FiberNeat Tutorial

Chandio, B.Q., Chattopadhyay, T., Owens-Walton, C., Reina, J.E.V., Nabulsi, L., Thomopoulos, S.I., Garyfallidis, E. and Thompson, P.M., 2021. FiberNeat: unsupervised streamline clustering and white matter tract filtering in latent space. bioRxiv.

https://www.biorxiv.org/content/10.1101/2021.10.26.465991v3.full.pdf

In [68]:

```
from fiberneat import FiberNeat
from dipy.io.streamline import load_trk
import matplotlib.pyplot as plt
from dipy.viz import actor, window
from dipy.io.stateful_tractogram import Space, StatefulTractogram
from dipy.io.streamline import save_tractogram
```

In [71]:

```
# load data
filename = "data/UF_L.trk"
sft = load_trk(filename, "same", bbox_valid_check=False)
bundle = sft.streamlines
```

In [62]:

```
def show_bundle(bundle, fname, interactive=False):

    scene = window.Scene()
    scene.SetBackground(1, 1, 1)
    lines_actor = actor.streamtube(bundle, linewidth=0.5)
    lines_actor.RotateX(-70)
    lines_actor.RotateZ(90)
    scene.add(lines_actor)

    # set interactive=True for interactive visualization
    if interactive:
        window.show(scene)

    window.record(scene, n_frames=1, out_path=fname, size=(1200, 1200))

    im = plt.imread(fname)
    plt.figure(figsize=(10,10))
    plt.imshow(im)
```

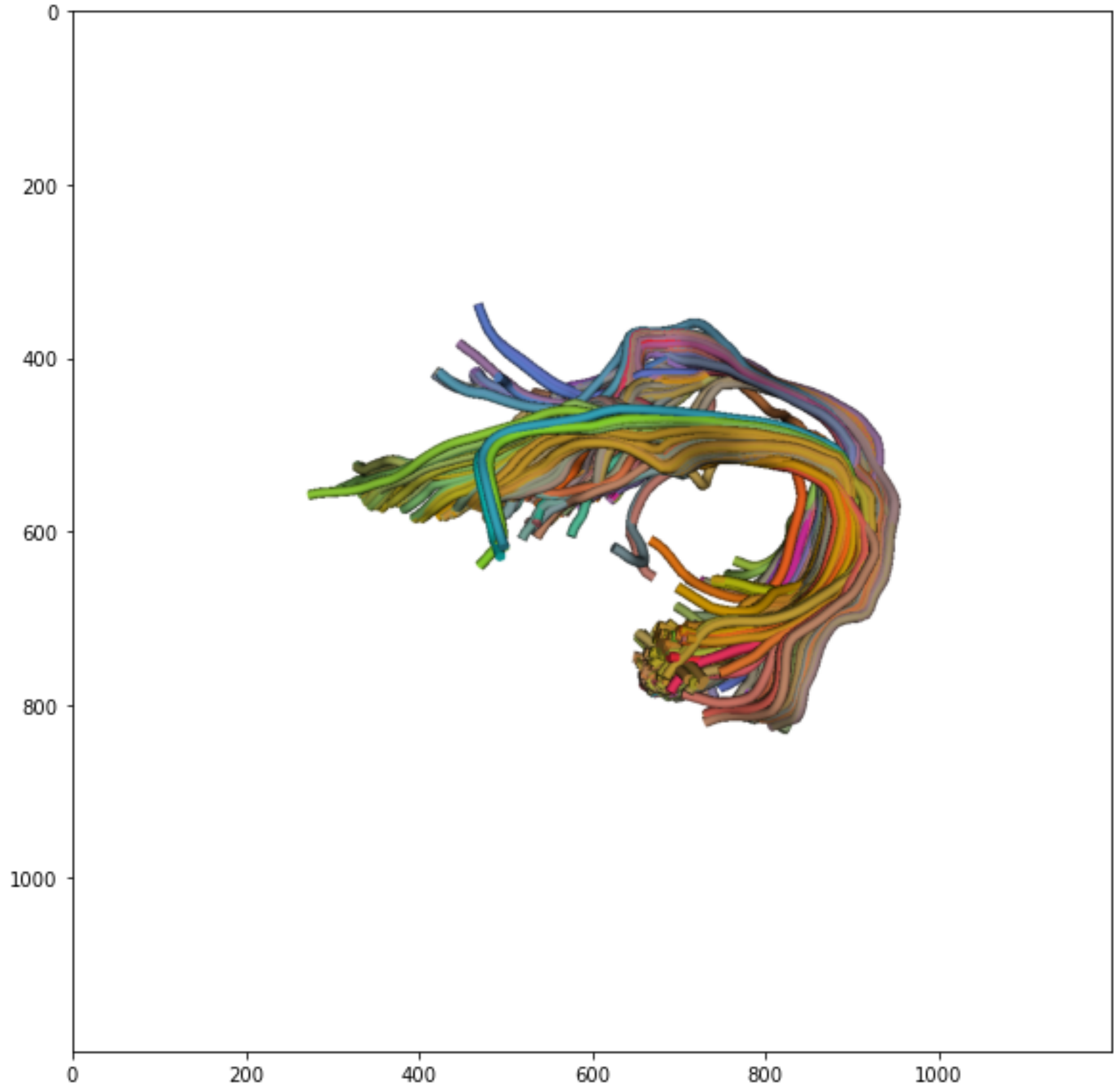
In [38]:

```
def show_bundle_overlap(bundle1, bundle2, fname, interactive=False):

    scene = window.Scene()
    scene.SetBackground(1, 1, 1)
    lines_actor = actor.streamtube(bundle1, linewidth=0.5, colors=(0,1,0))
    lines_actor.RotateX(-70)
    lines_actor.RotateZ(90)
    lines_actor2 = actor.streamtube(bundle2, linewidth=0.5, colors=(1,0,0), o
    lines_actor2.RotateX(-70)
    lines_actor2.RotateZ(90)
    scene.add(lines_actor)
    scene.add(lines_actor2)

    # set interactive=True for interactive visualization
    if interactive:
        window.show(scene)

    window.record(scene, n_frames=1, out_path=fname, size=(1200, 1200))
    im = plt.imread(fname)
    plt.figure(figsize=(10,10))
    plt.imshow(im)
```

