Results Template

A Subtitle

Contents

Packages

Introduction

Sliding windows

```
import sys
sys.path.insert(1, 'libs/')

import dynfc as dyn
import numpy as np
from numpy.random import seed, rand
import scipy as sc
from scipy import io
import seaborn as sns
import matplotlib.pyplot as plt
import matplotlib.cbook as cbook
import matplotlib.cm as cm
import matplotlib.patches as patches

font = {'weight' : 'regular',
        'size'   : 24}
plt.rc('font', **font)

ts = sc.io.loadmat('data/ts.mat')['ts']
ts = ts.transpose()
```

```
corr_mats, idx = dyn.corr_slide(ts,300,50)

idx.shape
```

```
> (24,)
```

```
a = [1,1,1,1,1.6]

fig,ax = plt.subplots(1)
fig.set_figheight(10)
fig.set_figwidth(20)
plt.style.use('tableau-colorblind10')
for i in range(5):

    plt.plot(2*i*a[i] + ts[i,]/1.4)
```

```
> [<matplotlib.lines.Line2D object at 0x7fc23f694dd8>]
> [<matplotlib.lines.Line2D object at 0x7fc281700470>]
> [<matplotlib.lines.Line2D object at 0x7fc2f10a5ef0>]
> [<matplotlib.lines.Line2D object at 0x7fc2f10a57f0>]
> [<matplotlib.lines.Line2D object at 0x7fc281700668>]
```

```
plt.xlabel('Time [TRs]')
```

```
> Text(0.5, 0, 'Time [TRs]')
```

```
plt.ylabel('BOLD')
```

```
> Text(0, 0.5, 'BOLD')
```

```
ax.tick_params(left=False)
ax.set_yticklabels([])
```

```
> [Text(0, -2.0, ''), Text(0, 0.0, ''), Text(0, 2.0, ''), Text(0, 4.0, ''), Text(0, 6.0, ''), Text(0, 8
```

```
ax.set_ylim(-3,15.4)
```

```
> (-3.0, 15.4)
```

```
ax.set_xlim(0,1200)
```

```
> (0.0, 1200.0)
```

```
rect = patches.Rectangle((idx[0],-2.8),300,18,linewidth=4,edgecolor='#595959',facecolor='none')
ax.add_patch(rect)
```

```
> <matplotlib.patches.Rectangle object at 0x7fc23f6ddc88>
```

```
rect = patches.Rectangle((idx[5],-2.8),300,18,linewidth=4,edgecolor='#A56B6B',facecolor='none')
ax.add_patch(rect)
```

```
> <matplotlib.patches.Rectangle object at 0x7fc23f6e9048>
```

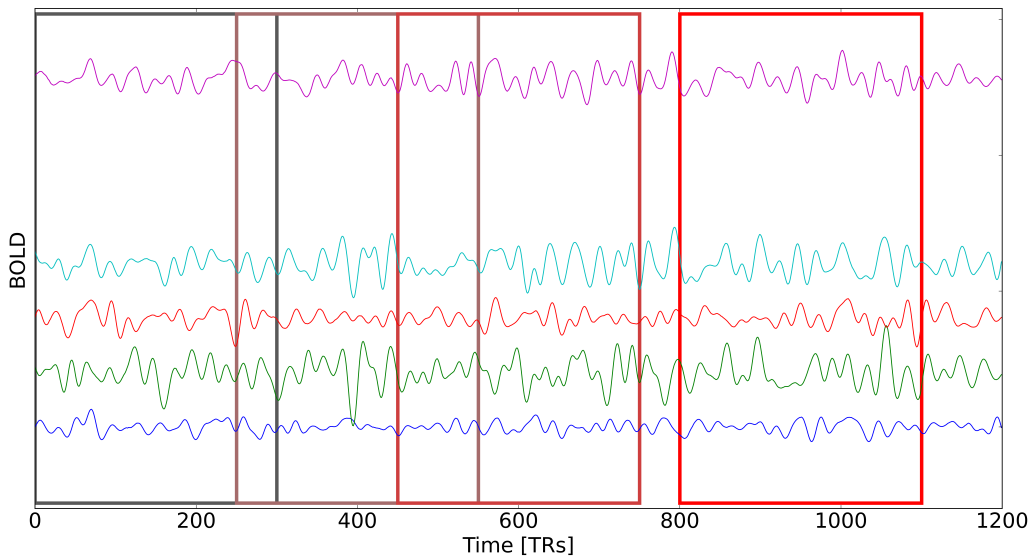
```
rect = patches.Rectangle((idx[9],-2.8),300,18,linewidth=4,edgecolor='#CE3E3E',facecolor='none')
ax.add_patch(rect)
```

```
> <matplotlib.patches.Rectangle object at 0x7fc23f6e9358>
```

```
rect = patches.Rectangle((idx[16],-2.8),300,18,linewidth=4,edgecolor='#FF0000',facecolor='none')
ax.add_patch(rect)
```

```
> <matplotlib.patches.Rectangle object at 0x7fc23f6e9668>
```

```
plt.show()
```

