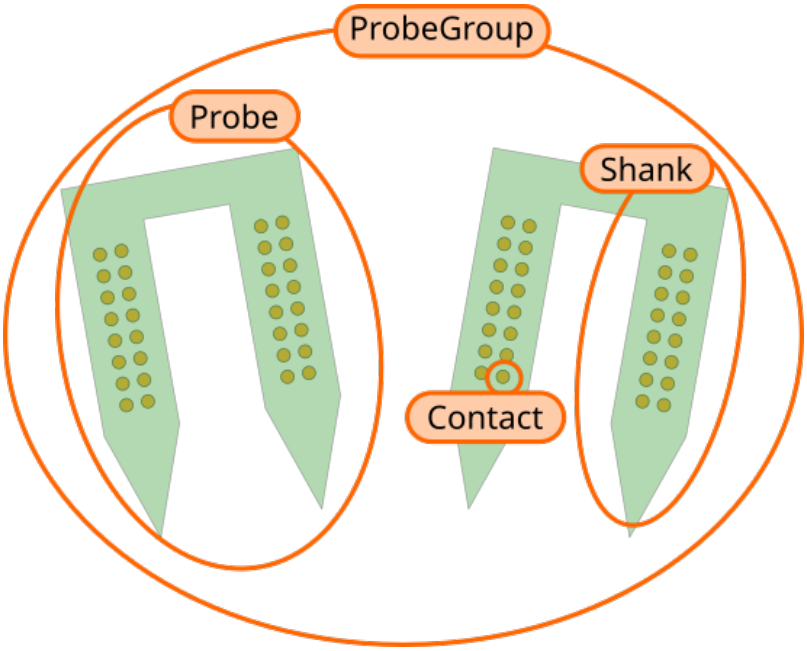
The package handles the following items:

- probe geometry (2D or 3D layout)
- probe shape (contour of the probe)
- shape and size of the s
- probe wiring to the recording device
- combination of several probes: global geometry + global wiring

The `probeinterface` package also provide:

- basic plotting functions with matplotlib
- input/output functions to several formats (PRB, NWB, CSV, MEArec, SpikeGLX, ...)

Here a schema for the naming used in the package:



orphan

CHAPTER

ONE

EXAMPLES

Start here with a tutorial showing probeinterface.

1.1 Generate a Probe from scratch

This example generates a probe from scratch.

```
import numpy as np
import matplotlib.pyplot as plt

from probeinterface import Probe
from probeinterface.plotting import plot_probe
```

First, let's create dummy positions for a 32-contact probe

```
n = 24
positions = np.zeros((n, 2))
for i in range(n):
    x = i // 8
    y = i % 8
    positions[i] = x, y
positions *= 20
positions[8:16, 1] -= 10
```

Now we can create a *Probe* object and set the position and shape of each contact

The *ndim* argument indicates that the contact is 2d, so the positions have a (n_elec, 2) shape. We can also define 3d probe with *ndim=3* and positions will have a (n_elec, 3) shape.

Note: *shapes* and *shape_params* could be arrays as well, indicating the shape for each contact separately.

```
probe = Probe(ndim=2, si_units='um')
probe.set_contacts(positions=positions, shapes='circle', shape_params={'radius': 5})
```

Probe objects have fancy prints!

```
print(probe)
```

Out:

```
Probe - 24ch - 1shanks
```

In addition to contacts, we can crate the planar contour (polygon) of the probe

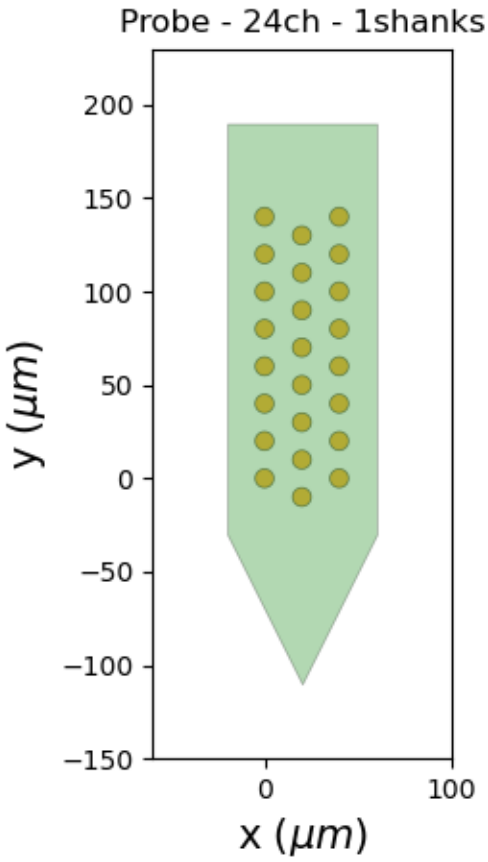
```
polygon = [(-20, -30), (20, -110), (60, -30), (60, 190), (-20, 190)]
probe.set_planar_contour(polygon)
```

If *pandas* is installed, the *Probe* object can be exported as a dataframe for a simpler view:

```
df = probe.to_dataframe()
df
```

If *matplotlib* is installed, the *Probe* can also be easily plotted:

```
plot_probe(probe)
```



Out:

```
(<matplotlib.collections.PolyCollection object at 0x7fa38ff02150>, <matplotlib.
↪collections.PolyCollection object at 0x7fa395a8cd10>)
```

A 2d *Probe* can be transformed to a 3d *Probe* by indicating the *axes* on which contacts will lie (Here the 'y' coordinate will be 0 for all contacts):

```
probe_3d = probe.to_3d(axes='xz')
plot_probe(probe_3d)
```

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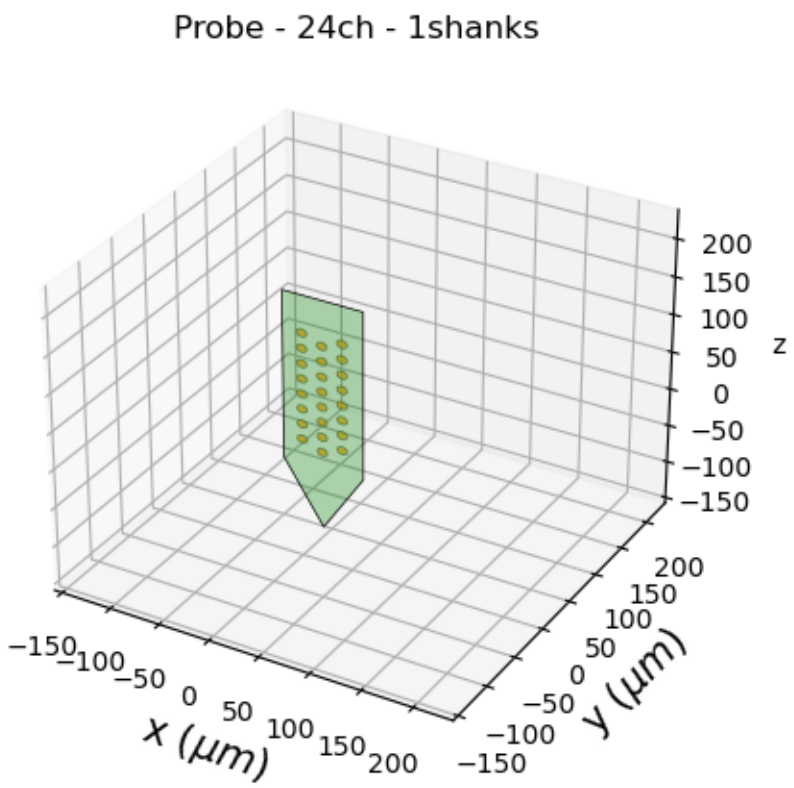
```
plt.show()
```



Total running time of the script: (0 minutes 1.380 seconds)

1.2 2d and 3d Probes

This example shows how to manipulate the probe in 2d or 3d.

Import

```
import numpy as np
import matplotlib.pyplot as plt

from probeinterface import Probe
from probeinterface.plotting import plot_probe
```

First, let's create one 2d probe with 32 contacts:

```
n = 24
positions = np.zeros((n, 2))
for i in range(n):
```

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```
    x = i // 8
    y = i % 8
    positions[i] = x, y
positions *= 20
positions[8:16, 1] -= 10

probe_2d = Probe(ndim=2, si_units='um')
probe_2d.set_contacts(positions=positions, shapes='circle', shape_params={'radius': 5})
probe_2d.create_auto_shape(probe_type='tip')
```

Let's transform it into a 3d probe.

Here the axes are 'xz' so y will be 0 for all contacts. The shape of probe_3d.contact_positions is now (n_elec, 3)

```
probe_3d = probe_2d.to_3d(axes='xz')
print(probe_2d.contact_positions.shape)
print(probe_3d.contact_positions.shape)
```

Out:

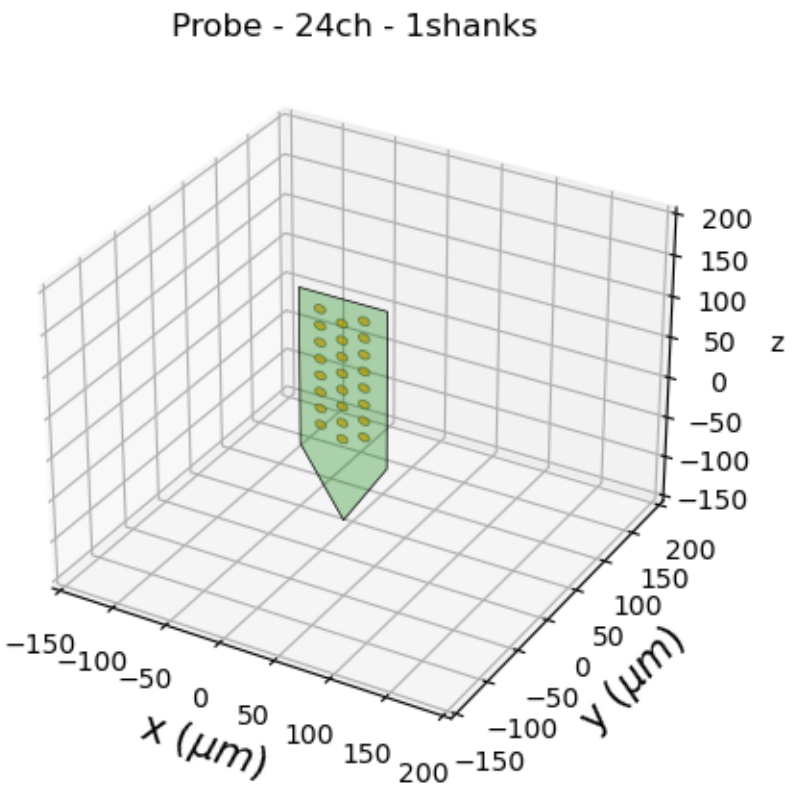
```
(24, 2)
(24, 3)
```

Note that all **"y"** coordinates are 0

```
df = probe_3d.to_dataframe()
df[['x', 'y', 'z']].head()
```

The plotting function autiomatically displays the *Probe* in 3d:

```
plot_probe(probe_3d)
```

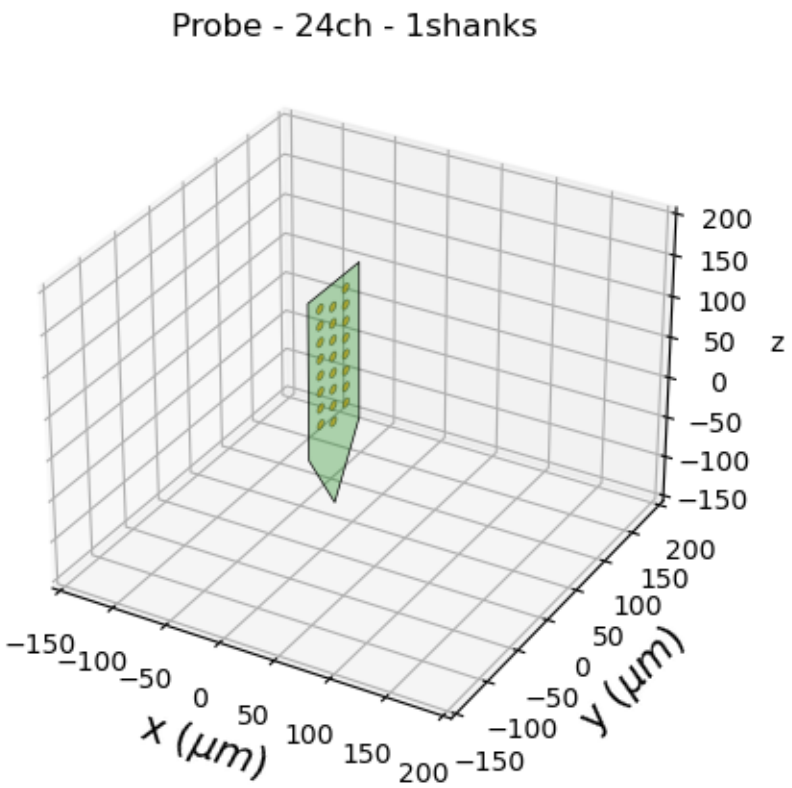


Out:

```
(<mpl_toolkits.mplot3d.art3d.Poly3DCollection object at 0x7fa385be90d0>, <mpl_toolkits.
↪mplot3d.art3d.Poly3DCollection object at 0x7fa38fe7b410>)
```

We can create another probe lying on another plane:

```
other_3d = probe_2d.to_3d(axes='yz')
plot_probe(other_3d)
```

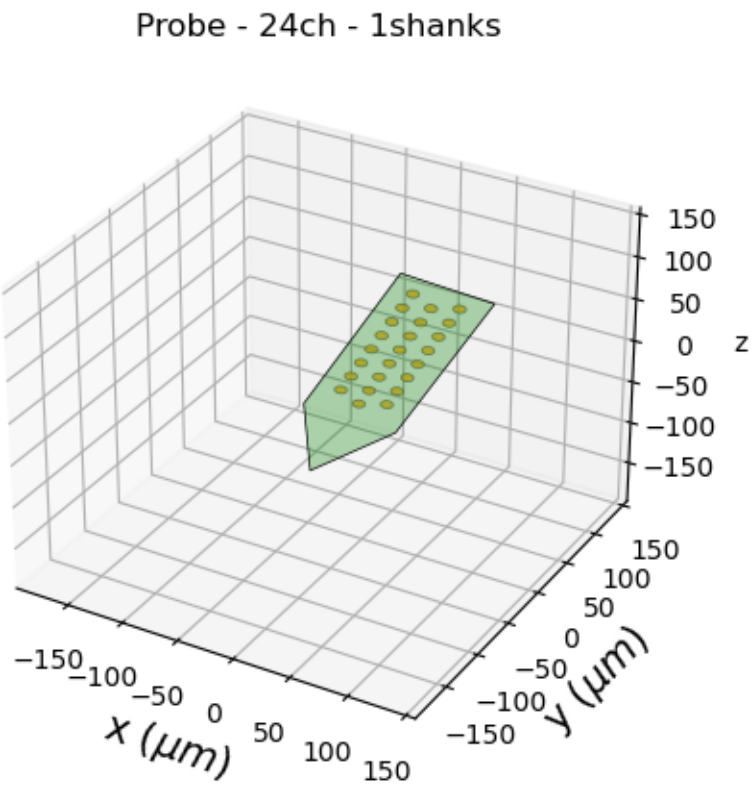


Out:

```
(<mpl_toolkits.mplot3d.art3d.Poly3DCollection object at 0x7fa38ffe7050>, <mpl_toolkits.
↪mplot3d.art3d.Poly3DCollection object at 0x7fa38ffe68d0>)
```

Probe can be moved and rotated in 3d:

```
probe_3d.move([0, 30, -50])
probe_3d.rotate(theta=35, center=[0, 0, 0], axis=[0, 1, 1])

plot_probe(probe_3d)

plt.show()
```



Total running time of the script: (0 minutes 0.375 seconds)

1.3 Generate a ProbeGroup

This example shows how to assemble several Probe objects into a ProbeGroup object.

Import

```
import numpy as np
import matplotlib.pyplot as plt

from probeinterface import Probe, ProbeGroup
from probeinterface.plotting import plot_probe_group
from probeinterface import generate_dummy_probe
```

Generate 2 dummy *Probe* objects with the utils function:

```
probe0 = generate_dummy_probe(elec_shapes='square')
probe1 = generate_dummy_probe(elec_shapes='circle')
probe1.move([250, -90])
```

Let's create a *ProbeGroup* and add the *Probe* objects into it:

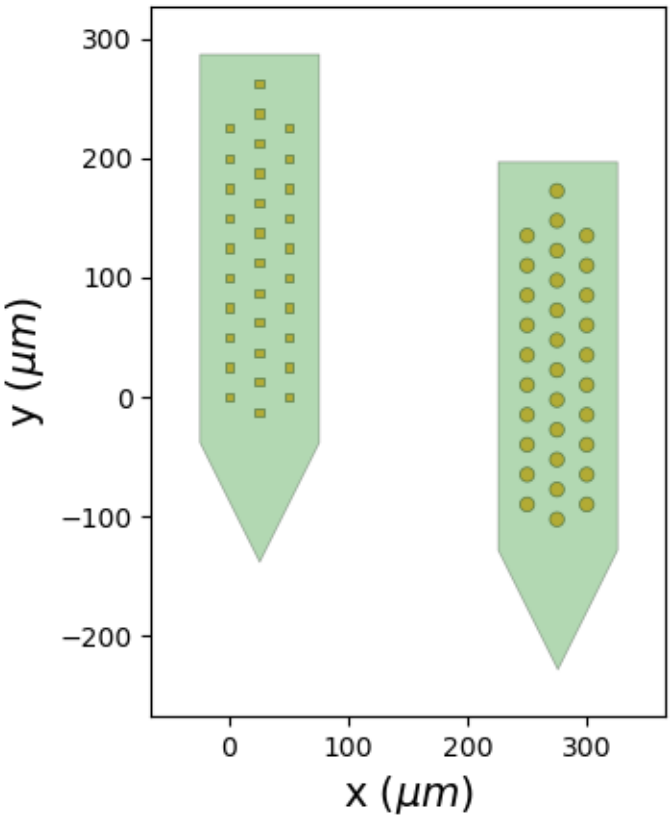
```
probegroup = ProbeGroup()
probegroup.add_probe(probe0)
probegroup.add_probe(probe1)

print('probe0.get_contact_count()', probe0.get_contact_count())
print('probe1.get_contact_count()', probe1.get_contact_count())
print('probegroup.get_channel_count()', probegroup.get_channel_count())
```

Out:

```
probe0.get_contact_count() 32
probe1.get_contact_count() 32
probegroup.get_channel_count() 64
```

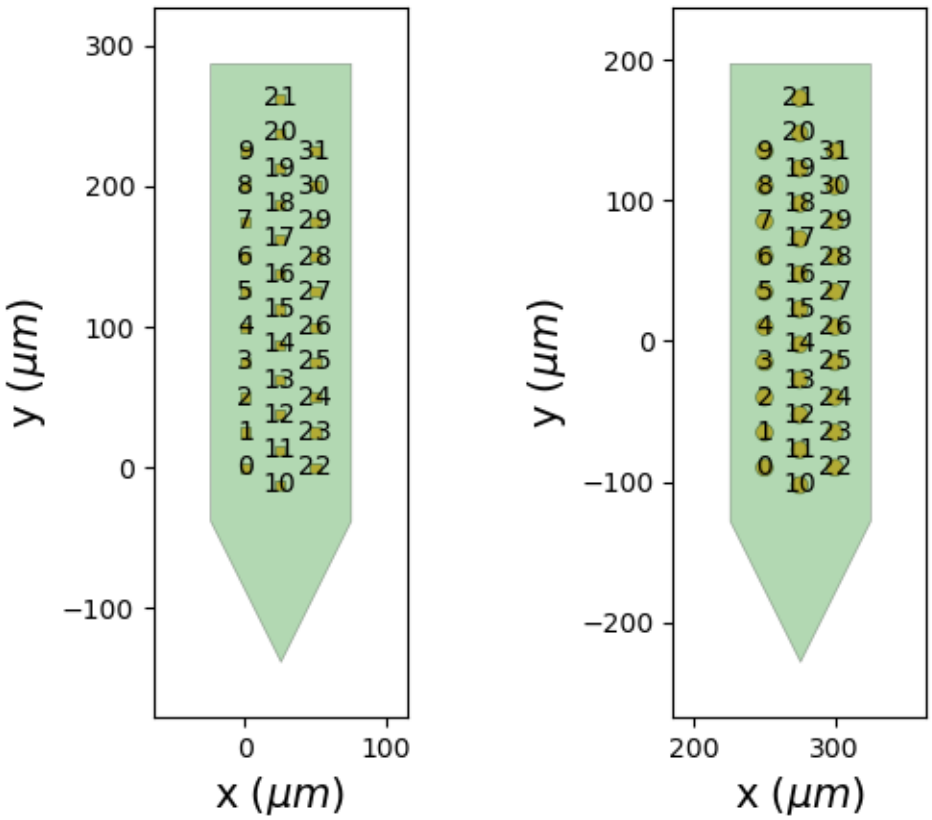
We can now plot all probes in the same axis:

```
plot_probe_group(probegroup, same_axes=True)
```



or in separate axes:

```
plot_probe_group(probegroup, same_axes=False, with_channel_index=True)

plt.show()
```



Total running time of the script: (0 minutes 0.256 seconds)

1.4 Multi shank probes

This example shows how to deal with multi-shank probes.

In *probeinterface* this can be done with a *Probe* object, but internally each probe handles a *shank_ids* vector to carry information about which contacts belong to which shanks.

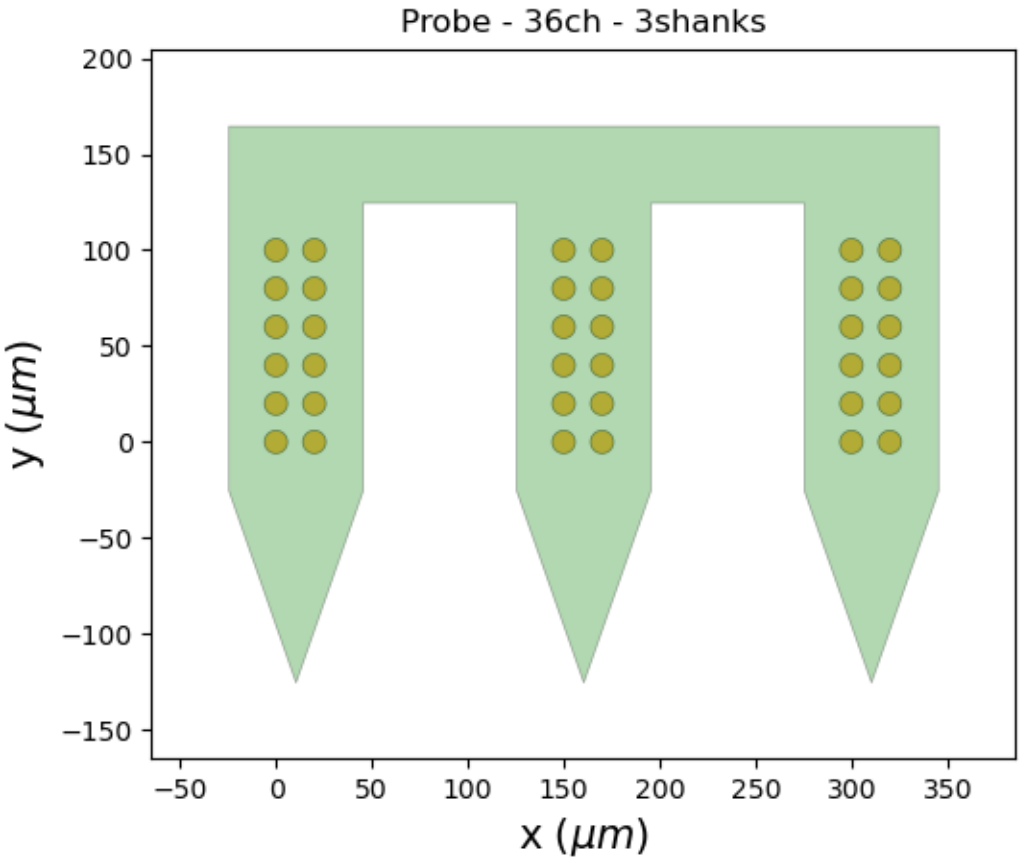
Optionally, a `Probe` object can be rendered split into `Shank`.

Import

```
import numpy as np
import matplotlib.pyplot as plt

from probeinterface import Probe, ProbeGroup
from probeinterface import generate_linear_probe, generate_multi_shank
from probeinterface import combine_probes
from probeinterface.plotting import plot_probe
```

Let's use a generator to create a multi shank probe:

```
multi_shank = generate_multi_shank(num_shank=3, num_columns=2, num_contact_per_column=6)
plot_probe(multi_shank)
```



Out:

```
(<matplotlib.collections.PolyCollection object at 0x7fa38ff142d0>, <matplotlib.
↪collections.PolyCollection object at 0x7fa394111490>)
```

multi_shank is one *probe* object, but internally the *Probe.shank_ids* vector handles the shank ids.

```
print(multi_shank.shank_ids)
```

Out:

```
['0' '0' '0' '0' '0' '0' '0' '0' '0' '0' '0' '0' '1' '1' '1' '1' '1' '1'
 '1' '1' '1' '1' '1' '1' '2' '2' '2' '2' '2' '2' '2' '2' '2' '2' '2' '2']
```

The dataframe displays the *shank_ids* column:

```
df = multi_shank.to_dataframe()
df
```

We can iterate over a multi-shank probe and get Shank objects. A *Shank* is link to a *Probe* object and can also retrieve positions, contact shapes, etc.:

```
for i, shank in enumerate(multi_shank.get_shanks()):
    print('shank', i)
    print(shank.__class__)
    print(shank.get_contact_count())
    print(shank.contact_positions.shape)
```

Out:

```
shank 0
<class 'probeinterface.shank.Shank'>
12
(12, 2)
shank 1
<class 'probeinterface.shank.Shank'>
12
(12, 2)
shank 2
<class 'probeinterface.shank.Shank'>
12
(12, 2)
```

Another option to create multi-shank probes is to create several *Shank* objects as separate probes and then combine then into a single *Probe* object

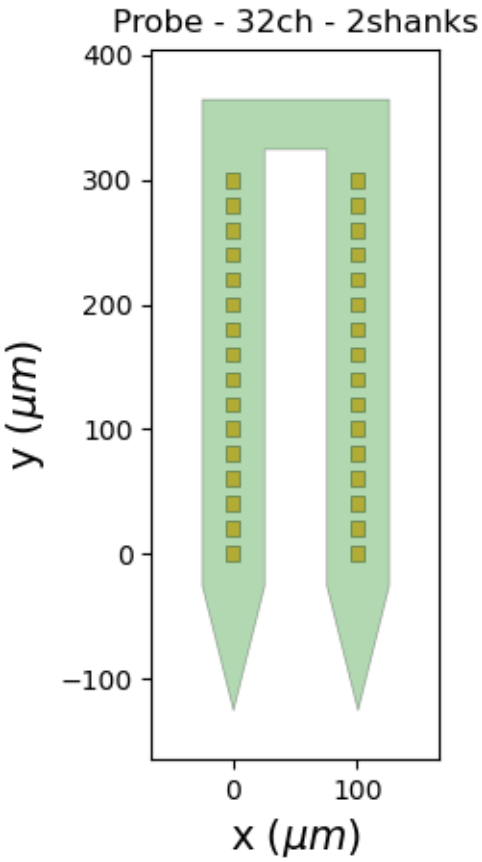
```
# generate a 2 shanks linear
probe0 = generate_linear_probe(num_elec=16, ypitch=20,
                               contact_shapes='square',
                               contact_shape_params={'width': 12})
probe1 = probe0.copy()
probe1.move([100, 0])

multi_shank = combine_probes([probe0, probe1])
```

```
print(multi_shank.shank_ids)
```

Out:

```
['0' '0' '0' '0' '0' '0' '0' '0' '0' '0' '0' '0' '0' '0' '0' '0' '1' '1'
 '1' '1' '1' '1' '1' '1' '1' '1' '1' '1' '1' '1' '1' '1' '1' '1' '1' '1']
```