Input uncinate fasciculus left bundle

In [74]:

```
# input uncinate fasciculus left bundle
fname = "output/before_FiberNeat_filtering.png"
show_bundle(bundle, fname)
```



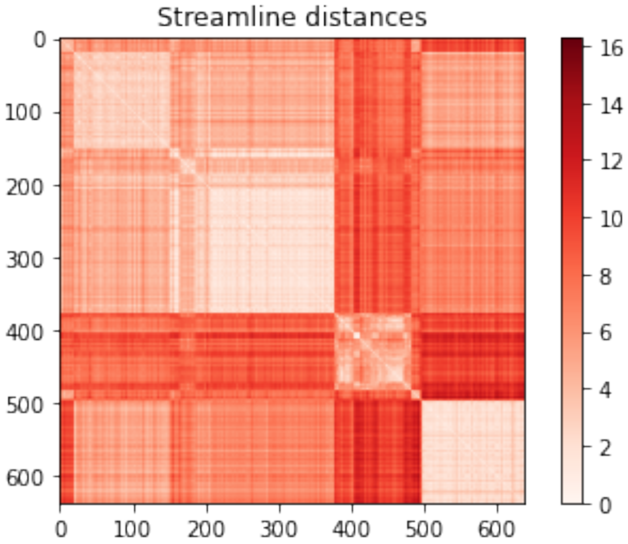
FiberNeat with t-SNE

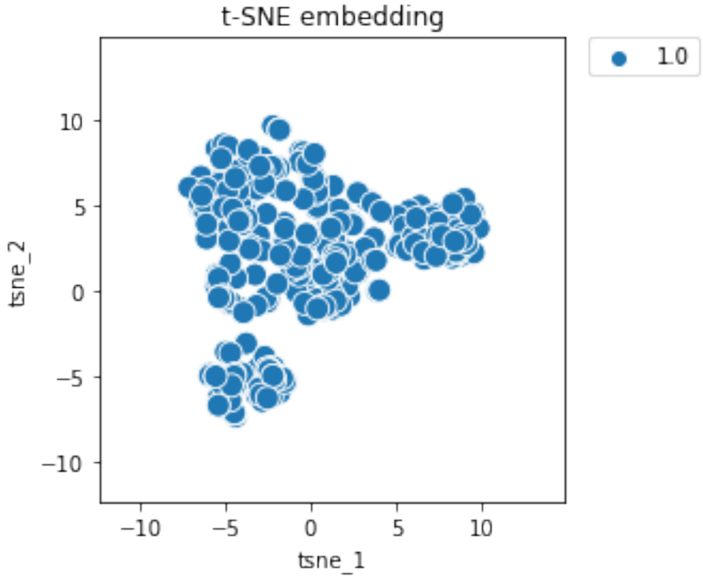
In [75]:

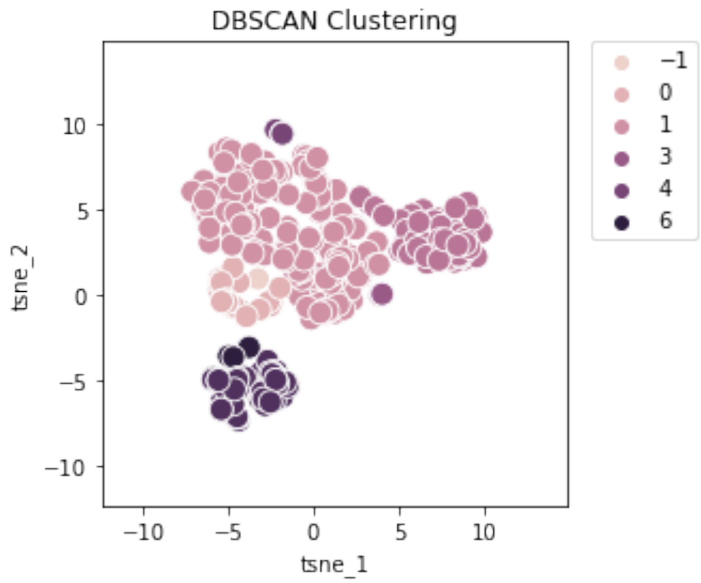
```
cleaned_bundle = FiberNeat(bundle, dim_method='tsne')
```

```
/Users/bramshqamarchandio/anaconda3/envs/umap/lib/python3.9/site-packages/skle
arn/manifold/_t_sne.py:790: FutureWarning: The default learning rate in TSNE w
ill change from 200.0 to 'auto' in 1.2.
  warnings.warn(
/Users/bramshqamarchandio/anaconda3/envs/umap/lib/python3.9/site-packages/skle
arn/manifold/_t_sne.py:819: FutureWarning: 'square_distances' has been introdu
ced in 0.24 to help phase out legacy squaring behavior. The 'legacy' setting w
```

```
ill be removed in 1.1 (renaming of 0.26), and the default setting will be chan
ged to True. In 1.3, 'square_distances' will be removed altogether, and distan
ces will be squared by default. Set 'square_distances'=True to silence this wa
rning.
  warnings.warn(
time taken in seconds =  6.858464002609253
```



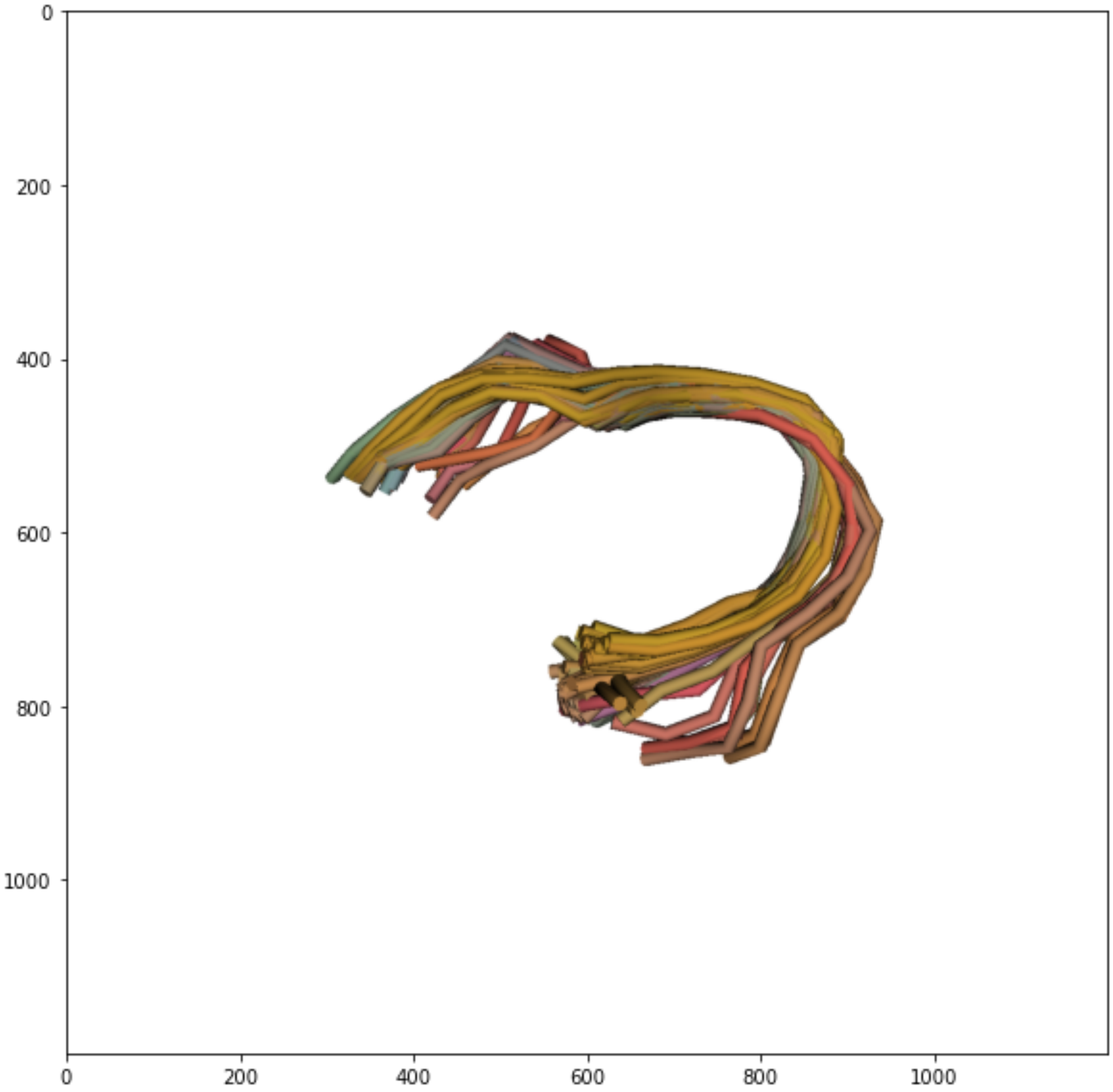




FiberNeat_tSNE output bundle

In [64]:

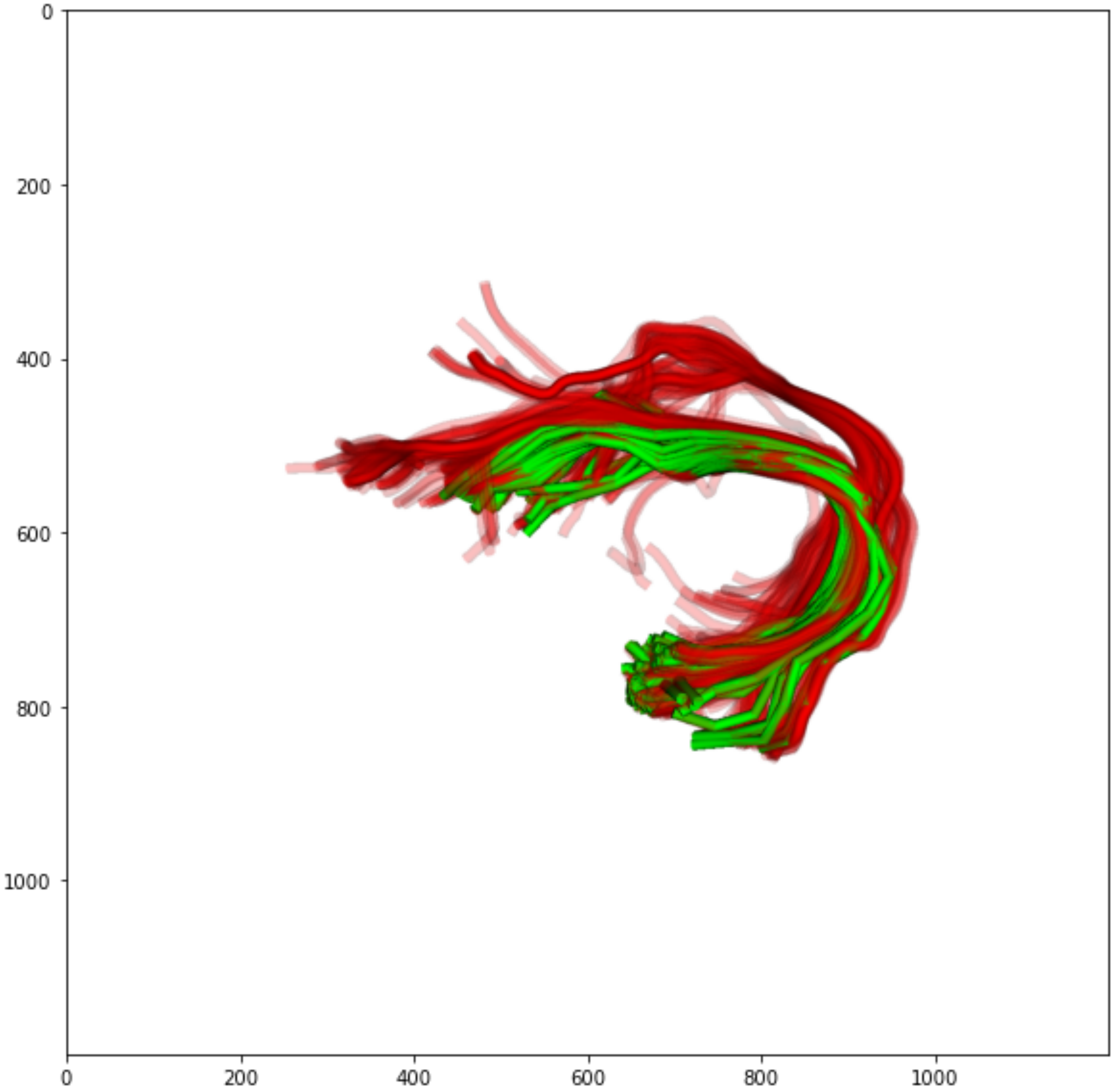
```
fname = "output/after_FiberNeat_filtering_tsne.png"
show_bundle(cleaned_bundle, fname)
```