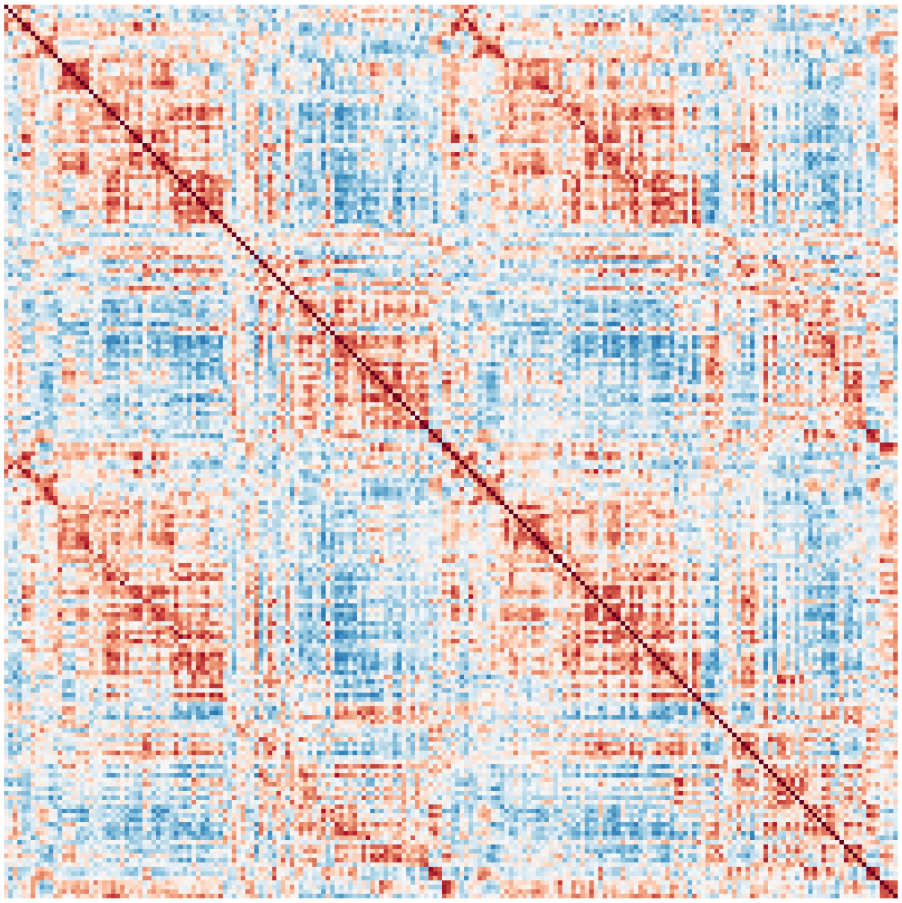



```
import sys
sys.path.insert(1, 'libs/')

import dynfc as dyn
import numpy as np
from numpy.random import seed, rand
import scipy as sc
from scipy import io
import seaborn as sns
import matplotlib.pyplot as plt
import matplotlib.cbook as cbook
import matplotlib.cm as cm
import matplotlib.patches as patches
```

```
aa = plt.figure(figsize = [6,6])
ax = sns.heatmap(corr_mats[:,:,0],
                 cmap = "RdBu_r",
                 vmin = -1,
                 vmax = 1,
                 square = True,
                 cbar = False)
ax.axis('off')
```

```
> (0.0, 200.0, 200.0, 0.0)
```

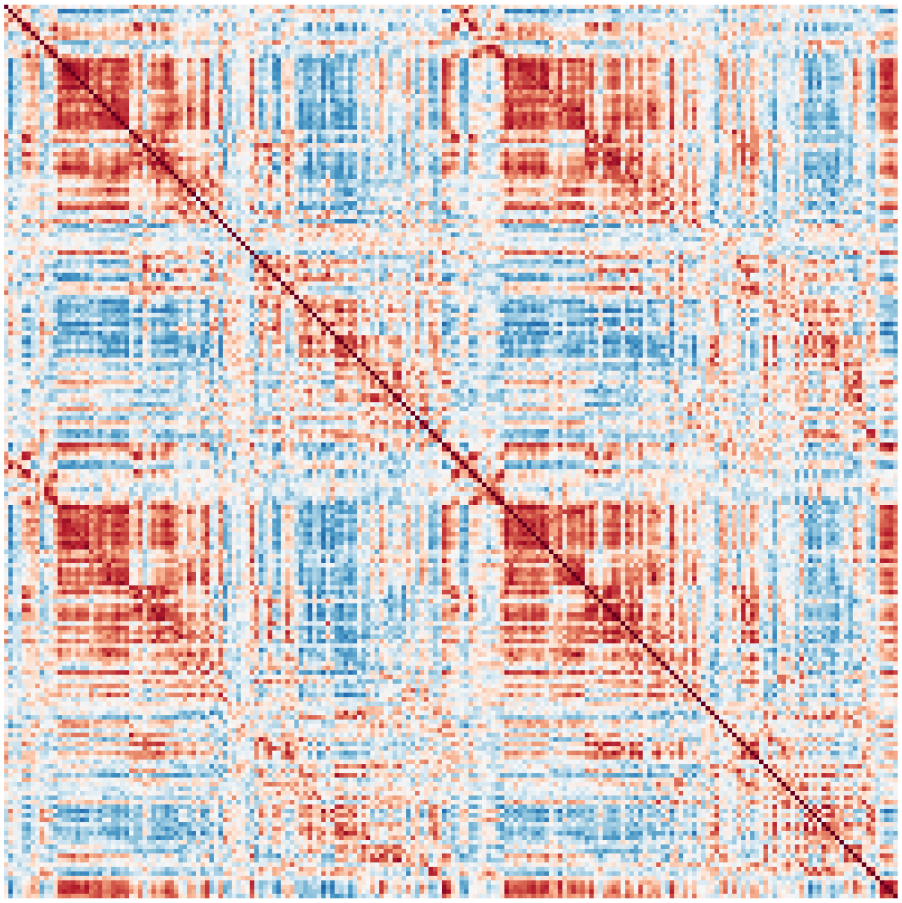
```
ax.tick_params(left=False, bottom=False)

plt.show()
```



```
aa = plt.figure(figsize = [6,6])
ax = sns.heatmap(corr_mats[:,:,5],
                 cmap = "RdBu_r",
                 vmin = -1,
                 vmax = 1,
                 square = True,
                 cbar = False)
ax.axis('off')
```

```
> (0.0, 200.0, 200.0, 0.0)
```