```
plot_probe(multi_shank)

plt.show()
```



Total running time of the script: (0 minutes 0.237 seconds)

1.5 Handle channel indices

Probes can have a complex contacts indexing system due to the probe layout. When they are plugged into a recording device like an Open Ephys with an Intan headstage, the channel order can be mixed again. So the physical contact channel index is rarely the channel index on the device.

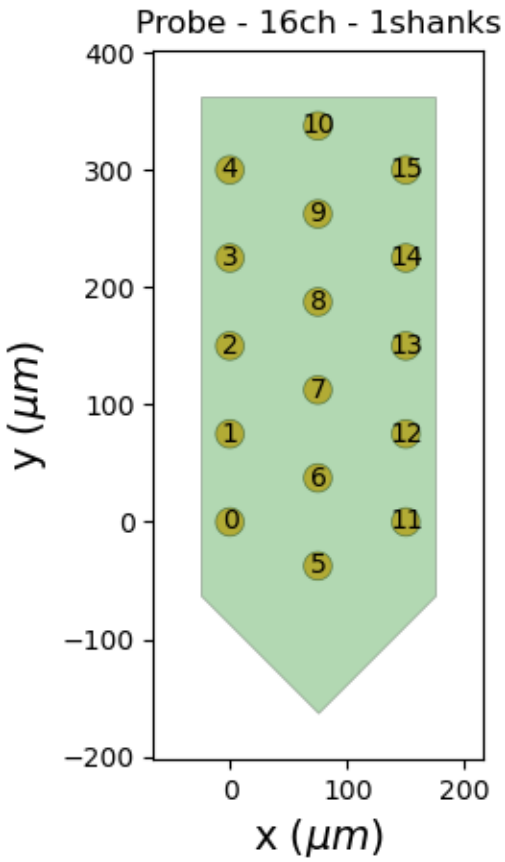
This is why the *Probe* object can handle separate *device_channel_indices*.

Import

```
import numpy as np
import matplotlib.pyplot as plt

from probeinterface import Probe, ProbeGroup
from probeinterface.plotting import plot_probe, plot_probe_group
from probeinterface import generate_multi_columns_probe
```

Let's first generate a probe. By default, the wiring is not complicated: each column increments the contact index from the bottom to the top of the probe:

```
probe = generate_multi_columns_probe(num_columns=3,
                                     num_contact_per_column=[5, 6, 5],
                                     xpitch=75, ypitch=75, y_shift_per_column=[0, -37.5,␣
↪0],
                                     contact_shapes='circle', contact_shape_params={
↪'radius': 12})

plot_probe(probe, with_channel_index=True)
```



Out:

```
(<matplotlib.collections.PolyCollection object at 0x7fa38fe88c50>, <matplotlib.
↪collections.PolyCollection object at 0x7fa3940dd5d0>)
```

The Probe is not connected to any device yet:

```
print(probe.device_channel_indices)
```

Out:

```
None
```

Let's imagine we have a headstage with the following wiring: the first half of the channels have natural indices, but the order of other half is reversed:

```
channel_indices = np.arange(16)
channel_indices[8:16] = channel_indices[8:16][::-1]
probe.set_device_channel_indices(channel_indices)
print(probe.device_channel_indices)
```

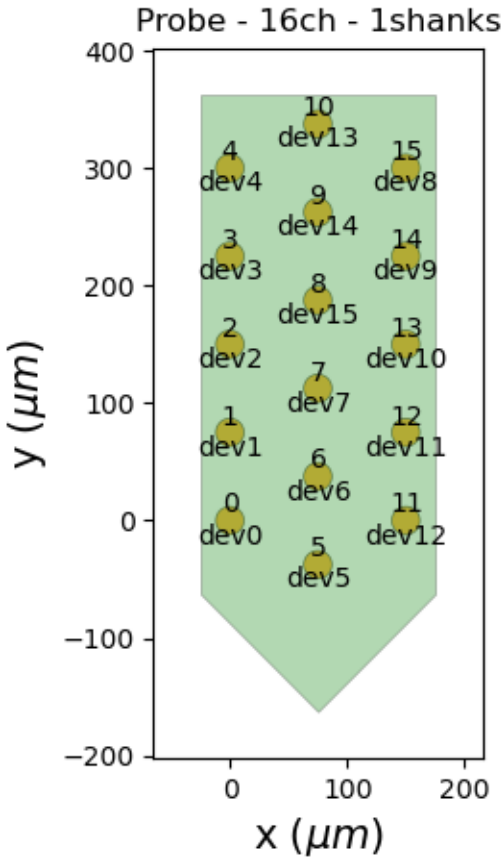
Out:

```
[ 0  1  2  3  4  5  6  7 15 14 13 12 11 10  9  8]
```

We can visualize the two sets of indices:

- the prbXX is the contact index ordered from 0 to N
- the devXX is the channel index on the device (with the second half reversed)

```
plot_probe(probe, with_channel_index=True, with_device_index=True)
```



Out:

```
(<matplotlib.collections.PolyCollection object at 0x7fa38ff86090>, <matplotlib.
↪collections.PolyCollection object at 0x7fa385c4f610>)
```

Very often we have several probes on the device and this can lead to even more complex channel indices. *ProbeGroup.get_global_device_channel_indices()* gives an overview of the device wiring.

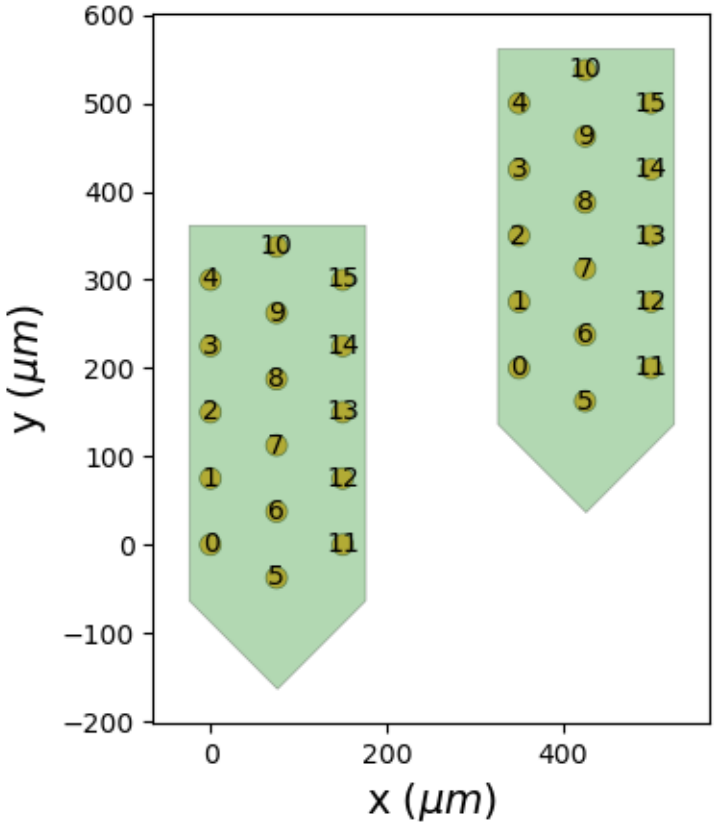
```
probe0 = generate_multi_columns_probe(num_columns=3,
                                      num_contact_per_column=[5, 6, 5],
                                      xpitch=75, ypitch=75, y_shift_per_column=[0, -37.5,
↪ 0],
                                      contact_shapes='circle', contact_shape_params={
↪'radius': 12})
probe1 = probe0.copy()

probe1.move([350, 200])
probegroup = ProbeGroup()
probegroup.add_probe(probe0)
probegroup.add_probe(probe1)

# wire probe0 0 to 31 and shuffle
channel_indices0 = np.arange(16)
np.random.shuffle(channel_indices0)
probe0.set_device_channel_indices(channel_indices0)

# wire probe0 32 to 63 and shuffle
channel_indices1 = np.arange(16, 32)
np.random.shuffle(channel_indices1)
probe1.set_device_channel_indices(channel_indices1)

print(probegroup.get_global_device_channel_indices())
```

Out:

```
[(0,  8) (0,  1) (0, 14) (0,  4) (0,  9) (0,  0) (0,  5) (0,  3) (0,  2)
 (0, 12) (0,  7) (0, 13) (0, 15) (0, 11) (0,  6) (0, 10) (1, 27) (1, 20)
 (1, 21) (1, 30) (1, 26) (1, 28) (1, 29) (1, 23) (1, 17) (1, 31) (1, 18)
 (1, 25) (1, 22) (1, 19) (1, 16) (1, 24)]
```

The indices of the probe group can also be plotted:

```
fig, ax = plt.subplots()
plot_probe_group(probegroup, with_channel_index=True, same_axes=True, ax=ax)

plt.show()
```



Total running time of the script: (0 minutes 0.365 seconds)

1.6 Import/export functions

probeinterface has its own format based on JSON. The format can handle several probes in one file. It has a 'probes' key that can contain a list of probes.

Each probe field in the json format contains the *Probe* class attributes.

It also supports reading (and sometimes writing) from theses formats:

- PRB (.prb) : used by klusta/spyking-circus/tridesclous
- CVS (.csv): 2 or 3 columns locations in text file
- mearec (.h5) : mearec handle the geometry
- spikeglx (.meta) : spikeglx handle the handle also the geometry

Import

```
import numpy as np
import matplotlib.pyplot as plt

from probeinterface import Probe, ProbeGroup
from probeinterface.plotting import plot_probe, plot_probe_group
```

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```
from probeinterface import generate_dummy_probe
from probeinterface import write_probeinterface, read_probeinterface
from probeinterface import write_prb, read_prb
```

Let's first generate 2 dummy probes and combine them into a ProbeGroup

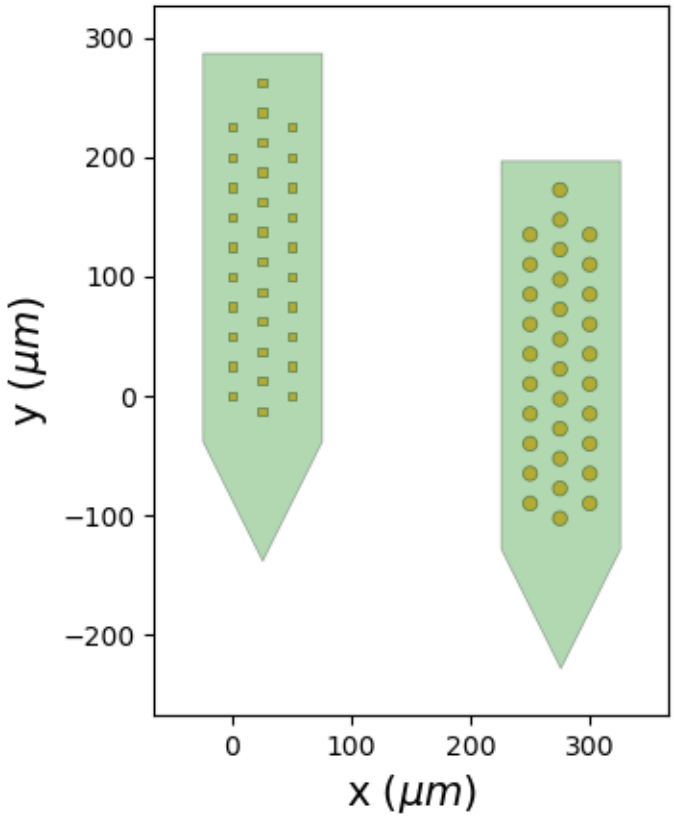
```
probe0 = generate_dummy_probe(elec_shapes='square')
probe1 = generate_dummy_probe(elec_shapes='circle')
probe1.move([250, -90])

probegroup = ProbeGroup()
probegroup.add_probe(probe0)
probegroup.add_probe(probe1)
```

With the *write_probeinterface* and *read_probeinterface* functions we can write to and read from the json-based probeinterface format:

```
write_probeinterface('my_two_probe_setup.json', probegroup)

probegroup2 = read_probeinterface('my_two_probe_setup.json')
plot_probe_group(probegroup2)
```



The format looks like this:

```
with open('my_two_probe_setup.json', mode='r') as f:
    txt = f.read()

print(txt[:600], '...')
```

Out:

```
{
    "specification": "probeinterface",
    "version": "0.2.11",
    "probes": [
        {
            "ndim": 2,
            "si_units": "um",
            "annotations": {
                "name": "",
                "manufacturer": "me"
            },
            "contact_annotations": {
                "quality": [
                    1000.0,
                    1000.0,
                    1000.0,
                    1000.0,
                    1000.0,
                    1000.0,
                    1000.0,
                    1000.0,
                    1000.0,
                    1000.0,
 ...
```

PRB is an historical format introduced by the Klusta team and it is also used by SpikeInterface, Spyking-circus, and Tridesclous. The format is in fact a python script that describes a dictionary. This format handles:

- multiple groups (multi-shank or multi-probe)
- contact_positions with 'geometry'
- device_channel_indices with 'channels'

Here an example .prb file with 2 channel groups of 4 channels each. It can be easily loaded and plotted with *probeinterface*

```
prb_two_tetrodes = """
channel_groups = {
    0: {
            'channels' : [0,1,2,3],
            'geometry': {
                0: [0, 50],
                1: [50, 0],
                2: [0, -50],
                3: [-50, 0],
            }
    },
```