Original and FiberNeat_tSNE output bundle Overlap

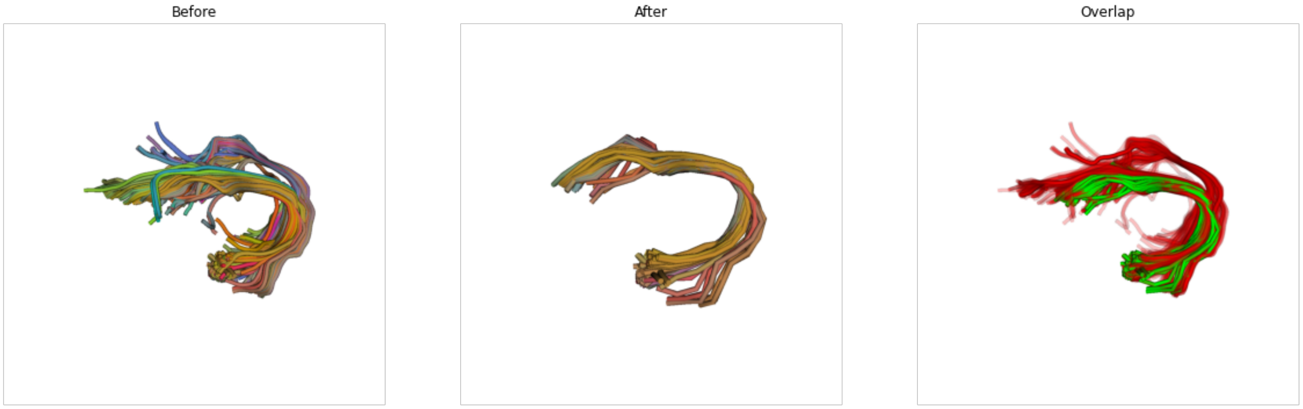
Red are the streamlines cleaned by FiberNeat

In [42]:
```
fname = "output/before_after_overlap_tsne.png"
show_bundle_overlap(cleaned_bundle, bundle, fname)

# red are the streamlines cleaned by FiberNeat
```


0
200
400
600
800
1000
0
200
400
600
800
1000

In [43]:

```
im1 = plt.imread("output/before_FiberNeat_filtering.png")
im2 = plt.imread("output/after_FiberNeat_filtering_tsne.png")
im3 = plt.imread("output/before_after_overlap_tsne.png")


fig = plt.figure(figsize=(20,20))
a = fig.add_subplot(1, 3, 1)
imgplot = plt.imshow(im1)
a.axis('off')
a.set_title('Before')
a = fig.add_subplot(1, 3, 2)
imgplot = plt.imshow(im2, cmap="gray")
a.axis('off')
a.set_title('After')
a = fig.add_subplot(1, 3, 3)
imgplot = plt.imshow(im3, cmap="gray")
a.axis('off')
a.set_title('Overlap')
plt.savefig('output/fiberneat_tsne_results.png', bbox_inches='tight', pad_inc
```