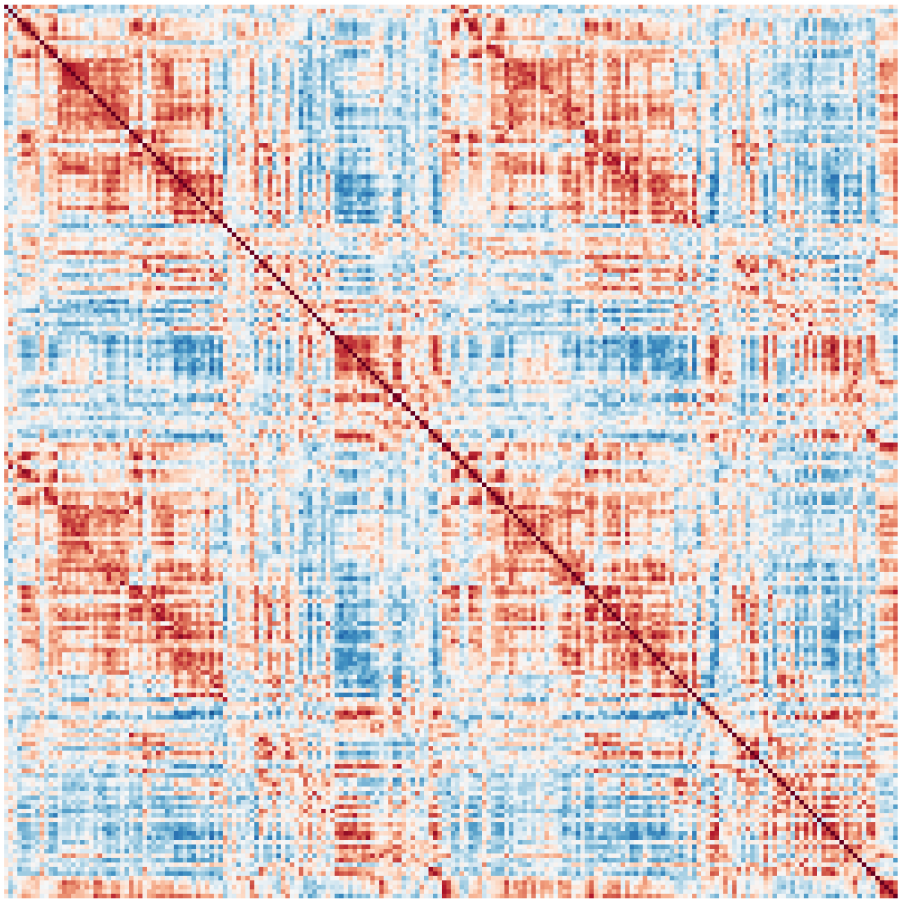
```
ax.tick_params(left=False, bottom=False)

plt.show()
```



```
aa = plt.figure(figsize = [6,6])
ax = sns.heatmap(corr_mats[:,:,9],
                 cmap = "RdBu_r",
                 vmin = -1,
                 vmax = 1,
                 square = True,
                 cbar = False)
ax.axis('off')
```

```
> (0.0, 200.0, 200.0, 0.0)
```

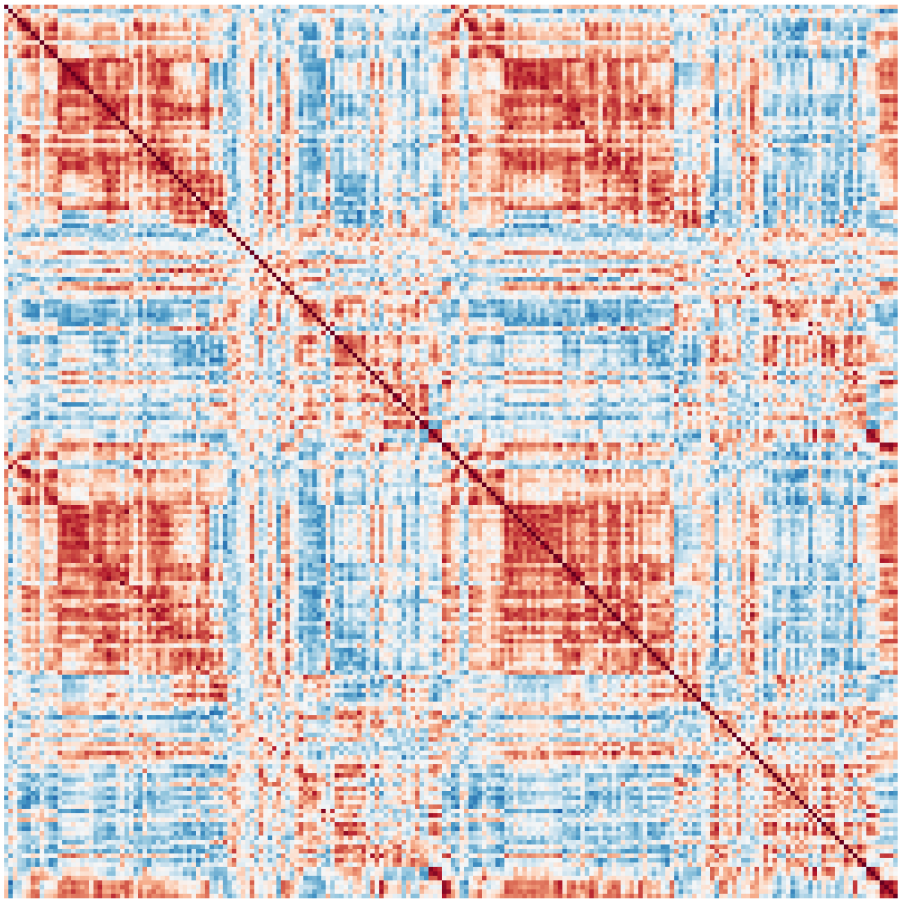
```
ax.tick_params(left=False, bottom=False)

plt.show()
```



```
aa = plt.figure(figsize = [6,6])
ax = sns.heatmap(corr_mats[:,:,16],
                 cmap = "RdBu_r",
                 vmin = -1,
                 vmax = 1,
                 square = True,
                 cbar = False)
ax.axis('off')
```

```
> (0.0, 200.0, 200.0, 0.0)
```

```
ax.tick_params(left=False, bottom=False)

plt.show()
```