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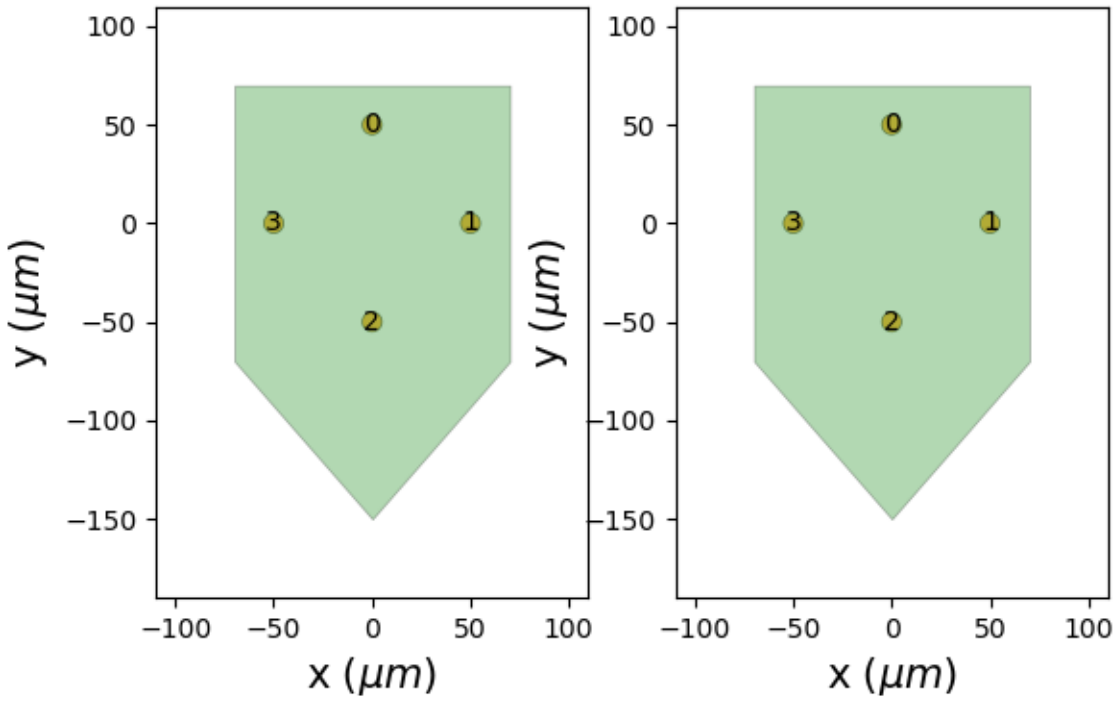
```
    1: {
            'channels' : [4,5,6,7],
            'geometry': {
                4: [0, 50],
                5: [50, 0],
                6: [0, -50],
                7: [-50, 0],
            }
    }
}
"""

with open('two_tetrodes.prb', 'w') as f:
    f.write(prb_two_tetrodes)

two_tetrode = read_prb('two_tetrodes.prb')
plot_probe_group(two_tetrode, same_axes=False, with_channel_index=True)

plt.show()
```



Total running time of the script: (0 minutes 0.244 seconds)

1.7 Probe generator

probeinterface have also basic function to generate simple contact layouts like:

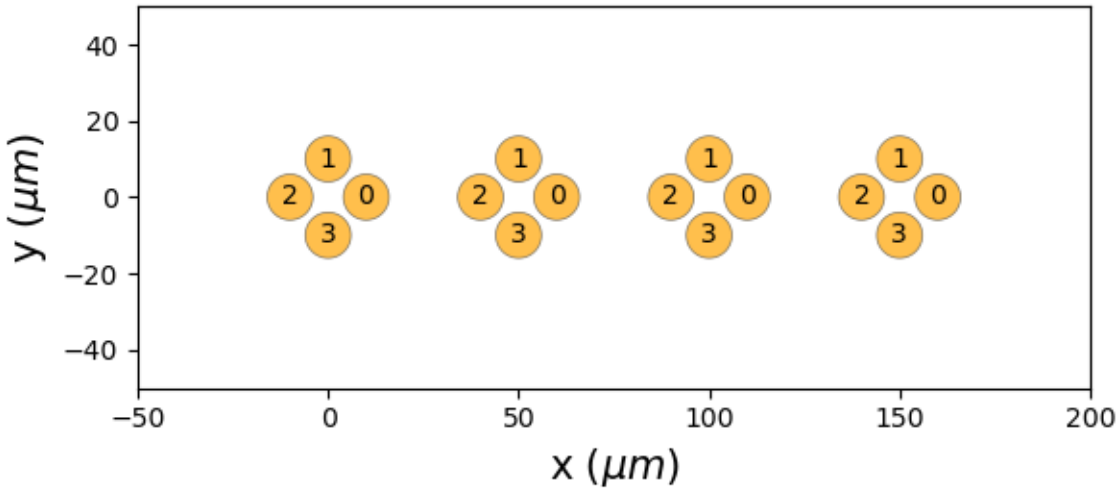
- tetrodes
- linear probes
- multi-column probes

Import

```
import numpy as np
import matplotlib.pyplot as plt

from probeinterface import Probe, ProbeGroup
from probeinterface.plotting import plot_probe, plot_probe_group
```

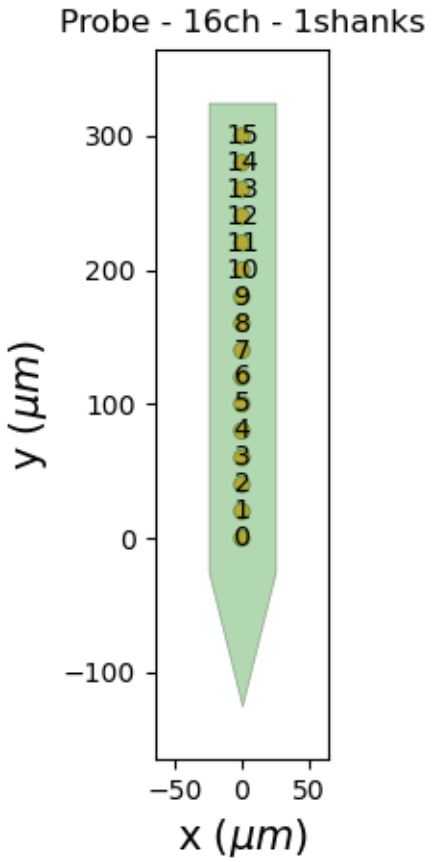
Generate 4 tetrodes:

```
from probeinterface import generate_tetrode

probegroup = ProbeGroup()
for i in range(4):
    tetrode = generate_tetrode()
    tetrode.move([i * 50, 0])
    probegroup.add_probe(tetrode)
probegroup.set_global_device_channel_indices(np.arange(16))

df = probegroup.to_dataframe()
df

plot_probe_group(probegroup, with_channel_index=True, same_axes=True)
```



Generate a linear probe:

```
from probeinterface import generate_linear_probe

linear_probe = generate_linear_probe(num_elec=16, ypitch=20)
plot_probe(linear_probe, with_channel_index=True)
```

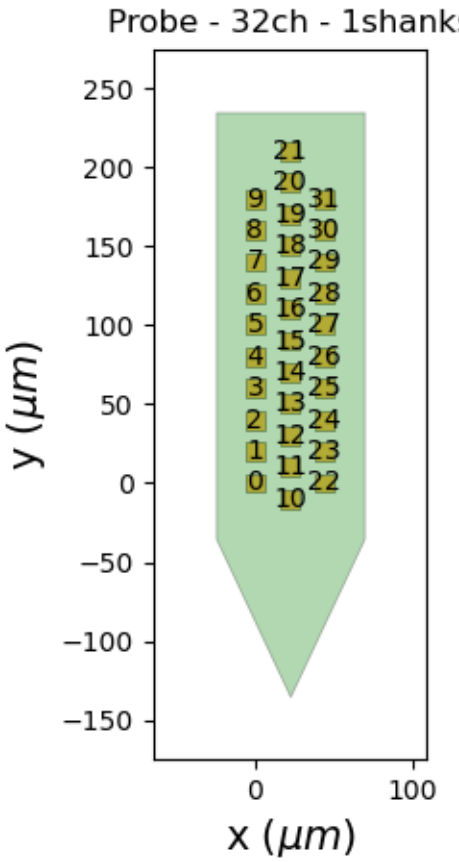


Out:

```
(<matplotlib.collections.PolyCollection object at 0x7fa38fe956d0>, <matplotlib.
↪collections.PolyCollection object at 0x7fa38ff28e10>)
```

Generate a multi-column probe:

```
from probeinterface import generate_multi_columns_probe

multi_columns = generate_multi_columns_probe(num_columns=3,
                                             num_contact_per_column=[10, 12, 10],
                                             xpitch=22, ypitch=20,
                                             y_shift_per_column=[0, -10, 0],
                                             contact_shapes='square', contact_shape_
↪params={'width': 12})
plot_probe(multi_columns, with_channel_index=True, )
```

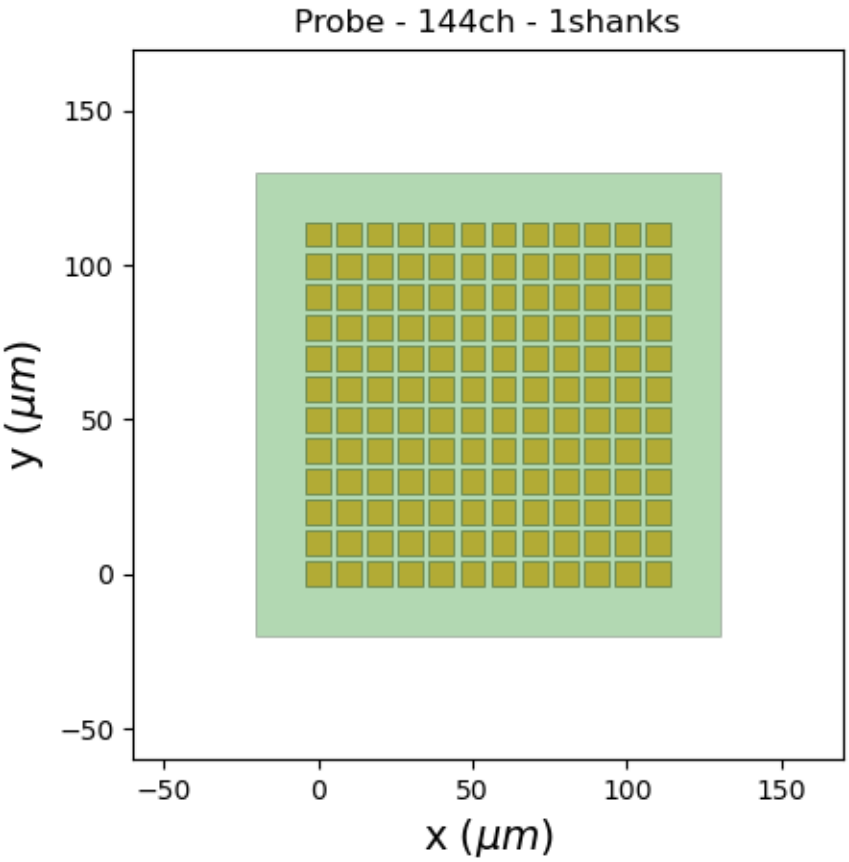


Out:

```
(<matplotlib.collections.PolyCollection object at 0x7fa385c76c90>, <matplotlib.
↪collections.PolyCollection object at 0x7fa385c439d0>)
```

Generate a square probe:

```
square_probe = generate_multi_columns_probe(num_columns=12,
                                            num_contact_per_column=12,
                                            xpitch=10, ypitch=10,
                                            contact_shapes='square', contact_shape_
↪params={'width': 8})
square_probe.create_auto_shape('rect')
plot_probe(square_probe)

plt.show()
```



Total running time of the script: (0 minutes 0.514 seconds)

1.8 More plotting examples

Here some examples to showcase several plotting scenarios.

Import

```
import numpy as np
import matplotlib.pyplot as plt

from probeinterface import Probe, ProbeGroup
from probeinterface.plotting import plot_probe, plot_probe_group
from probeinterface import generate_multi_columns_probe, generate_linear_probe
```

Some examples in 2d

```
fig, ax = plt.subplots()

probe0 = generate_multi_columns_probe()
plot_probe(probe0, ax=ax)

# make some colors for each probe
```

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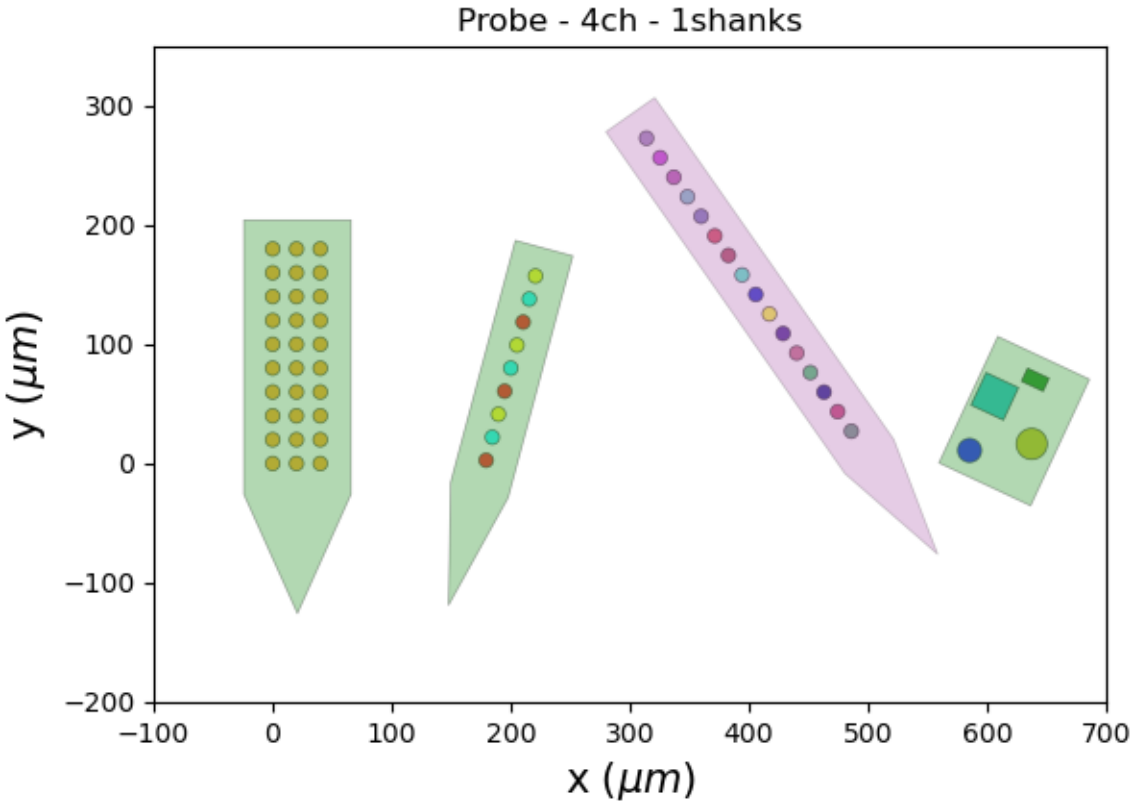
```
probe1 = generate_linear_probe(num_elec=9)
probe1.rotate(theta=15)
probe1.move([200, 0])
plot_probe(probe1, ax=ax,
           contacts_colors=['red', 'cyan', 'yellow'] * 3)

# prepare yourself for carnival!
probe2 = generate_linear_probe()
probe2.rotate(theta=-35)
probe2.move([400, 0])
n = probe2.get_contact_count()
rand_colors = np.random.rand(n, 3)
plot_probe(probe2, ax=ax, contacts_colors=rand_colors,
           probe_shape_kwargs={'facecolor': 'purple', 'edgecolor': 'k', 'lw': 0.5, 'alpha
↪': 0.2})

# and make some alien probes
probe3 = Probe()
positions = [[0, 0], [0, 50], [25, 77], [45, 27]]
shapes = ['circle', 'square', 'rect', 'circle']
params = [{'radius': 10}, {'width': 30}, {'width': 20, 'height': 12}, {'radius': 13}]
probe3.set_contacts(positions=positions, shapes=shapes,
                    shape_params=params)
probe3.create_auto_shape(probe_type='rect')
probe3.rotate(theta=25)
probe3.move([600, 0])
plot_probe(probe3, ax=ax, contacts_colors=['b', 'c', 'g', 'y'])

ax.set_xlim(-100, 700)
ax.set_ylim(-200, 350)

ax.set_aspect('equal')
```