Before

After

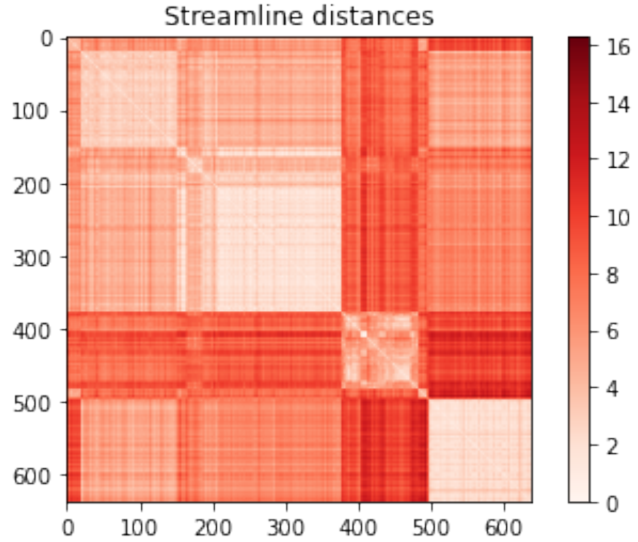
Overlap

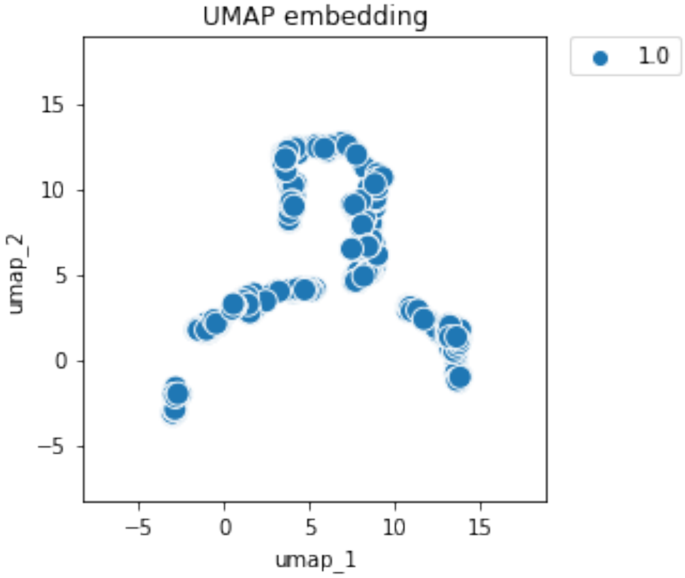
FiberNeat with UMAP

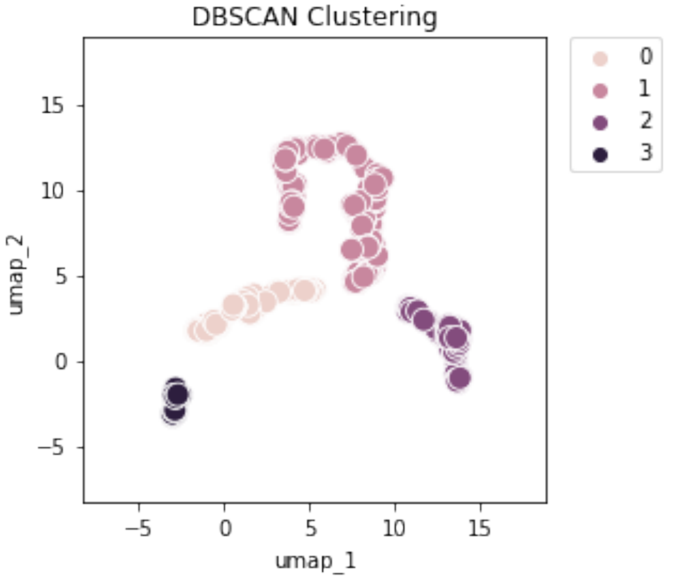
In [76]:

```
cleaned_bundle2 = FiberNeat(bundle, dim_method='umap')
```

```
time taken in seconds =  5.952687740325928
```



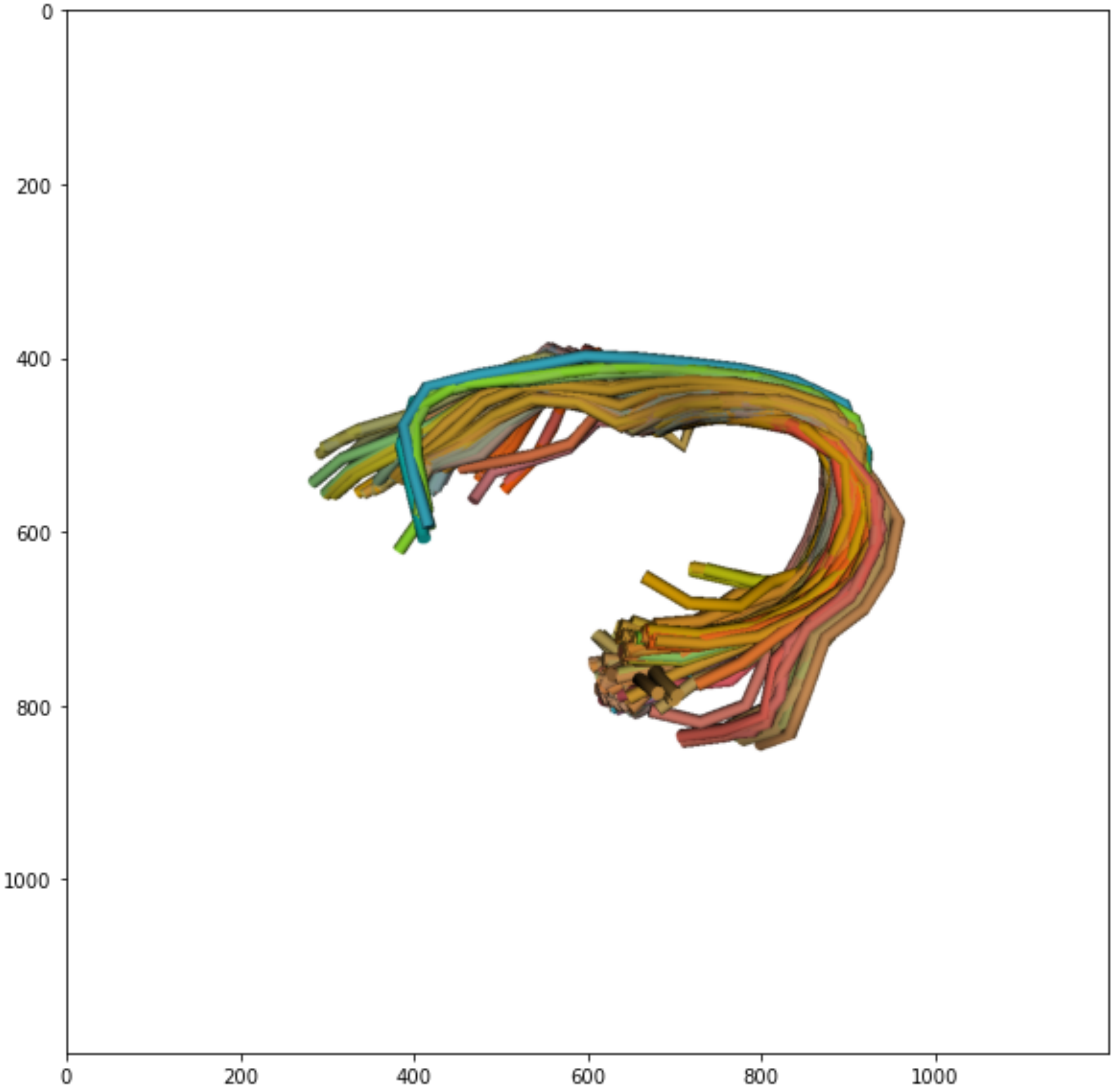




FiberNeat_UMAP output bundle

In [77]:

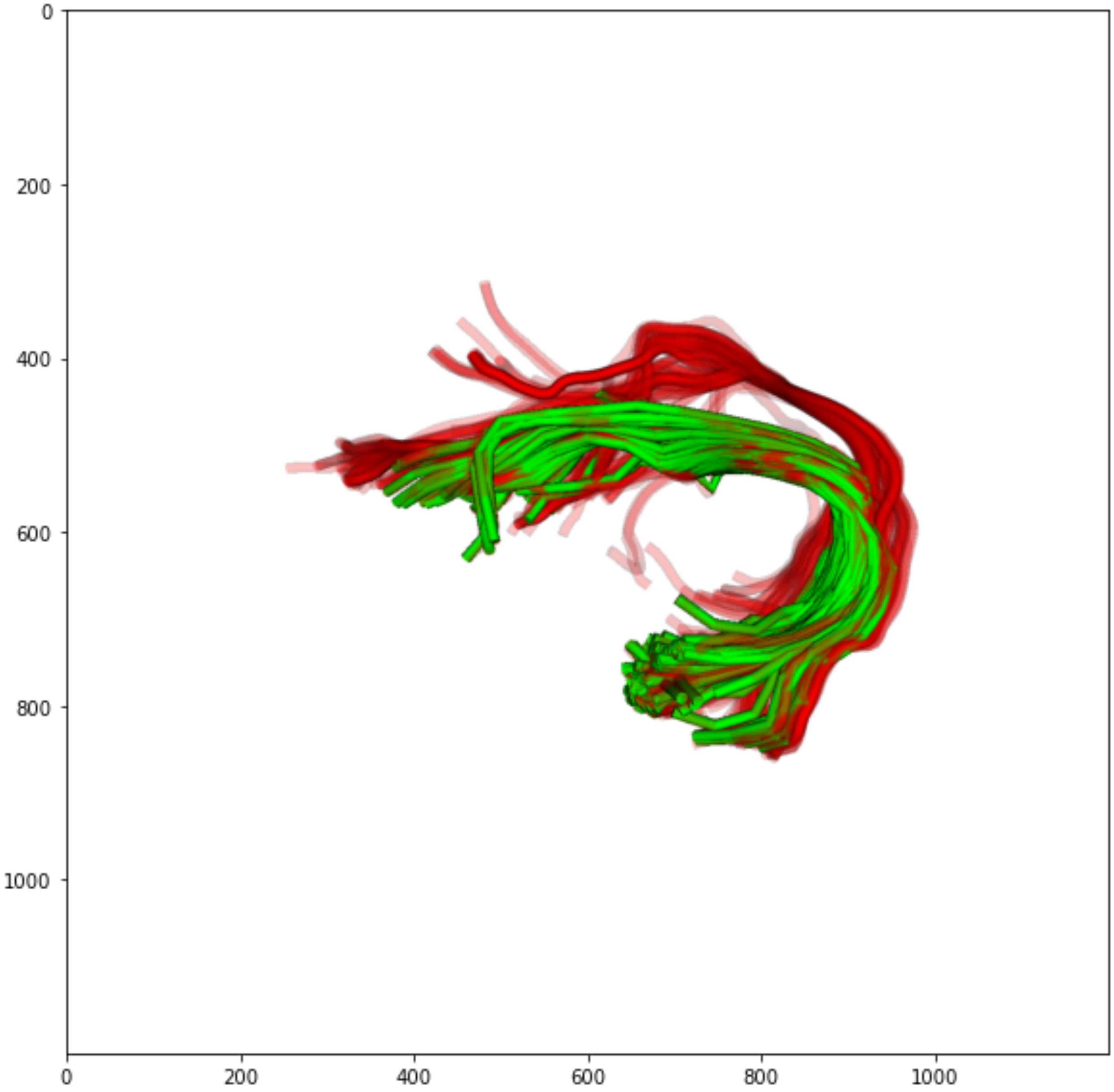
```
fname = "output/after_FiberNeat_filtering_umap.png"
show_bundle(cleaned_bundle2, fname)
```



Original and FiberNeat_tSNE output bundle Overlap Red are the streamlines cleaned by FiberNeat

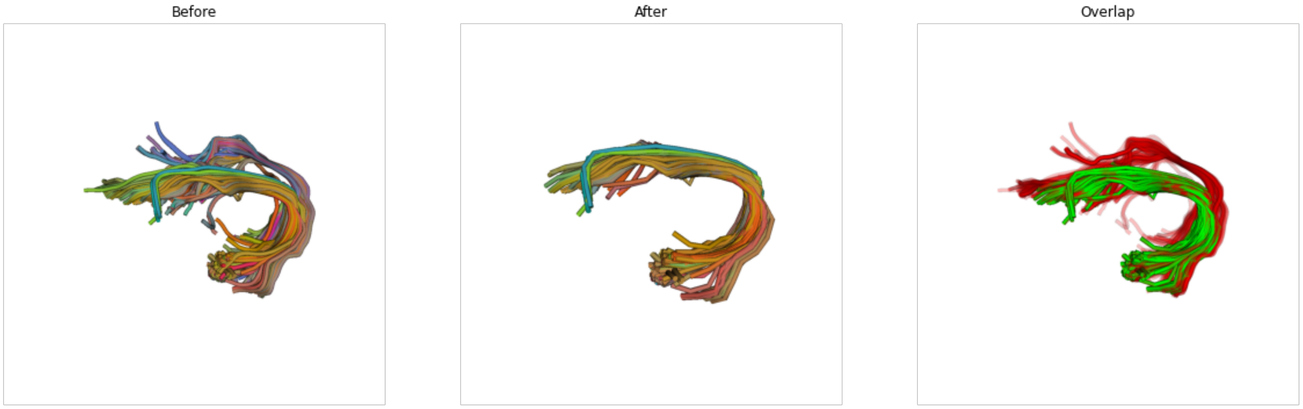
In [46]:

```
fname = "output/before_after_overlap_umap.png"
show_bundle_overlap(cleaned_bundle2, bundle, fname)
```