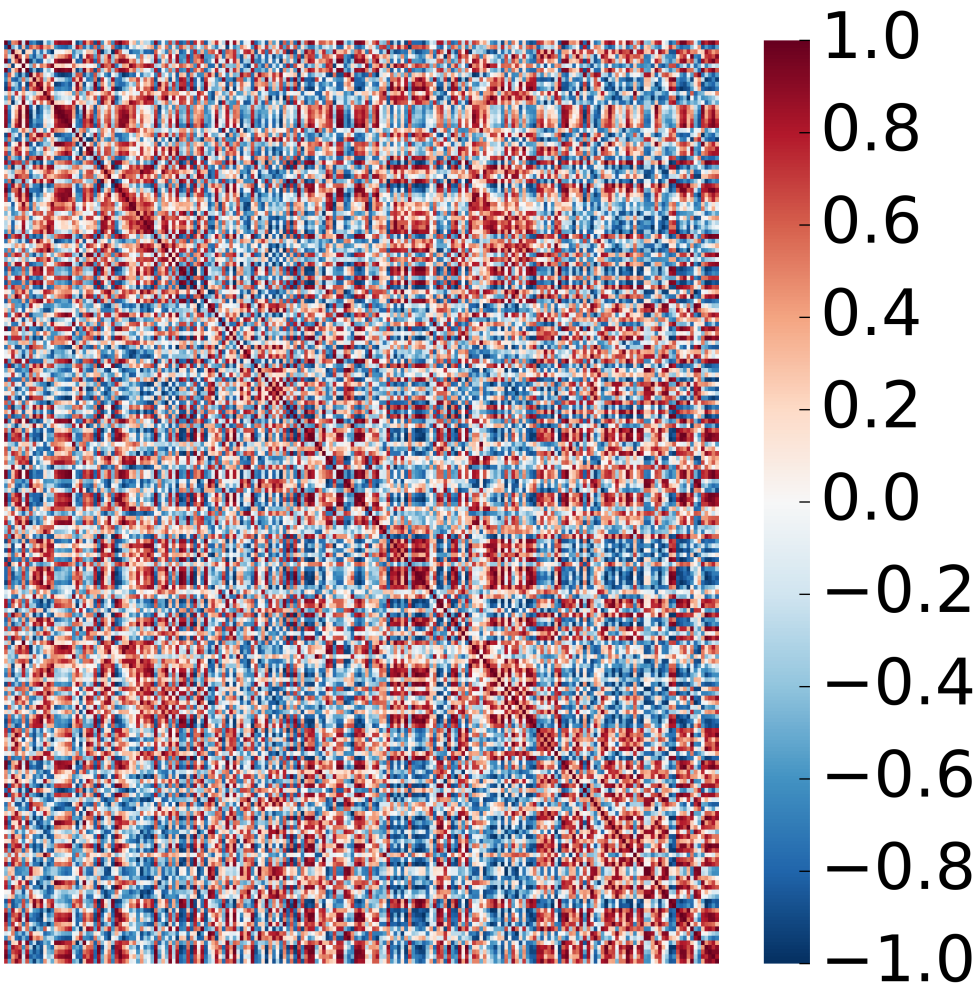


Cofluctuations

```
import sys
sys.path.insert(1, 'libs/')

import numpy as np
import scipy as sc
from scipy import io
import dynfc as dyn
import seaborn as sns
import matplotlib.pyplot as plt

ts = sc.io.loadmat('data/ts.mat')['ts']
ts = ts.transpose()

mat1, rss = dyn.corr_slide(ts,24)
mat1 = mat1[:,:,0]

aa = plt.figure(figsize = [6,6])
ax = sns.heatmap(mat1,
                 cmap = "RdBu_r",
                 vmin = -1,
                 vmax = 1,
                 square = False,
                 cbar = True)
ax.axis('off')
```

```
> (0.0, 200.0, 200.0, 0.0)
```

```
ax.tick_params(left=False, bottom=False)
plt.show()
```




```
upt = np.triu_indices(mat1.shape[0], k = 1)
vec = (mat1[upt])

toPlot = np.zeros((vec.shape[0],1))
toPlot[:,0] = vec

aa = plt.figure(figsize = (12/50,4))
ax = sns.heatmap(toPlot[:,0:1],
                 cmap = "RdBu_r",
                 vmin = -1,
                 vmax = 1,
                 square = False,
                 cbar = False)
ax.axis('off')
```

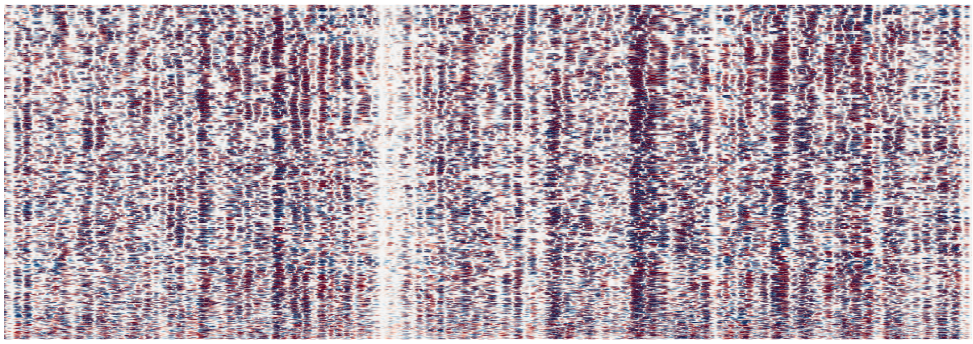
```
> (0.0, 1.0, 19900.0, 0.0)
```

```
plt.show()
```

```
edges_series, corr_mats, rss = dyn.cofluct(ts, 24)

aa = plt.figure(figsize = (12,4))
ax = sns.heatmap(edges_series,
                 cmap = "RdBu_r",
                 vmin = -1,
                 vmax = 1,
                 square = False,
                 cbar = False)
ax.axis('off')
```

```
> (0.0, 1200.0, 19900.0, 0.0)
```

```
plt.show()
```



#Phase difference

```
import sys
sys.path.insert(1, 'libs/')

import numpy as np
import matplotlib.pyplot as plt
import matplotlib.patches as patches
from mpl_toolkits.mplot3d import Axes3D

theta = np.linspace(0*np.pi, 8*np.pi, 100)
time = np.linspace(0, 8, 100)
y1 = np.sin(theta)
x1 = np.cos(theta)
y2 = np.sin(theta + np.pi/2)
x2 = np.cos(theta + np.pi/2)
r = time/np.max(time)
ones = np.ones(time.shape[0])

fig = plt.figure()
ax = fig.add_subplot(projection='3d')
plt.style.use('classic')

ax.plot(time, x1, y1, color = '#67001f', linewidth=2)
```

```
> [<mpl_toolkits.mplot3d.art3d.Line3D object at 0x7fc2f0e85be0>]
```

```
ax.plot(time,ones,y1, linestyle = '--', color = '#0f0f0f')
```

```
> [<mpl_toolkits.mplot3d.art3d.Line3D object at 0x7fc382a0c4e0>]
```

```
ax.plot(time,x1,-ones, linestyle = '--', color = '#0f0f0f')
```

```
> [<mpl_toolkits.mplot3d.art3d.Line3D object at 0x7fc389b00cc0>]
```

```
ax.quiver(time,0,0,0, 0.99*x1, 0.99*y1,
          length = 0.9,
          normalize = False,
```

```
          arrow_length_ratio = 0.1,
          alpha = 0.4,
          color = '#053061')
```

```
> <mpl_toolkits.mplot3d.art3d.Line3DCollection object at 0x7fc281786278>
```

```
ax.text(0.5, 1, 0.5, r'$\sin(\theta)$', fontsize = 20)
```

```
> Text(0.5, 1, '$\\sin(\\theta)$')
```

```
ax.text(0.5, -1, -1, r'$\cos(\theta)$', fontsize = 20)
```

```
> Text(0.5, -1, '$\\cos(\\theta)$')
```

```
ax.set_xlabel('Time')
```

```
> Text(0.5, 0, 'Time')
```

```
ax.set_ylabel('Re')
```

```
> Text(0.5, 0, 'Re')
```

```
ax.set_zlabel('Im')
```

```
> Text(0.5, 0, 'Im')
```

```
ax.set_xlim(0,8)
```

```
> (0.0, 8.0)
```

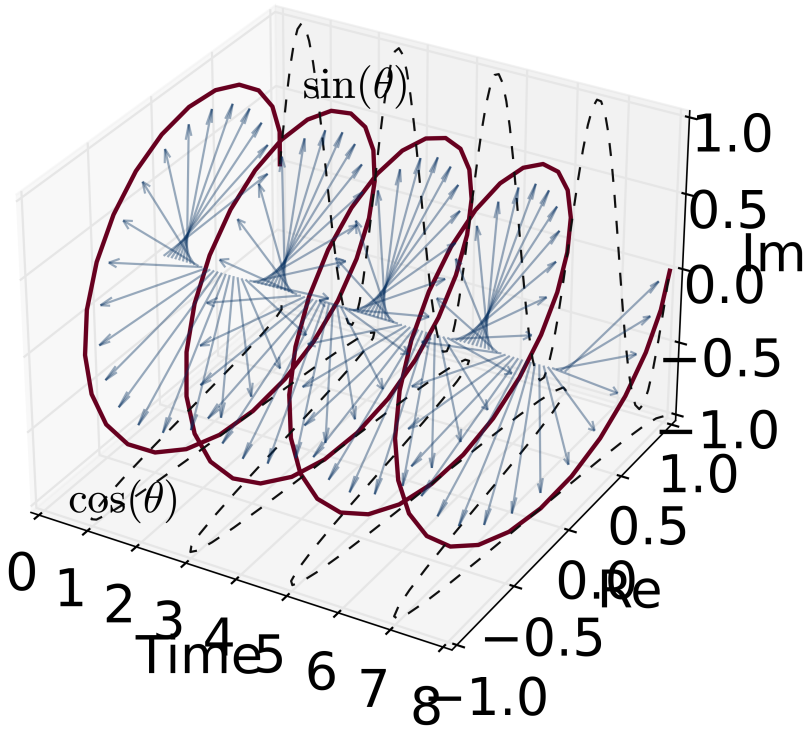
```
ax.set_ylim(-1,1)
```

```
> (-1.0, 1.0)
```

```
ax.set_zlim(-1,1)
```

```
> (-1.0, 1.0)
```

```
plt.show()
```




```
colors1 = plt.cm.Reds(np.arange(0,1,0.01))
colors1[:,-1] = np.arange(0,1,0.01)

colors2 = plt.cm.Blues(np.arange(0,1,0.01))
colors2[:,-1] = np.arange(0,1,0.01)

fig = plt.figure(figsize = (12,8))
ax = fig.add_subplot(projection='3d')
plt.style.use('classic')

ax.scatter(time,ones,r*y1, color = colors1, marker = ",", s = 3)
```

```
> <mpl_toolkits.mplot3d.art3d.Path3DCollection object at 0x7fc23f678e10>
```

```
ax.scatter(time,r*x1,-ones, color = colors1, marker = ",", s = 3)
```

```
> <mpl_toolkits.mplot3d.art3d.Path3DCollection object at 0x7fc382904ba8>
```

```
ax.scatter(time,ones,r*y2, color = colors2, marker = ",", s = 3)
```

```
> <mpl_toolkits.mplot3d.art3d.Path3DCollection object at 0x7fc244d3e9e8>
```

```
ax.scatter(time,r*x2,-ones, color = colors2, marker = ",", s = 3)
#ax.plot(time,r*x2,-ones, linestyle = '--', color = colors2[-10,:])
```

```
> <mpl_toolkits.mplot3d.art3d.Path3DCollection object at 0x7fc244d3ef98>
```

```
ax.quiver(time,0,0,0, 0.99*r*x1, 0.99*r*y1,
          length = 0.9,
          normalize = False,
          arrow_length_ratio = 0.1,
          alpha = 1,
          color = colors1)
```

```
> <mpl_toolkits.mplot3d.art3d.Line3DCollection object at 0x7fc244d3ea20>
```

```
ax.quiver(time,0,0,0, 0.99*r*x2, 0.99*r*y2,
          length = 0.9,
          normalize = False,
          arrow_length_ratio = 0.1,
          alpha = 1,
          color = colors2)
```

```
> <mpl_toolkits.mplot3d.art3d.Line3DCollection object at 0x7fc244d3e5c0>
```

```
ax.text(0.5, 1, 0.4, r'$A(t)$ $\sin(\theta)$', fontsize = 20)
```

```
> Text(0.5, 1, '$A(t)$ $\\sin(\\theta)$')
```

```
ax.text(0.5, -0.9, -1, r'$A(t)$ $\cos(\theta)$', fontsize = 20)
```

```
> Text(0.5, -0.9, '$A(t)$ $\\cos(\\theta)$')
```

```
ax.set_xlabel('Time')
```

```
> Text(0.5, 0, 'Time')
```

```
ax.set_ylabel('Re')
```

```
> Text(0.5, 0, 'Re')
```

```
ax.set_zlabel('Im')
```

```
> Text(0.5, 0, 'Im')
```

```
ax.set_xlim(0,8)
```

```
> (0.0, 8.0)
```

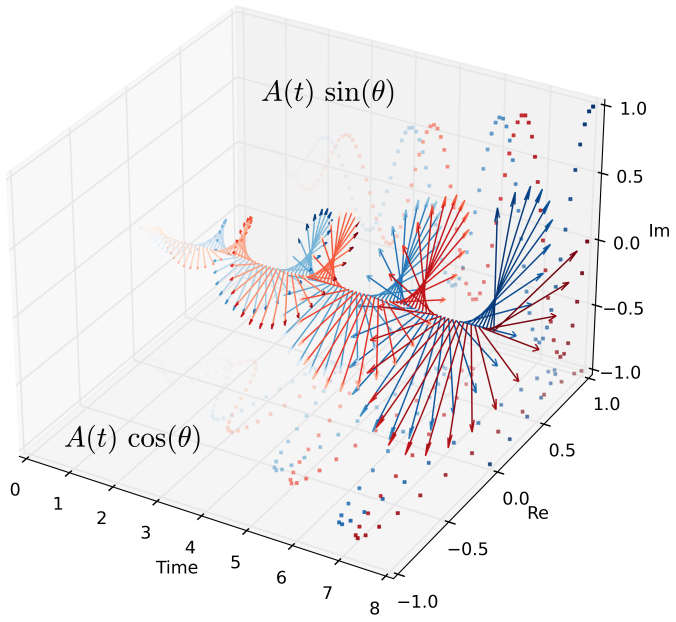
```
ax.set_ylim(-1,1)
```

```
> (-1.0, 1.0)
```

```
ax.set_zlim(-1,1)
```

```
> (-1.0, 1.0)
```

```
plt.show()
```




```
x1_vec = x1
x1_vec = x1_vec[99]
y1_vec = y1
y1_vec = y1_vec[99]

x2_vec = x2
x2_vec = x2_vec[99]
y2_vec = y2
y2_vec = y2_vec[99]

x, y = 0.0, 0.0

fig,ax = plt.subplots(1)
fig.set_figheight(6)
fig.set_figwidth(7)
ax.scatter(r*x1,r*y1, color = colors1, marker = ".", s = 100)
```

```
> <matplotlib.collections.PathCollection object at 0x7fc389b0f588>
```

```
ax.scatter(r*x2,r*y2, color = colors2, marker = ".", s = 100)
```

```
> <matplotlib.collections.PathCollection object at 0x7fc2ef4a6f28>
```

```
ax.arrow(0,0,x1_vec,y1_vec, width = 0.015, color = colors1[-1,:], head_width = 0.1)
```

```
> <matplotlib.patches.FancyArrow object at 0x7fc2ef4a6668>
```

```
ax.arrow(0,0,x2_vec,y2_vec, width = 0.015, color = colors2[-1,:], head_width = 0.1)
```

```
> <matplotlib.patches.FancyArrow object at 0x7fc23f328160>
```

```
ax.add_patch(patches.Arc((x,y), 2.3, 2.3, theta1=0.0, theta2=90.0, linestyle = '--'))
```

```
> <matplotlib.patches.Arc object at 0x7fc23f328f60>
```

```
ax.text(0.7,1, r'$\mathcal{\Delta\varphi = \frac{\pi}{2}}$', fontsize = 24)
```

```
> Text(0.7, 1, '$\\mathcal{\\Delta\\varphi = \\frac{\\pi}{2}}$')
```

```
ax.text(1.18*x1_vec,y1_vec, r'$\mathcal{\varphi}_{1}$', fontsize = 20)
```

```
> Text(1.18, -9.797174393178826e-16, '$\\mathcal{\\varphi}_{1}$')
```

```
ax.text(x2_vec,1.22*y2_vec, r'$\mathcal{\varphi}_{2}$', fontsize = 20)
```

```
> Text(-7.354070601250002e-16, 1.22, '$\\mathcal{\\varphi}_{2}$')
```

```
ax.set_xlim(-1.35,1.35)
```

```
> (-1.35, 1.35)
```

```
ax.set_ylim(-1.35,1.35)
```

```
> (-1.35, 1.35)
```

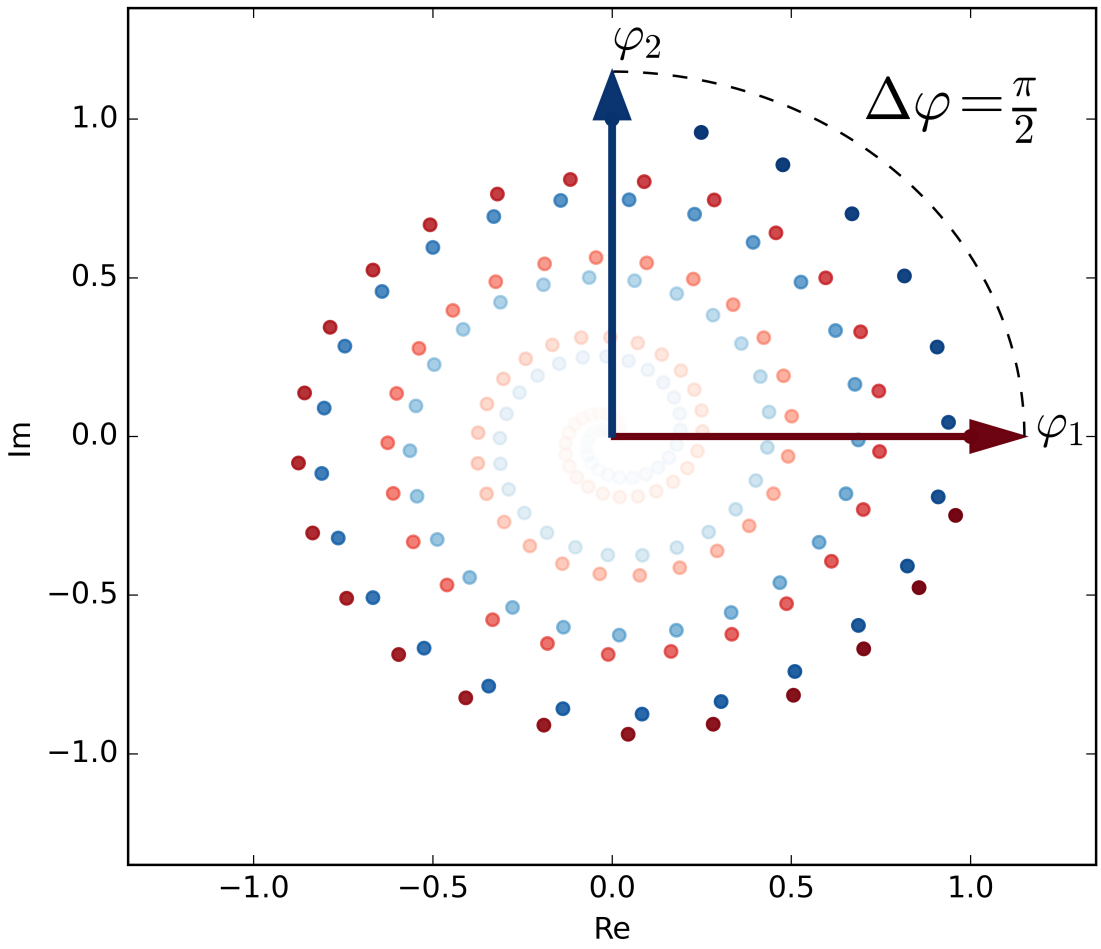
```
ax.set_xlabel('Re')
```

```
> Text(0.5, 0, 'Re')
```

```
ax.set_ylabel('Im')
```

```
> Text(0, 0.5, 'Im')
```

```
plt.show()
```



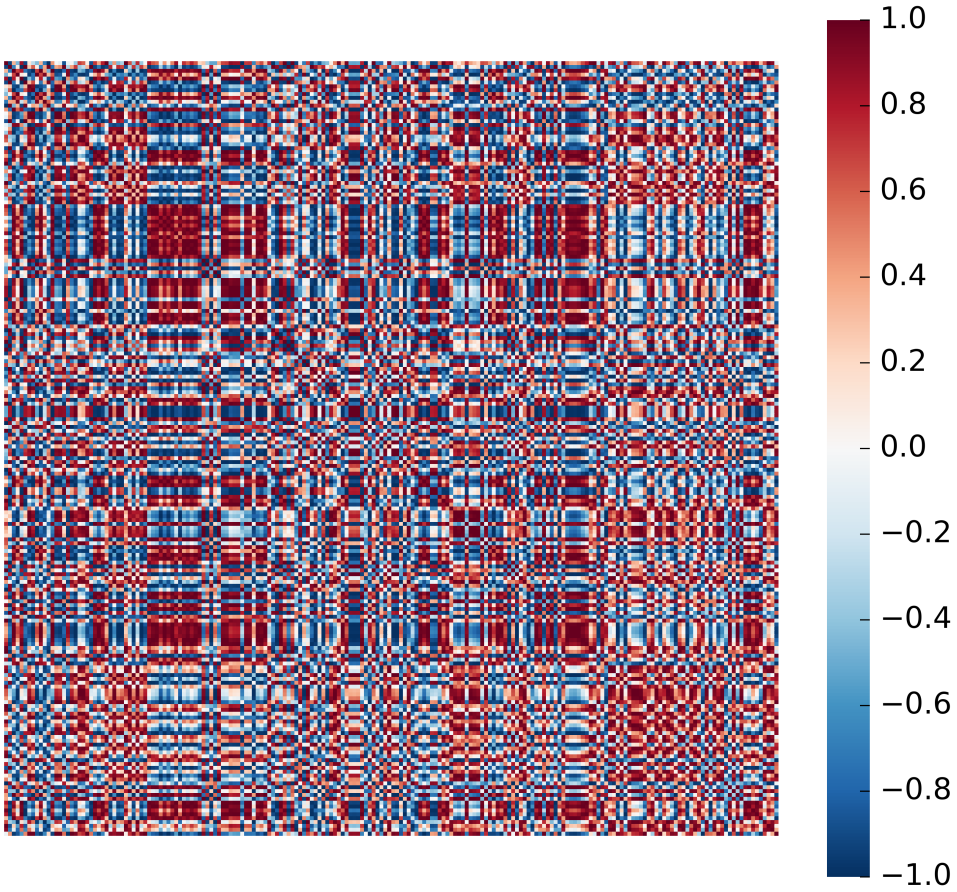

```
import sys
sys.path.insert(1, 'libs/')

import numpy as np
import scipy as sc
from scipy import io
import dynfc as dyn
import seaborn as sns
import matplotlib.pyplot as plt

ts = sc.io.loadmat('data/ts.mat')['ts']
ts = ts

RSsig = np.zeros((ts.shape[0],ts.shape[1],1))
RSsig[:,:,0] = ts

Phases, syncConn, leidaArray = dyn.run_multiPat(RSsig)
```

```
> Signal filtered.
> Phases obtained.
> Matrices obtained.
> Routine finished for patient no. 1.
```

```
mat1 = syncConn[:,:,0,0]

aa = plt.figure(figsize = [7,6])
ax = sns.heatmap(mat1,
                 cmap = "RdBu_r",
                 vmin = -1,
                 vmax = 1,
                 square = True,
                 cbar = True)
ax.axis('off')
```

```
> (0.0, 200.0, 200.0, 0.0)
```

```
ax.tick_params(left=False, bottom=False)
plt.show()
```




```
aa = plt.figure(figsize = (12/50,4))
ax = sns.heatmap(leidaArray[:,0,]/max(abs(leidaArray[:,0,])),
                 cmap = "RdBu_r",
                 vmin = -1,
                 vmax = 1,
                 square = False,
                 cbar = False)
ax.axis('off')
```

```
> (0.0, 1.0, 1180.0, 0.0)
```

```
plt.show()
```

This document was prepared on 2021-02-14.

Package References

```
report::cite_packages(sessionInfo())
```

- JJ Allaire and Yihui Xie and Jonathan McPherson and Javier Luraschi and Kevin Ushey and Aron Atkins and Hadley Wickham and Joe Cheng and Winston Chang and Richard Iannone (2020). rmarkdown: Dynamic Documents for R. R package version 2.6. URL https://rmarkdown.rstudio.com.
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- R Core Team (2020). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.