Some example in 3d for romantic who like flowers…

```
fig = plt.figure()
ax = fig.add_subplot(1, 1, 1, projection='3d')

n = 8
for i in range(n):
    probe = generate_multi_columns_probe(num_columns=3,
                                         num_contact_per_column=[8, 9, 8],
                                         xpitch=20, ypitch=20,
                                         y_shift_per_column=[0, -10, 0]).to_3d()
    probe.rotate(theta=35, center=[0, 0, 0], axis=[0, 1, 0])
    probe.move([100, 50, 0])
    probe.rotate(theta=i * 360 / n, center=[0, 0, 0], axis=[0, 0, 1])
    plot_probe(probe, ax=ax,
               probe_shape_kwargs={'facecolor': ['purple', 'cyan'][i % 2], 'edgecolor':
↪'k', 'lw': 0.5, 'alpha': 0.2})

probe = generate_linear_probe(num_elec=24, ypitch=20).to_3d()

probe.move([0, 0, -450])
plot_probe(probe, ax=ax)

lims = -450, 450
```

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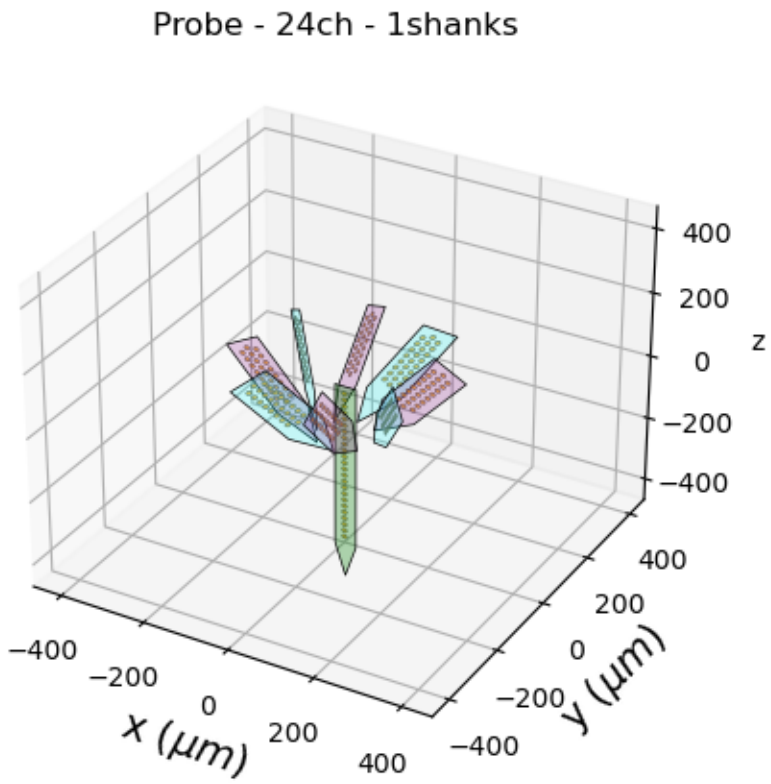
```
ax.set_xlim(*lims)
ax.set_ylim(*lims)
ax.set_zlim(*lims)

plt.show()
```



Total running time of the script: (0 minutes 0.338 seconds)

1.9 More complicated probes

This example demonstrates how to generate more complicated probe with hybrid contacts shape and contact rotations with the *contact_plane_axes* attribute.

```
import numpy as np
import matplotlib.pyplot as plt

from probeinterface import Probe
from probeinterface.plotting import plot_probe
```

Let's first set the positions of the contacts

```
n = 24
positions = np.zeros((n, 2))
for i in range(3):
    positions[i * 8: (i + 1) * 8, 0] = i * 30
    positions[i * 8: (i + 1) * 8, 1] = np.arange(0, 240, 30)
```

Electrode shapes can be arrays to handle hybrid shape contacts

```
shapes = np.array(['circle', 'square'] * 12)
shape_params = np.array([{'radius': 8}, {'width': 12}] * 12)
```

The *plane_axes* argument handles the axis for each contact.

It can be used for contact-wise rotations.

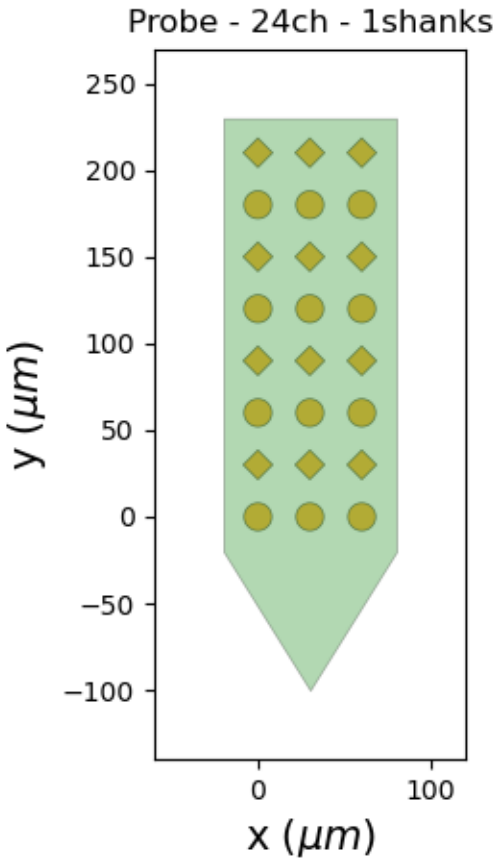
plane_axes has a shape of (num_elec, 2, ndim)

```
plane_axes = [[[1 / np.sqrt(2), 1 / np.sqrt(2)], [-1 / np.sqrt(2), 1 / np.sqrt(2)]]] * n
plane_axes = np.array(plane_axes)
```

Create the probe

```
probe = Probe(ndim=2, si_units='um')
probe.set_contacts(positions=positions, plane_axes=plane_axes,
                   shapes=shapes, shape_params=shape_params)
probe.create_auto_shape()
```

```
plot_probe(probe)
```



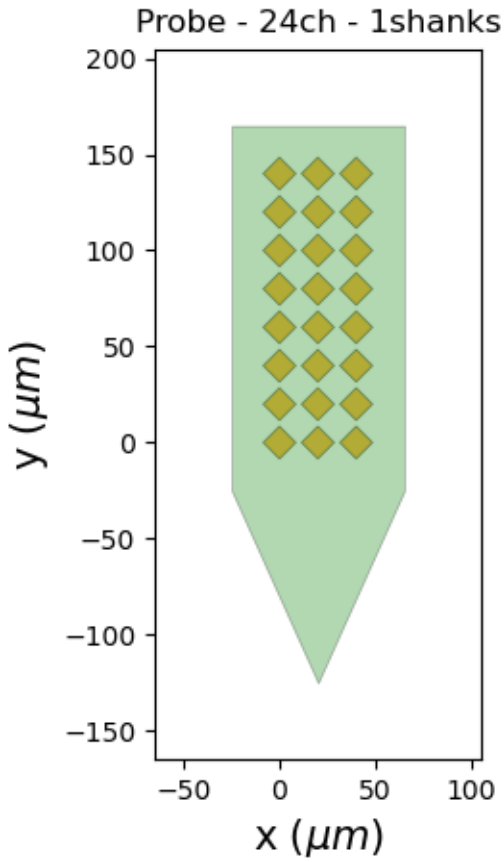
Out:

```
(<matplotlib.collections.PolyCollection object at 0x7fa385c1a350>, <matplotlib.
↪collections.PolyCollection object at 0x7fa385bef4d0>)
```

We can also use the *rotate_contacts* to make contact-wise rotations:

```
from probeinterface import generate_multi_columns_probe

probe = generate_multi_columns_probe(num_columns=3,
                                     num_contact_per_column=8, xpitch=20, ypitch=20,
                                     contact_shapes='square', contact_shape_params={
↪'width': 12})
probe.rotate_contacts(45)
plot_probe(probe)
```

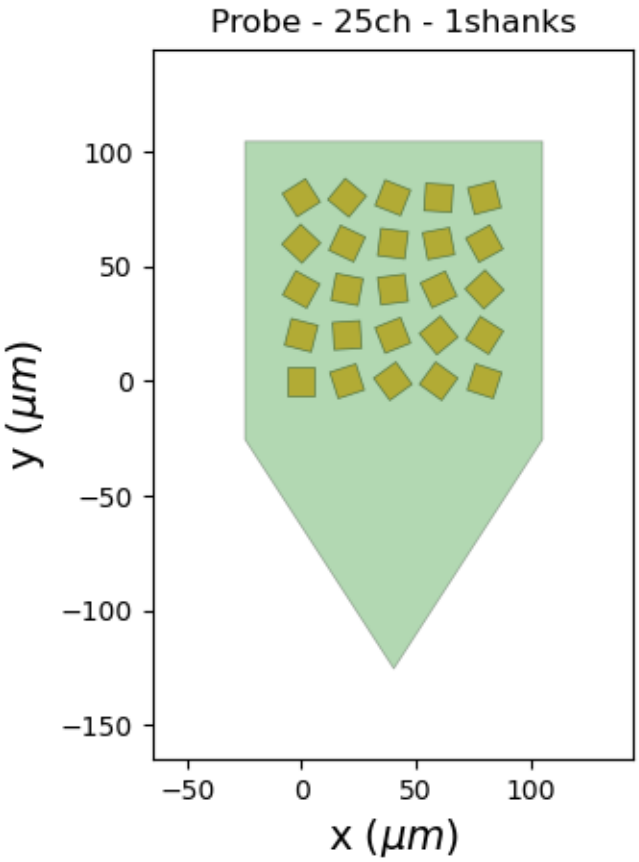


Out:

```
(<matplotlib.collections.PolyCollection object at 0x7fa385caf650>, <matplotlib.
↪collections.PolyCollection object at 0x7fa385c77950>)
```

```
probe = generate_multi_columns_probe(num_columns=5,
                                     num_contact_per_column=5, xpitch=20, ypitch=20,
                                     contact_shapes='square', contact_shape_params={
↪'width': 12})
thetas = np.arange(25) * 360 / 25
probe.rotate_contacts(thetas)
plot_probe(probe)

plt.show()
```



Total running time of the script: (0 minutes 0.282 seconds)

1.10 Get probe from library

probeinterface provides a library of probes from several manufacturers on the gin platform: https://gin.g-node.org/spikeinterface/probeinterface_library

Users and manufacturers are welcome to contribute to it.

The Python module provide a function to download and cache files locally in the *probeinterface* json-based format.

```
from pprint import pprint

import numpy as np
import matplotlib.pyplot as plt

from probeinterface import Probe, get_probe
from probeinterface.plotting import plot_probe
```

Download one probe:

```
manufacturer = 'neuronexus'
probe_name = 'A1x32-Poly3-10mm-50-177'
```

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```
probe = get_probe(manufacturer, probe_name)
print(probe)
```

Out:

```
neuronexus - A1x32-Poly3-10mm-50-177 - 32ch - 1shanks
```

Files from the library also contain annotations specific to manufacturers. We can see here that Neuronexus probes have contact indices starting at "1" (one-based)

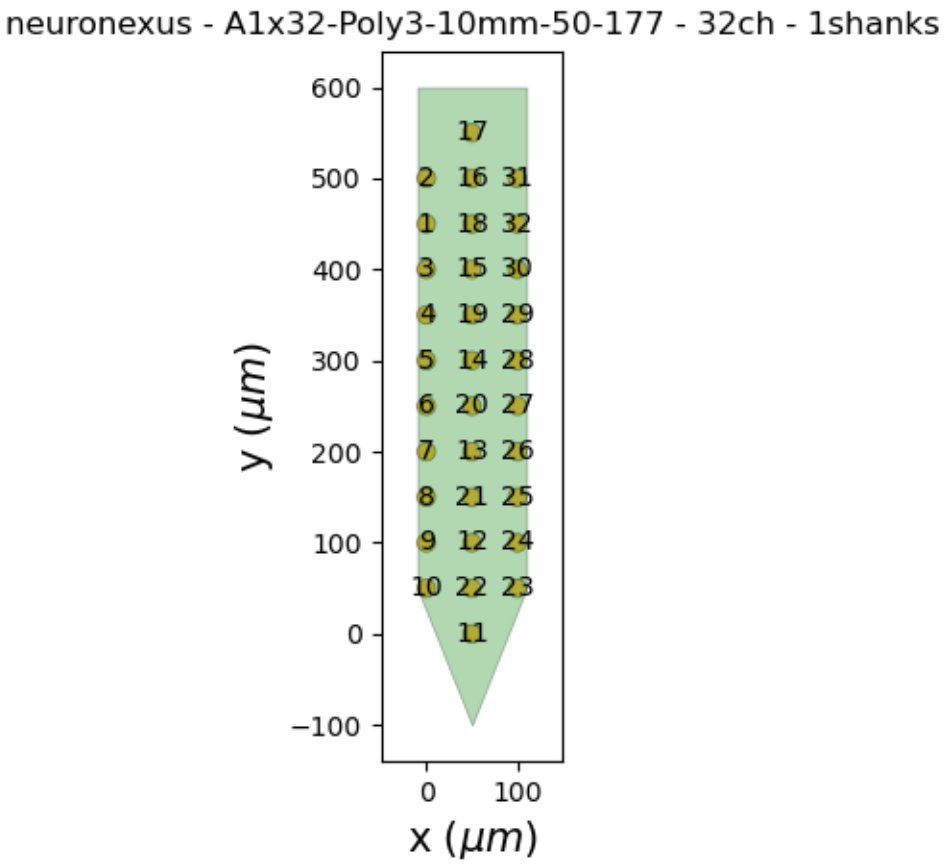
```
pprint(probe.annotations)
```

Out:

```
{'first_index': 1,
 'manufacturer': 'neuronexus',
 'name': 'A1x32-Poly3-10mm-50-177'}
```

When plotting, the channel indices are automatically displayed with one-based notation (even if internally everything is still zero based):

```
plot_probe(probe, with_channel_index=True)
```



Out:

```
(<matplotlib.collections.PolyCollection object at 0x7fa385befd50>, <matplotlib.
↪collections.PolyCollection object at 0x7fa38fe6e810>)
```

```
plt.show()
```

Total running time of the script: (0 minutes 0.144 seconds)

1.11 Automatic wiring

Here is an example on how to handle the wiring automatically and to get the device_channel_indices.

```
from pprint import pprint

import numpy as np
import matplotlib.pyplot as plt

from probeinterface import Probe, get_probe
from probeinterface.plotting import plot_probe
```

Download one probe:

```
manufacturer = 'neuronexus'
probe_name = 'A1x32-Poly3-10mm-50-177'

probe = get_probe(manufacturer, probe_name)
print(probe)
```

Out:

```
neuronexus - A1x32-Poly3-10mm-50-177 - 32ch - 1shanks
```

We can "wire" this probe to a recording device. Imagine we connect this Neuronexus probe with an Omnetic to an Intan RHD headstage.

Using this 2 wiring documentation https://neuronexus.com/wp-content/uploads/2018/09/Wiring_H32.pdf http://intantech.com/RHD_headstages.html?tabSelect=RHD32ch&yPos=0

after long headache we can figura out the wiring to device manually and set it using the *probe.set_device_channel_indices()* function:

```
device_channel_indices = [
    16, 17, 18, 20, 21, 22, 31, 30, 29, 27, 26, 25, 24, 28, 23, 19,
    12, 8, 3, 7, 6, 5, 4, 2, 1, 0, 9, 10, 11, 13, 14, 15]
probe.set_device_channel_indices(device_channel_indices)
```

In order to ease this process, *probeinterface* also includes some commonly used wiring based on standard connectors. In our case, we can simply use:

```
probe.wiring_to_device('H32>RHD2132')
print(probe.device_channel_indices)
```

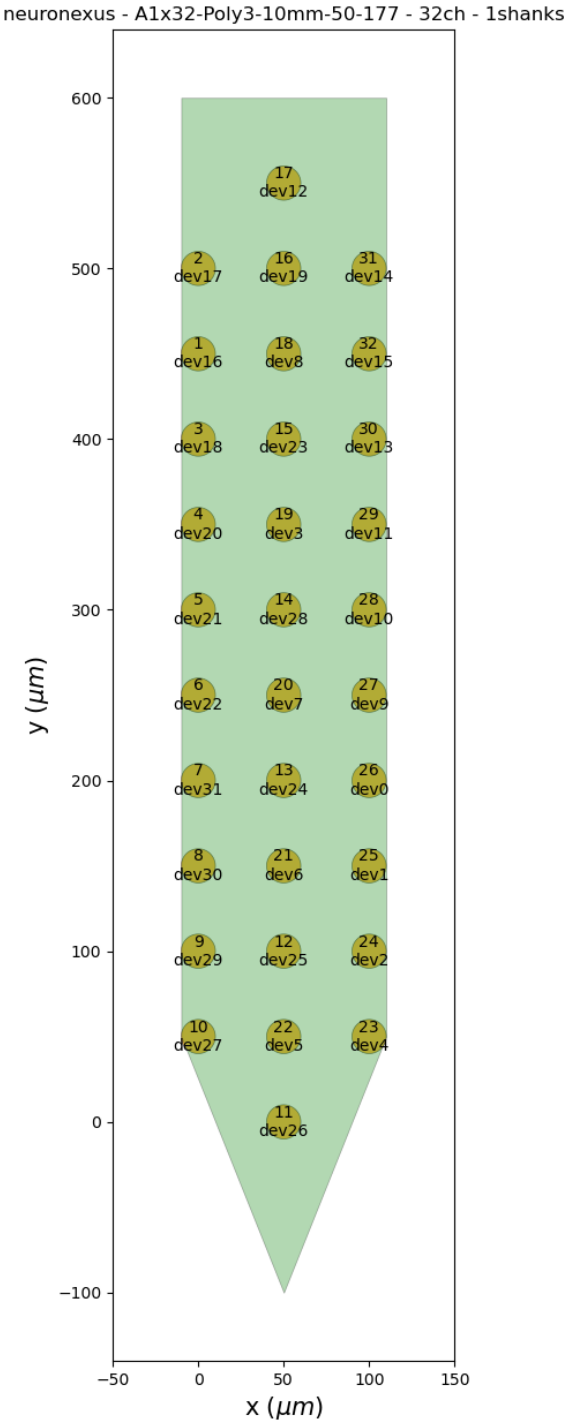
Out:

```
[16 17 18 20 21 22 31 30 29 27 26 25 24 28 23 19 12  8  3  7  6  5  4  2
  1  0  9 10 11 13 14 15]
```

In this figure we have 2 numbers for each contact:

- the upper number "prbXX" is the Neuronexus index (one-based)
- the lower "devXX" is the channel on the Intan device (zero-based)

```
fig, ax = plt.subplots(figsize=(5, 15))
plot_probe(probe, with_channel_index=True, with_device_index=True, ax=ax)


plt.show()
```


neuronexus - A1x32-Poly3-10mm-50-177 - 32ch - 1shanks
17
dev12
2
dev17
16
dev19
31
dev14
1
dev16
18
dev8
32
dev15
3
dev18
15
dev23
30
dev13
4
dev20
19
dev3
29
dev11
5
dev21
14
dev28
28
dev10
6
dev22
20
dev7
27
dev9
7
dev31
13
dev24
26
dev0
8
dev30
21
dev6
25
dev1
9
dev29
12
dev25
24
dev2
10
dev27
22
dev5
23
dev4
11
dev26
600
500
400
300
200
100
0
−100
−50
0
50
100
150
y (μm)
x (μm)

Total running time of the script: (0 minutes 0.213 seconds)

1.12 Plot values

Here is an example on how to plot values with color scales. And also plot interpolated image.

```
from pprint import pprint

import numpy as np
import matplotlib.pyplot as plt

from probeinterface import Probe, get_probe
from probeinterface.plotting import plot_probe
```

Download one probe:

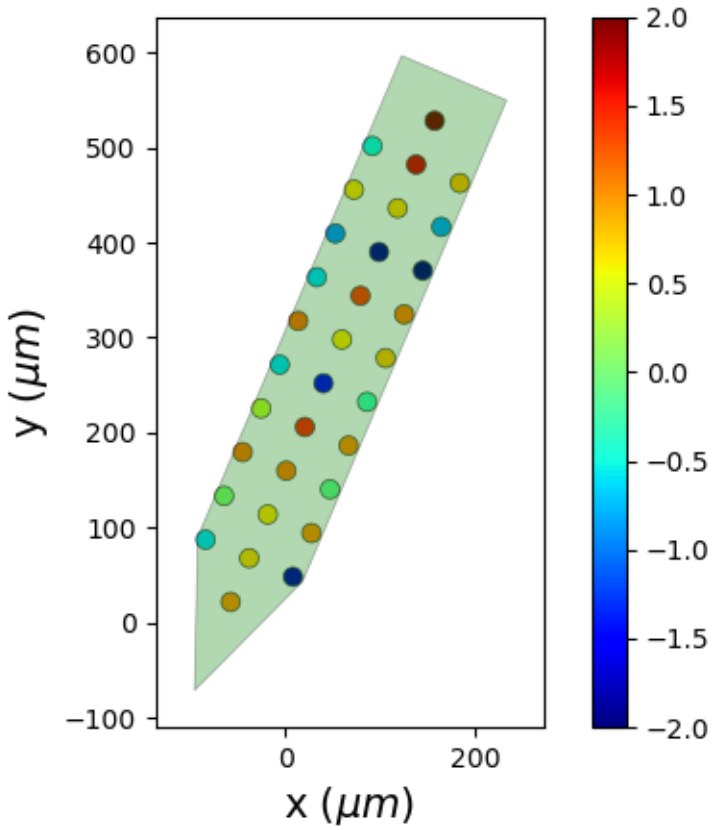
```
manufacturer = 'neuronexus'
probe_name = 'A1x32-Poly3-10mm-50-177'

probe = get_probe(manufacturer, probe_name)
probe.rotate(23)
```

fake values

```
values = np.random.randn(32)
```

plot with value

```
fig, ax = plt.subplots()
poly, poly_contour = plot_probe(probe, contacts_values=values,
            cmap='jet', ax=ax, contacts_kargs={'alpha' : 1},  title=False)
poly.set_clim(-2, 2)
fig.colorbar(poly)
```

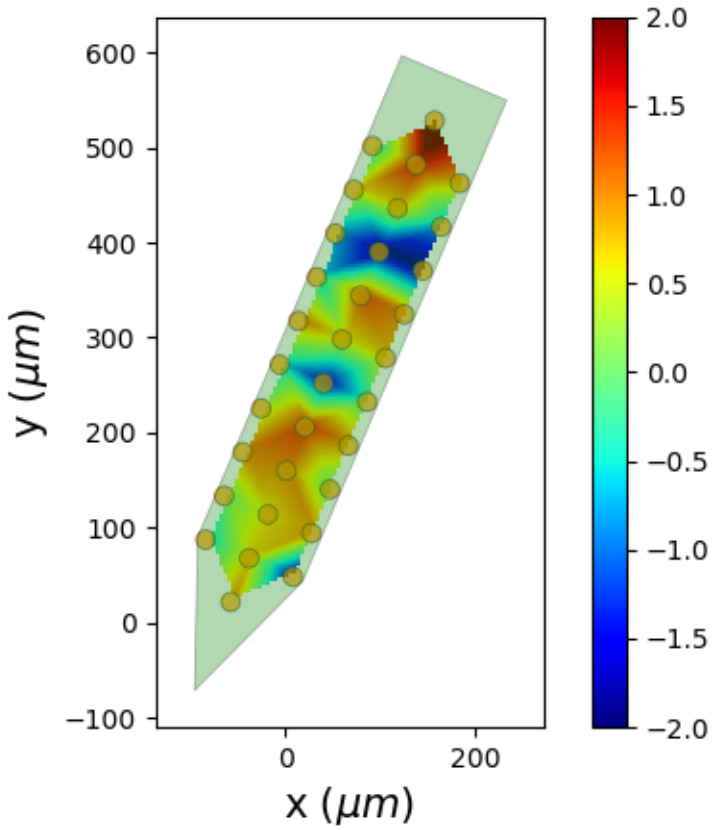


Out:

```
<matplotlib.colorbar.Colorbar object at 0x7fa385cbe7d0>
```

generated an interpolated image and plot it on top

```
image, xlims, ylims = probe.to_image(values, pixel_size=4, method='linear')

print(image.shape)

fig, ax = plt.subplots()
plot_probe(probe, ax=ax, title=False)
im = ax.imshow(image, extent=xlims+ylims, origin='lower', cmap='jet')
im.set_clim(-2,2)
fig.colorbar(im)
```

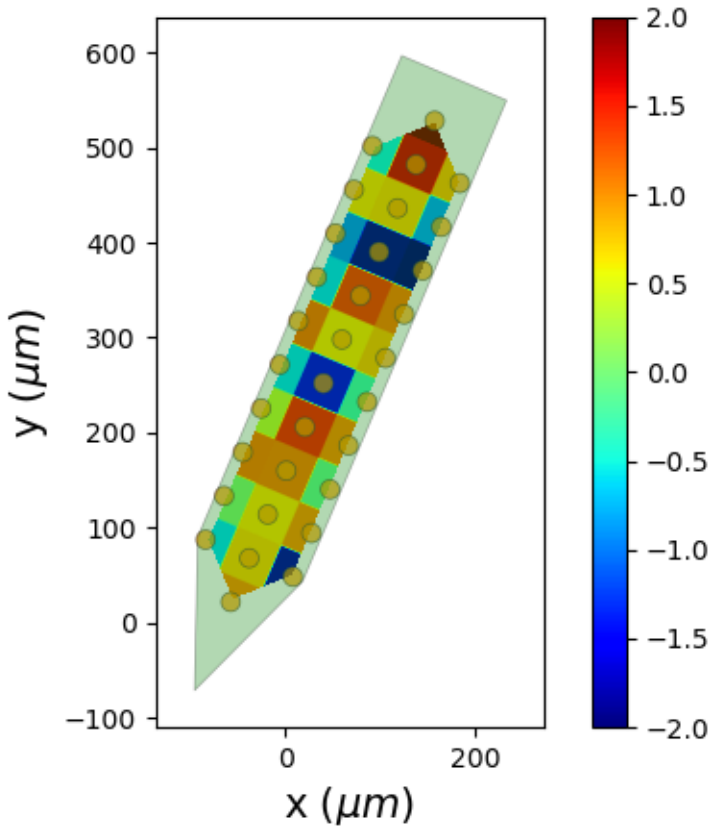


Out:

```
(127, 67)

<matplotlib.colorbar.Colorbar object at 0x7fa3848ada10>
```

works with several interpolation method

```
image, xlims, ylims = probe.to_image(values, num_pixel=1000, method='nearest')

fig, ax = plt.subplots()
plot_probe(probe, ax=ax, title=False)
im = ax.imshow(image, extent=xlims+ylims, origin='lower', cmap='jet')
im.set_clim(-2,2)
fig.colorbar(im)



plt.show()
```



Total running time of the script: (0 minutes 1.639 seconds)

1.13 Overview

1.13.1 Introduction

To record neural electrical signals, extracellular neural probes are inserted in the brain. Neural probes are (usually) multi-channel arrays able to record from multiple contacts simultaneously, spanning from a few channels (e.g. tetrodes) to high-dense silicon probes (e.g. Neuropixels - with up to 384 recorded channels).

These probes (especially silicon probes) generally have a complex layout (or geometry) and can be connected to the recording system in multiple ways (wiring). To connect a neural probe to a recording device (e.g. Open Ephys, Blackrock, Ripple, Plexon, Intan, Multi-channel System) a headstage is used that is connected to the main recording device.

The complexity of the probe wiring and device wiring leads to the difficult task to directly link the **physical contacts on the probe** and the **logical channel index on the device**.

Recent *spike sorting* (i.e. methods to extract single neurons' activity from the extracellular recordings) algorithms mainly strongly rely on the probe geometry to exploit the spatial distribution of the contacts and improve their performance.

Therefore, there is a need to correctly handle probe geometry and the wiring to the device in an easy-to-use and standardized way.

As an example, imagine you have:

- a **Neuronexus A1x32-Poly2** probe
- with the **intan RHD2132** headstage using the **omnetics 1315** connector
- connected on the **port B of Open Ephys board**

What would be your final channel mapping?

Of course one can sit down in the lab and try to figure it out… The goal of `probeinterface` is to make this time-consuming and error-prone step easier and standardized.

1.13.2 Scope

The scope of this project is to handle one (or several) Probe with three simple python classes:

- Shank
- *Probe*
- *ProbeGroup*.

These classes handle:

- probe geometry (2D or 3D contact layout)
- probe planar contour (polygon)
- shape and size of the contacts
- probe wiring to the recording device
- combination of several probes: global geometry + global wiring

This package also provide:

- read/write to a common format (JSON based)
- read/write function to existing format (PRB, NWB, CSV, MEArec, SpikeGLX, …)
- plotting routines
- generator functions to create user-defined probes

1.13.3 Goal 1

This common interface could be used by several projects for spike sorting and electrophysiology analysis:

- SpikeInterface: integrate this into spikeextractors to handle channel location and wiring
- NEO: handle array_annotations for AnalogSignal
- SpikeForest: use this package for plotting probe activity
- Phy: integrate for probe display
- SpiKING Circus: handle probe with this package
- Kilosort: handle probe with this package
- Tridesclous: handle probe with this package
- …and more

1.13.4 Goal 2

Implement and maintain a collection of widely used probes in Neuroscience, for example:

- Neuronexus
- IMEC
- Cambridge Neurotech

We have started a work-in-progess repo with a probe library

1.13.5 Existing projects

`probeinterface` is not the first attempt to build a library of available probes. Here is a list of available resources:

- JRClust probe library - Matlab format
- Klusta probe library - PRB format
- SpyKING Circus probe library - PRB format
- Justin Kiggins did some script for neuronexus mapping

All of these projects only describe the contact positions. Furthermore there is a strong ambiguity for users between the **contact index on the probe** and the **channel index on device**. This could lead to a wrong interpretation of the wiring.

With `probeinterface` we try to provide a unified framework for probe description, handling, and a comprehensive probe library.

1.13.6 Acknowledgements

The `probeinterface` is inspired on the MEAutility package, written by Alessio Buccino.

While the general idea of having an enhanced probe description is present, the `MEAutility` package mainly focuses on handling probes for modeling purposes, hence missing the wiring concept, and it can only handle a single probe at a time.

With `probeinterface` the focus is also to combinade several Probes and to handle complex wiring for experimental description.

1.14 Examples

Start here with a tutorial showing probeinterface.

1.15 Format specifications

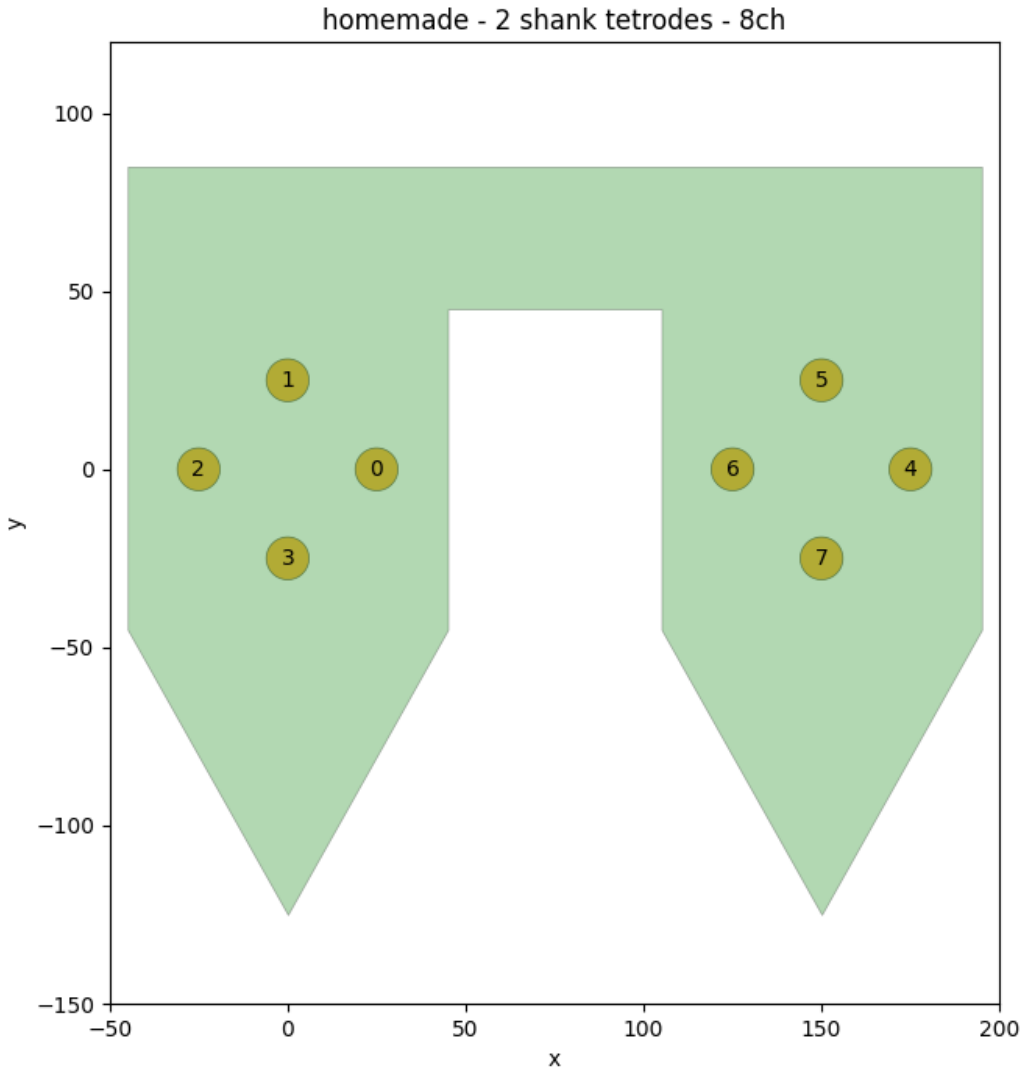
With `probeinterface` we introduce a simple format based on JSON format. The format is a trivial json-serialisation of a Python dictionary. The dictionary maps every attributes of the Probe class.

In fact, the format itself describes a ProbeGroup, so it can include several probes. The format can describe a simple unique probe with its geometry and wiring, as well as a full experimental setup with several probes and their wiring to the recordingdevice.

Here a description of the fields in the json file.

Let's imagine we want to describe a probe with:

- 8 channels
- 2 shanks (one tetrode on each shank)



The first part contains fields about the `probeinterface` version and a list of probes:

```
{
  "specification": "probeinterface",
  "version": "0.1.0",
  "probes": [
    {
      ...
    }
```

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```
  ]
}
```

Then each probe will be a sub-dictionary in the `probes` list:

```
{
    "ndim": 2,
    "si_units": "um",
    "annotations": {
        "name": "2 shank tetrodes",
        "manufacturer": "homemade"
    },
    "contact_positions": [
...
```

The probe dictionary contains all necessary fields and optional fields.

Necessary:

- ndim
- si_units
- annotations
- contact_positions
- contact_shapes
- contact_shape_params

Optional:

- contact_plane_axes
- probe_planar_contour
- device_channel_indices
- shank_ids

The full json file looks as follows:

```
{
    "specification": "probeinterface",
    "version": "0.1.0",
    "probes": [
        {
            "ndim": 2,
            "si_units": "um",
            "annotations": {
                "name": "2 shank tetrodes",
                "manufacturer": "homemade"
            },
            "contact_positions": [
                [
                    25.0,
                    0.0
                ],
```

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```
                [
                    0.0,
                    25.0
                ],
                [
                    -25.0,
                    0.0
                ],
                [
                    0.0,
                    -25.0
                ],
                [
                    175.0,
                    0.0
                ],
                [
                    150.0,
                    25.0
                ],
                [
                    125.0,
                    0.0
                ],
                [
                    150.0,
                    -25.0
                ]
            ],
            "contact_plane_axes": [
                [
                    [
                        1.0,
                        0.0
                    ],
                    [
                        0.0,
                        1.0
                    ]
                ],
                [
                    [
                        1.0,
                        0.0
                    ],
                    [
                        0.0,
                        1.0
                    ]
                ],
                [
                    [
```

(continues on next page)

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```
                    1.0,
                    0.0
                ],
                [
                    0.0,
                    1.0
                ]
            ],
            [
                [
                    1.0,
                    0.0
                ],
                [
                    0.0,
                    1.0
                ]
            ],
            [
                [
                    1.0,
                    0.0
                ],
                [
                    0.0,
                    1.0
                ]
            ],
            [
                [
                    1.0,
                    0.0
                ],
                [
                    0.0,
                    1.0
                ]
            ],
            [
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                    0.0
                ],
                [
                    0.0,
                    1.0
                ]
            ],
            [
                [
                    1.0,
                    0.0
```

(continues on next page)

(continued from previous page)

```
                ],
                [
                    0.0,
                    1.0
                ]
            ]
        ],
        "contact_shapes": [
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            "circle",
            "circle",
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            {
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            }
        ],
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                85.0
            ],
            [
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                45.0
            ],
```

(continues on next page)

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```
                [
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                    -45.0
                ],
                [
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                    -125.0
                ],
                [
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                    -45.0
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                0,
                0,
                1,
                1,
                1,
                1
            ]
        }
```

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```
    ]
}
```

1.16 Probeinterface public library

Probeinterface also handle a collection of probe description on the gin platform

The python module have simple function to download and chache locally *get_probe(...)*

```
from probeinterface import get_probe
probe = get_probe(manufacturer='neuronexus',
            probe_name='A1x32-Poly3-10mm-50-177')
```

The gin platform is a github like platform that make possible to handle "big files" with git annex. So user contribution in gin is as easy as a standard github pull request.

We expect to build rapidly commonly used probes in this public repository.

1.16.1 How to contribute

TODO: exclain with more details

1. **Genertae the JSON file with probeinterface function (or directly** with another language)
2. Generate animage with *plot_probe*
3. Clone with gin client the probeinterface_library repo
4. Put files at the good place.
5. Ask for an account
6. Push to a branch with gin client
7. Make a pull request on the gin portal (like a github PR)

1.17 API

1.17.1 Probe

class probeinterface.**Probe**(*ndim=2*, *si_units='um'*)

Class to handle the geometry of one probe.

This class mainly handles contact positions, in 2D or 3D. Optionally, it can also handle the shape of the contacts and the shape of the probe.

annotate(***kwargs*)

Annotates the probe object.

**kwargs : list of kwyword arguments to add to the annotations

copy()

Copy to another Probe instance.

Note: device_channel_indices is not copied and contact_ids is not copied

create_auto_shape(*probe_type='tip'*, *margin=20.0*)

Create planar contour automatically based on probe contact positions.

probe_type
[str, optional] The probe type ('tip' or 'rect'), by default 'tip'

margin
[float, optional] The margin to add to the contact positions, by default 20

static from_dataframe(*df*)

Create Probe from a pandas.DataFrame see Probe.to_dataframe()

df
[pandas.DataFrame] The dataframe representation of the probe

probe
[Probe] The instantiated Probe object

static from_dict(*d*)

Instantiate a Probe from a dictionary

d
[dict] The dictionary representation of the probe

probe
[Probe] The instantiated Probe object

static from_numpy(*arr*)

Create Probe from a complex numpy array see Probe.to_numpy()

arr
[np.array] The structured np.array representation of the probe

probe
[Probe] The instantiated Probe object

get_contact_count()

Return the number of contacts on the probe.

get_contact_vertices()

Return a list of contact vertices.

get_shank_count()

Return the number of shanks for this probe.

get_shanks()

Return the list of Shank objects for this Probe

get_slice(*selection*)

Get a copy of the Probe with a sub selection of contacts.

Selection can be boolean or by index

selection : np.array of bool or int (for index)

`move`(*translation_vector*)

Translate the probe in one direction.

translation_vector
[list or array] The translation vector in shape 2D or 3D

`rotate`(*theta*, *center=None*, *axis=None*)

Rotate the probe around a specified axis.

theta
[float] In degrees, anticlockwise.

center
[array] Center of rotation. If None, the center of probe is used

axis
[None] Axis of rotation. It must be None for 2D probes and specified for 3D ones

`rotate_contacts`(*thetas*)

Rotate each contact of the probe. Internaly, it modifies the contact_plane_axes.

thetas
[array of float] Rotation angle in degree. If scalar, then it is applied to all contacts.

`set_contact_ids`(*contact_ids*)

Set contact ids. Channel ids are converted to strings. Contact ids must be **unique** for the **Probe** and also for the **ProbeGroup**

contact_ids
[list or array] Array with contact ids. If contact_ids are int or float they are converted to str

`set_contacts`(*positions*, *shapes='circle'*, *shape_params={'radius': 10}*, *plane_axes=None*, *shank_ids=None*)

Sets contacts to a Probe.

positions
[array (num_contacts, ndim)] Positions of contacts (2D or 2D depending on probe 'ndim').

shapes
[str or array] Shape of each contact ('circle'/'square'/'rect').

shape_params
[dict or list of dict] Contains kwargs for shapes ("radius" for circle, "width" for square, "width/height" for rect)

plane_axes
[(num_contacts, 2, ndim)] Defines the axes of the contact plane (2d or 3d)

shank_ids
[None or array of str] Defines the shank ids for the contacts. If None, then these are assigned to a unique Shank.

`set_device_channel_indices`(*channel_indices*)

Manually set the device channel indices.

If some channels are not connected or not recorded then channel should be set to "-1"

channel_indices
[array of int] The device channel indices to set

set_planar_contour(*contour_polygon*)

Set the planar countour (the shape) of the probe.

contour_polygon
[list] List of contour points (2D or 3D depending on ndim)

set_shank_ids(*shank_ids*)

Set shank ids.

shank_ids
[list or array] Array with shank ids

to_2d(*axes='xy'*)

Transform 3d probe to 2d probe.

Note: device_channel_indices is not copied.

plane
[str] The plane on which the 2D probe is defined. 'xy', 'yz' ', xz'

to_3d(*axes='xz'*)

Transform 2d probe to 3d probe.

Note: device_channel_indices is not copied.

axes
[str] The axes that define the plane on which the 2D probe is defined. 'xy', 'yz' ', xz'

to_dataframe(*complete=False*)

Export the probe to a pandas dataframe

complete
[bool] If True, export complete information about the probe, including the probe plane axis.

df
[pandas.DataFrame] The dataframe representation of the probe

to_dict(*array_as_list=False*)

Create a dictionary of all necessary attributes. Useful for dumping and saving to json.

array_as_list
[bool, optional] If True, arrays are converted to lists, by default False

d
[dict] The dictionary representation of the probe

to_image(*values*, *pixel_size=0.5*, *num_pixel=None*, *method='linear'*, *xlims=None*, *ylims=None*)

Generated a 2d (image) from a values vector which an interpolation into a grid mesh.

values :
vector same size as contact number to be color plotted

pixel_size :
size of one pixel in micrometers

num_pixel :
alternative to pixel_size give pixel number of the image width

method : 'linear' or 'nearest' or 'cubic' xlims : tuple or None

Force image xlims

ylims
[tuple or None] Force image ylims

image
[2d array] The generated image

xlims
[tuple] The x limits

ylims
[tuple] The y limits

`to_numpy`(*complete=False*)

Export to a numpy vector (structured array). This vector handles all contact attributes.

Equivalent to the 'to_dataframe()' pandas function, but without pandas dependency.

Very useful to export/slice/attach to a recording.

complete
[bool] If True, export complete information about the probe, including contact_plane_axes/si_units/device_channel_indices (default False)

arr
[numpy.array] With complex dtype

`wiring_to_device`(*pathway*, *channel_offset=0*)

Automatically set device_channel_indices based on a pathway.

See probeinterface.get_available_pathways()

pathway
[str] The pathway. E.g. 'H32>RHD'

1.17.2 ProbeGroup

`class` probeinterface.**ProbeGroup**

Class to handle a group of Probe objects and the global wiring to a device.

Optionally, it can handle the location of different probes.

`add_probe`(*probe*)

`auto_generate_contact_ids`(**args*, ***kwargs*)

Annotate all contacts with unique contact_id values.

*args: will be forwarded to *probeinterface.utils.generate_unique_ids* **kwargs: will be forwarded to *probeinterface.utils.generate_unique_ids*

`auto_generate_probe_ids`(**args*, ***kwargs*)

Annotate all probes with unique probe_id values.

*args: will be forwarded to *probeinterface.utils.generate_unique_ids* **kwargs: will be forwarded to *probeinterface.utils.generate_unique_ids*

static from_dict(*d*)

Instantiate a ProbeGroup from a dictionary

d
[dict] The dictionary representation of the probegroup

probegroup
[ProbeGroup] The instantiated ProbeGroup object

get_channel_count()

Total number of channels.

get_global_contact_ids()

get all contact ids concatenated across probes

get_global_device_channel_indices()

return a numpy array vector with 2 columns (probe_index, device_channel_indices)

Note:
channel -1 means not connected

set_global_device_channel_indices(*channels*)

Set global indices for all probes

to_dict(*array_as_list=False*)

Create a dictionary of all necessary attributes.

array_as_list
[bool, optional] If True, arrays are converted to lists, by default False

d
[dict] The dictionary representation of the probegroup

to_numpy(*complete=False*)

Export all probes into a numpy array.

1.17.3 Import/export to formats

Read/write probe info using a variety of formats:

- probeinterface (.json)
- PRB (.prb)
- CSV (.csv)
- mearec (.h5)
- spikeglx (.meta)
- ironclust/jrclust (.mat)
- Neurodata Without Borders (.nwb)

probeinterface.io.**read_probeinterface**(*file*)

Read probeinterface JSON-based format.

file: Path or str
The file path

probegroup : ProbeGroup object

probeinterface.io.**write_probeinterface**(*file*, *probe_or_probegroup*)

Write a probeinterface JSON file.

The format handles several probes in one file.

file
[Path or str] The file path

probe_or_probegroup
[Probe or ProbeGroup object] If probe is given a probegroup is created anyway

probeinterface.io.**read_prb**(*file*)

Read a PRB file and return a ProbeGroup object.

Since PRB does not handle contact shapes, contacts are set to be circle of 5um radius. Same for the probe shape, where an auto shape is created.

PRB format does not contain any information about the channel of the probe Only the channel index on device is given.

file
[Path or str] The file path

probegroup : ProbeGroup object

probeinterface.io.**write_prb**(*file*, *probegroup*, *total_nb_channels=None*, *radius=None*, *group_mode='by_probe'*)

Write ProbeGroup into a prb file.

This format handles:

- multi Probe with channel group index key
- channel positions with "geometry"
- device_channel_indices with "channels "key

Note: much information is lost in the PRB format:

- contact shape
- shape
- channel index

Note:

- "total_nb_channels" is needed by spyking-circus
- "radius" is needed by spyking-circus
- "graph" is not handled

probeinterface.io.**read_csv**(*file*)

Return a 2 or 3 columns csv file with contact positions

probeinterface.io.**write_csv**(*file*, *probe*)

Write contact postions into a 2 or 3 columns csv file

probeinterface.io.**read_spikeglx**(*file*)

Read probe position for the meta file generated by SpikeGLX

See http://billkarsh.github.io/SpikeGLX/#metadata-guides for implementation. The x_pitch/y_pitch/width are set automatically depending the NP version.

The shape is auto generated as a shank.

Now read:

- NP1.0 (=phase3B2)
- NP2.0 with 4 shank

file
[Path or str] The .meta file path

probe : Probe object

probeinterface.io.**read_mearec**(*file*)

Read probe position, and contact shape from a MEArec file.

See https://mearec.readthedocs.io/en/latest/ and https://doi.org/10.1007/s12021-020-09467-7 for implementation.

file
[Path or str] The file path

probe : Probe object

probeinterface.io.**read_nwb**(*file*)

Read probe position from an NWB file

1.17.4 Probe generators

This module contains useful helper functions for generating probes.

probeinterface.generator.**generate_dummy_probe**(*elec_shapes='circle'*)

Generate a dummy probe with 3 columns and 32 contacts. Mainly used for testing and examples.

elec_shapes
[str, optional] Shape of the electrodes, by default 'circle'

probe
[Probe] The generated probe

probeinterface.generator.**generate_dummy_probe_group**()

Generate a ProbeGroup with 2 probes. Mainly used for testing and examples.

probe
[Probe] The generated probe

probeinterface.generator.**generate_tetrode**(*r=10*)

Generate a tetrode Probe.

probe
[Probe] The generated probe

probeinterface.generator.**generate_multi_columns_probe**(*num_columns=3*, *num_contact_per_column=10*, *xpitch=20*, *ypitch=20*, *y_shift_per_column=None*, *contact_shapes='circle'*, *contact_shape_params={'radius': 6}*)

Generate a Probe with several columns.

num_columns
[int, optional] Number of columns, by default 3

num_contact_per_column
[int, optional] Number of contacts per column, by default 10

xpitch
[float, optional] Pitch in x direction, by default 20

ypitch
[float, optional] Pitch in y direction, by default 20

y_shift_per_column
[float, optional] Shift in y direction per column, by default None

contact_shapes
[str, optional] Shape of the contacts ('circle', 'rect', 'square'), by default 'circle'

contact_shape_params
[dict, optional] Parameters for the shape, by default {'radius': 6}

probe
[Probe] The generated probe

probeinterface.generator.**generate_linear_probe**(*num_elec=16*, *ypitch=20*, *contact_shapes='circle'*, *contact_shape_params={'radius': 6}*)

Generate a one-column linear probe.

num_elec
[int, optional] Number of electrodes, by default 16

ypitch
[float, optional] Pitch in y direction, by default 20

contact_shapes
[str, optional] Shape of the contacts ('circle', 'rect', 'square'), by default 'circle'

contact_shape_params
[dict, optional] Parameters for the shape, by default {'radius': 6}

probe
[Probe] The generated probe

1.17.5 Plotting

A simple implementation for plotting a Probe or ProbeGroup using matplotlib.

Depending on Probe.ndim, the plotting is done in 2D or 3D

probeinterface.plotting.**plot_probe**(*probe*, *ax=None*, *contacts_colors=None*, *with_channel_index=False*, *with_contact_id=False*, *with_device_index=False*, *text_on_contact=None*, *first_index='auto'*, *contacts_values=None*, *cmap='viridis'*, *title=True*, *contacts_kargs={}*, *probe_shape_kwargs={}*, *xlims=None*, *ylims=None*, *zlims=None*, *show_channel_on_click=False*)

Plot a Probe object. Generates a 2D or 3D axis, depending on Probe.ndim

probe
[Probe] The probe object

ax
[matplotlib.axis, optional] The axis to plot the probe on. If None, an axis is created, by default None

contacts_colors
[matplotlib color, optional] The color of the contacts, by default None

with_channel_index
[bool, optional] If True, channel indices are displayed on top of the channels, by default False

with_contact_id
[bool, optional] If True, channel ids are displayed on top of the channels, by default False

with_device_index
[bool, optional] If True, device channel indices are displayed on top of the channels, by default False

text_on_contact: None or list or numpy.array
Addintional text to plot on each contact

first_index
[str, optional] The first index of the contacts, by default 'auto' (taken from channel ids)

contacts_values
[np.array, optional] Values to color the contacts with, by default None

cmap
[str, optional] [description], by default 'viridis'

title
[bool, optional] If True, the axis title is set to the probe name, by default True

contacts_kargs
[dict, optional] Dict with kwargs for contacts (e.g. alpha, edgecolor, lw), by default {}

probe_shape_kwargs
[dict, optional] Dict with kwargs for probe shape (e.g. alpha, edgecolor, lw), by default {}

xlims
[tuple, optional] Limits for x dimension, by default None

ylims
[tuple, optional] Limits for y dimension, by default None

zlims
[tuple, optional] Limits for z dimension, by default None

show_channel_on_click
[bool, optional] If True, the channel information is shown upon click, by default False

poly
[PolyCollection] The polygon collection for contacts

poly_contour
[PolyCollection] The polygon collection for the probe shape

probeinterface.plotting.**plot_probe_group**(*probegroup*, *same_axes=True*, ***kargs*)

Plot all probes from a ProbeGroup Can be in an existing set of axes or separate axes.

probegroup
[ProbeGroup] The ProbeGroup to plot

same_axes
[bool, optional] If True, the probes are plotted on the same axis, by default True

1.17.6 Library

Provides functions to download and cache pre-existing probe files from some manufacturers.

The library is hosted here: https://gin.g-node.org/spikeinterface/probeinterface_library

The gin platform enables contributions from users.

probeinterface.library.**get_probe**(*manufacturer*, *probe_name*)

Get probe from ProbeInterface library

manufacturer
[str] The probe manufacturer (e.g. 'cambridgeneurotech')

probe_name
[str] The probe name

probe : Probe object

1.18 Release notes

1.18.1 probeinterface 0.2.11

September, 14th 2022

- do not rely on BASESTATION field to parse OpenEphys probe

1.18.2 probeinterface 0.2.10

September, 1st 2022

- fix read_openephys()
- fix read_spikeglx()
- regenerate cambridge neurotec
- implement read_imro() / write_imro()

- Add new wiring : 'ASSY-77>Adpt.A64-Om32_2x-sm>two_RHD2132'
- Handle OpenEphys NPIX with multiple probes
- Add cross-checked ASSY-116>RHD2132 mapping

1.18.3 probeinterface 0.2.9

April, 15th 2022

- openephys neuropixel
- fix examples

1.18.4 probeinterface 0.2.8

March, 23rd 2022

- wiring CambridgeNeurotec mini-amp-64
- expose function select_dimensions (2d>3d and 3d>2d)
- add to_dict/from_dict in ProbeGroup
- Add "text_on_contact" in plot_probe()
- Add read_openephys function for Neuropux-PXI plugin

1.18.5 probeinterface 0.2.7

March, 1 2022

- add read_3brain to io
- annotate spikeGLX with probe version

1.18.6 probeinterface 0.2.6

November, 26 2021

- documention improvement
- spikeglx neuropixel2 integration
- plotting improvement

1.18.7 probeinterface 0.2.5

September, 14 2021

- vector annotations added to numpy representation
- add "electrode" to annotations from read_maxwell

1.18.8 probeinterface 0.2.4

July, 30 2021

- expose read_maxwell function
- vector annotations
- changes to BIDS format

1.18.9 probeinterface 0.2.3

May, 21 2021

- add a pathway
- show_channel_on_click
- debug read_mearec()

1.18.10 probeinterface 0.2.2

April, 4 2021

- better plot_probe with index
- write_prb handle group_mode
- add wriring RDH2164
- doc improvement

1.18.11 probeinterface 0.2.1

March, 24 2021

- read/write to BIDS proposal.
- to_numpy()/from_numpy()
- to_dataframe()/from_dataframe()
- read_mearec

1.18.12 probeinterface 0.2.0

March, 2 2021

Format improvement with all ids in str.

1.18.13 probeinterface 0.1.0

11th jan 2021

Initial release.

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