In [50]:

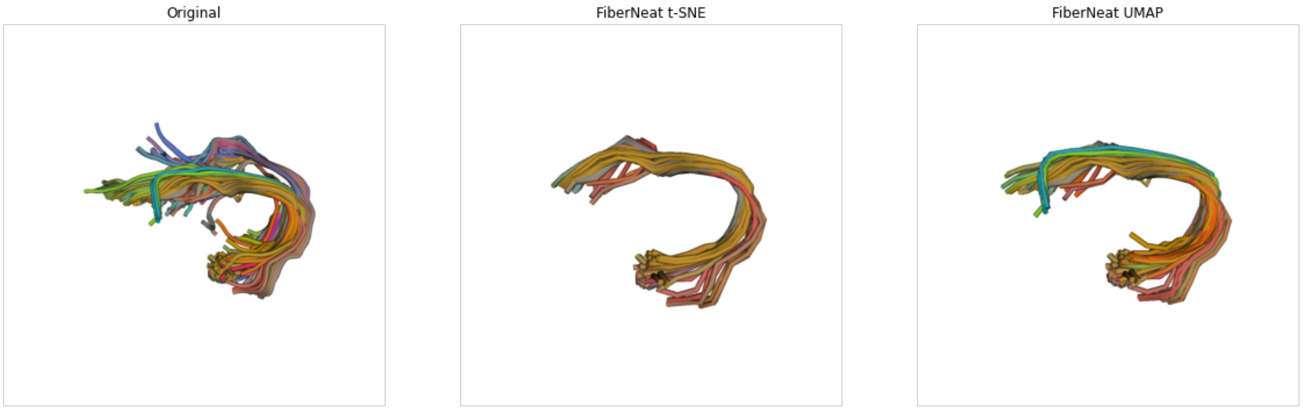
```
im1 = plt.imread("output/before_FiberNeat_filtering.png")
im2 = plt.imread("output/after_FiberNeat_filtering_umap.png")
im3 = plt.imread("output/before_after_overlap_umap.png")


fig = plt.figure(figsize=(20,20))
a = fig.add_subplot(1, 3, 1)
imgplot = plt.imshow(im1)
a.axis('off')
a.set_title('Before')
a = fig.add_subplot(1, 3, 2)
imgplot = plt.imshow(im2, cmap="gray")
a.axis('off')
a.set_title('After')
a = fig.add_subplot(1, 3, 3)
imgplot = plt.imshow(im3, cmap="gray")
a.axis('off')
a.set_title('Overlap')
plt.savefig('output/fiberneat_tsne_results.png', bbox_inches='tight', pad_inc
```



FiberNeat_tSNE and FiberNeat_UMAP comparison

In [51]:

```
im1 = plt.imread("output/before_FiberNeat_filtering.png")
im2 = plt.imread("output/after_FiberNeat_filtering_tsne.png")
im3 = plt.imread("output/after_FiberNeat_filtering_umap.png")


fig = plt.figure(figsize=(20,20))
a = fig.add_subplot(1, 3, 1)
imgplot = plt.imshow(im1)
a.axis('off')
a.set_title('Original')
a = fig.add_subplot(1, 3, 2)
imgplot = plt.imshow(im2, cmap="gray")
a.axis('off')
a.set_title('FiberNeat t-SNE')
a = fig.add_subplot(1, 3, 3)
imgplot = plt.imshow(im3, cmap="gray")
a.axis('off')
a.set_title('FiberNeat UMAP')
plt.savefig('output/fiberneat_tsne_umap_results.png', bbox_inches='tight', pa
```



Original

FiberNeat t-SNE

FiberNeat UMAP

Save bundles

In [73]:

```
filename_t = "output/cleaned_fiberneat_tsne_"+filename[5:]
new_tractogram = StatefulTractogram(cleaned_bundle, filename, Space.RASMM)
save_tractogram(new_tractogram, filename_t, bbox_valid_check=False)

filename_u = "output/cleaned_fiberneat_umap_"+filename[5:]
new_tractogram = StatefulTractogram(cleaned_bundle2, filename, Space.RASMM)
save_tractogram(new_tractogram, filename_u, bbox_valid_check=False)
```

Out[73]:

```
True
```

In [ ]: