20200324_FS_LT_distance_and_speed

March 30, 2020

imports from a raw subfile

```
In [1]: import pandas as pd
        import matplotlib.pyplot as plt
        import matplotlib as mpl
        import seaborn as sns
        from matplotlib.patches import Circle
        import matplotlib.tri as tri
        import numpy as np
        from scipy.spatial.transform import Rotation as R
        from statistics import mean
        import math

        root = 'C:/Users/Fabian/Desktop/Analysis/Multiple_trial_analysis/Data/Raw/'
        figures = 'C:/Users/Fabian/Desktop/Analysis/Multiple_trial_analysis/Figures/'

        #Data with beacon metadata
        beacon = pd.read_csv(root+'beacons 20200128-151826.txt',sep=" ", header=None)
        beacon2 = pd.read_csv(root+'beacons 20200128-160013.txt',sep=" ", header=None)

        Day46_fs1 = pd.read_csv(root+'position 20190923-174441.txt',sep=" ", header=None)
        Day46_fs2 = pd.read_csv(root+'position 20190923-171112.txt',sep=" ", header=None)
        Day47_fs1 = pd.read_csv(root+'position 20191001-112411.txt',sep=" ", header=None)
        Day47_fs2 = pd.read_csv(root+'position 20191001-115127.txt',sep=" ", header=None)
        Day48_fs1 = pd.read_csv(root+'position 20191002-115000.txt',sep=" ", header=None)
        Day48_fs2 = pd.read_csv(root+'position 20191002-111038.txt',sep=" ", header=None)
        Day51_fs1 = pd.read_csv(root+'position 20191106-170809.txt',sep=" ", header=None)
        Day52_fs2 = pd.read_csv(root+'position 20191107-174215.txt',sep=" ", header=None)
        Day52_fs1 = pd.read_csv(root+'position 20191107-183857.txt',sep=" ", header=None)
        Day53_fs2 = pd.read_csv(root+'position 20191108-142321.txt',sep=" ", header=None)
        Day53_fs1 = pd.read_csv(root+'position 20191108-145125.txt',sep=" ", header=None)
        Day66_fs1 = pd.read_csv(root+'position 20191118-161325.txt',sep=" ", header=None)
        Day66_fs2 = pd.read_csv(root+'position 20191118-171209.txt',sep=" ", header=None)
        Day72_fs1 = pd.read_csv(root+'position 20191127-122008.txt',sep=" ", header=None)
        Day72_fs2 = pd.read_csv(root+'position 20191127-132223.txt',sep=" ", header=None)
```

```
Day79_fs2 = pd.read_csv(root+'position 20200121-154004.txt',sep=" ", header=None)
Day79_fs1 = pd.read_csv(root+'position 20200121-161359.txt',sep=" ", header=None)

Day80_fs2 = pd.read_csv(root+'position 20200122-141738.txt',sep=" ", header=None)
Day80_fs1 = pd.read_csv(root+'position 20200122-133022.txt',sep=" ", header=None)

Day81_fs2 = pd.read_csv(root+'position 20200123-141930.txt',sep=" ", header=None)
Day81_fs1 = pd.read_csv(root+'position 20200123-150059.txt',sep=" ", header=None)

Day82_fs2 = pd.read_csv(root+'position 20200124-151642.txt',sep=" ", header=None)
Day82_fs1 = pd.read_csv(root+'position 20200124-160826.txt',sep=" ", header=None)

Day83_fs2 = pd.read_csv(root+'position 20200126-183810.txt',sep=" ", header=None)
Day83_fs1 = pd.read_csv(root+'position 20200126-180200.txt',sep=" ", header=None)

Day84_fs2 = pd.read_csv(root+'position 20200127-205615.txt',sep=" ", header=None)
Day84_fs1 = pd.read_csv(root+'position 20200127-155645.txt',sep=" ", header=None)

Day85_fs2 = pd.read_csv(root+'position 20200128-112255.txt',sep=" ", header=None)
Day85_fs1 = pd.read_csv(root+'position 20200128-104637.txt',sep=" ", header=None)

Day86_fs2 = pd.read_csv(root+'position 20200128-160013.txt',sep=" ", header=None)
Day86_fs1 = pd.read_csv(root+'position 20200128-151826.txt',sep=" ", header=None)

Day87_fs2 = pd.read_csv(root+'position 20200129-153534.txt',sep=" ", header=None)
Day87_fs1 = pd.read_csv(root+'position 20200129-161806.txt',sep=" ", header=None)

Day88_fs2 = pd.read_csv(root+'position 20200130-102126.txt',sep=" ", header=None)
Day88_fs1 = pd.read_csv(root+'position 20200130-111741.txt',sep=" ", header=None)

Day89_fs2 = pd.read_csv(root+'position 20200130-161126.txt',sep=" ", header=None)
Day89_fs1 = pd.read_csv(root+'position 20200130-151829.txt',sep=" ", header=None)

Day90_fs2 = pd.read_csv(root+'position 20200203-154441.txt',sep=" ", header=None)
Day90_fs1 = pd.read_csv(root+'position 20200203-145842.txt',sep=" ", header=None)

Day91_fs2 = pd.read_csv(root+'position 20200204-125552.txt',sep=" ", header=None)
Day91_fs1 = pd.read_csv(root+'position 20200204-133905.txt',sep=" ", header=None)

Day92_fs2 = pd.read_csv(root+'position 20200205-143220.txt',sep=" ", header=None)
Day92_fs1 = pd.read_csv(root+'position 20200205-151052.txt',sep=" ", header=None)

Day93_fs2 = pd.read_csv(root+'position 20200206-133529.txt',sep=" ", header=None)
Day93_fs1 = pd.read_csv(root+'position 20200206-125706.txt',sep=" ", header=None)
```

0.1 Function to visualize particular days with heatmaps.

0.1.1 How to use: Take a position and name it Day#_AnimalID then run rotation_correction (Day#_AnimalID, Day#_AnimalID2)

```
In [2]: def rotation_correction(Day_fs1,Day_fs2,day):
            alpha = (5) * np.pi / 180
            Day_fs1x = Day_fs1[1] * np.cos(alpha) - Day_fs1[3] * np.sin(alpha)
            Day_fs1y = Day_fs1[1] * np.sin(alpha) + Day_fs1[3] * np.cos(alpha)
            Day_fs2x = Day_fs2[1] * np.cos(alpha) - Day_fs2[3] * np.sin(alpha)
            Day_fs2y = Day_fs2[1] * np.sin(alpha) + Day_fs2[3] * np.cos(alpha)

            fig,ax = plt.subplots(1,2)
            #fig.set_size_inches( 7.2/2,16.2/2)
            plt.xticks([])

            ax[0].hist2d(Day_fs1x,Day_fs1y,bins = 30,cmap='terrain',cmax=1000 )
            ax[0].plot(Day_fs1x,Day_fs1y,color='olive',alpha=.6)


            ax[1].hist2d(Day_fs2x,Day_fs2y,bins = 30,cmap='terrain',cmax=1000 )
            ax[1].plot(Day_fs2x,Day_fs2y,color='olive',alpha=.6)


            #ax[0].add_patch(mpl.patches.Circle((-.3429, 0.2),.15,edgecolor='red', fill = Fals
            #ax[1].add_patch(mpl.patches.Circle((-.3429, 0.2),.15,edgecolor='red', fill = Fals
            ax[0].set_title('FS1', fontsize=10)
            ax[1].set_title('FS2', fontsize=10)
            ax[0].set_ylabel('Day %s ' %day)
            ax[0].set_xticks([])
            ax[1].set_xticks([])

            fig.dpi=200
            plt.tight_layout()
            plt.show()
```

```
In [3]: #rotation_correction(Day72_fs1,Day72_fs2,72)
```

```
In [4]: #rotation_correction(Day46_fs1,Day46_fs2,46)
```

```
In [5]: #rotation_correction(Day52_fs1,Day52_fs2,52)
```

```
In [6]: #rotation_correction(Day66_fs1[1200:6800],Day66_fs2[1200:6800],66)
```

0.2 recording speed : 100 hz

0.3 Calculate speed and distance for each then plot over time. - DONE

```
In [7]: def calculateDistance(x,y):
            travel=0
```

```
    for i in range(len(y)-1):
        dist = math.sqrt((x[0+i] - x[1+i])**2 + (y[0+i] - y[1+i])**2)
        travel+=dist

    return travel



from statistics import mean

def calculateSpeed(x,y,time):
    travel=0
    speed=[]
    for i in range(len(y)-1):
        dist = math.sqrt((x[0+i] - x[1+i])**2 + (y[0+i] - y[1+i])**2)/time[0+i]
        speed.append(dist)
    return (mean(speed))

import numpy
Day79_fs1[0][1]-Day79_fs1[0][0]
time = numpy.arange(0.01, len(Day79_fs1[0]), 0.01)


# average speed per minute in meters
print (60 * 100* calculateSpeed(Day79_fs1[1],Day79_fs1[3],time))
```

```
0.12588907356003765
```

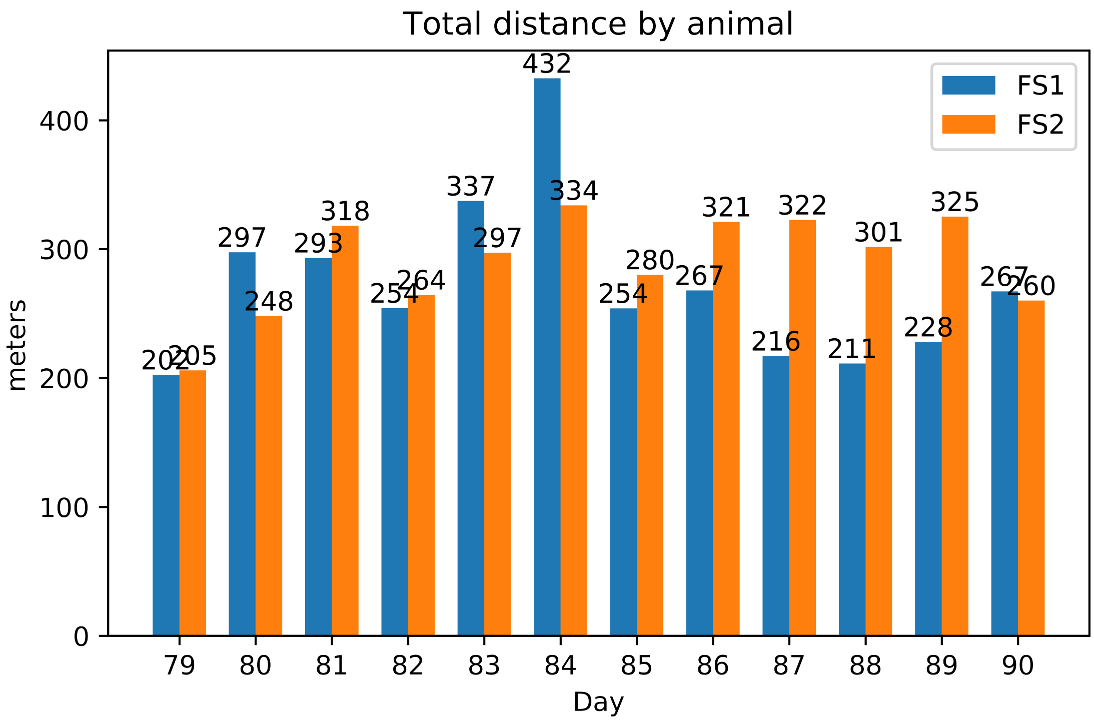
0.4 Long-term distance visualization

```
In [11]: def Distance_over_days (list_of_fs1_days,list_of_fs2_days,list_of_number_of_days) :
             """this function takes lists of days for each animal and plots a distance covered

             LT_distance_fs1 = []
             for day in list_of_fs1_days:
                 LT_distance_fs1.append (calculateDistance(list(day[1]),list(day[3])))

             LT_distance_fs2 = []
             for day in list_of_fs2_days:
                 LT_distance_fs2.append (calculateDistance(list(day[1]),list(day[3])))

             x = np.arange(len(list_of_number_of_days))  # the label locations
             width = 0.35  # the width of the bars

             fig, ax = plt.subplots(dpi= 1000)
             FS1 = ax.bar(x - width/2, LT_distance_fs1, width, label='FS1')
             FS2 = ax.bar(x + width/2, LT_distance_fs2, width, label='FS2')
```

```
    ax.set_ylabel('meters')
    ax.set_xlabel('Day')
    ax.set_title('Total distance by animal')
    ax.set_xticks(x)
    ax.set_xticklabels(list_of_number_of_days)
    ax.legend()


    def autolabel(rects):
        """Attach a text label above each bar in *rects*, displaying its height."""
        for rect in rects:
            height = rect.get_height()
            ax.annotate('{}'.format(int(height)),
                        xy=(rect.get_x() + rect.get_width() / 2, height),
                        xytext=(0, 0),  # 3 points vertical offset
                        textcoords="offset points",
                        ha='center', va='bottom')


    autolabel(FS1)
    autolabel(FS2)

    fig.tight_layout()
    plt.savefig(figures+'distance_over_days_'+Day_number_list[0]+'-'+Day_number_list[
    plt.show()
```

0.5 Calculating LT averges for Days 79-90 - times when beacon appearance and randomization of place frequencey was increasing

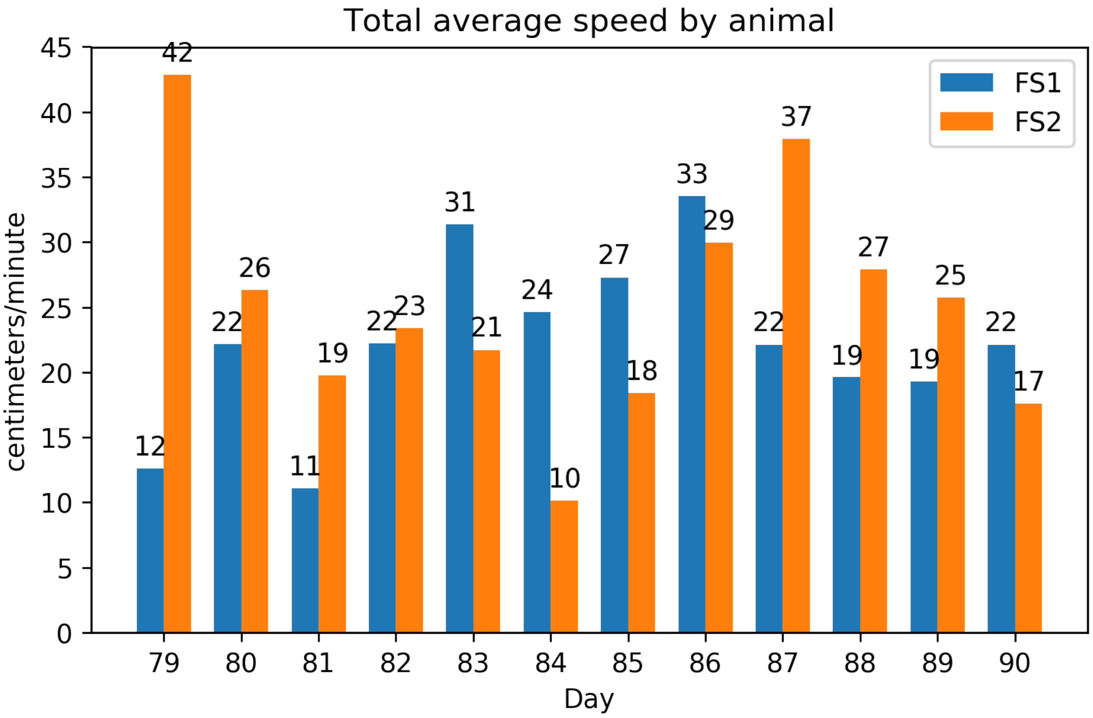
```
In [12]: list_of_days = [Day79_fs1,Day80_fs1,Day81_fs1,Day82_fs1,Day83_fs1,Day84_fs1,Day85_fs1
         list_of_days2 = [Day79_fs2,Day80_fs2,Day81_fs2,Day82_fs2,Day83_fs2,Day84_fs2,Day85_fs
         Day_number_list =['79','80','81','82','83','84','85','86','87','88','89','90']
         Distance_over_days(list_of_days, list_of_days2, Day_number_list)
```



0.5.1 Plot average speed

```
In [13]: list_of_days = [Day79_fs1,Day80_fs1,Day81_fs1,Day82_fs1,Day83_fs1,Day84_fs1,Day85_fs1
         list_of_days2 = [Day79_fs2,Day80_fs2,Day81_fs2,Day82_fs2,Day83_fs2,Day84_fs2,Day85_fs
         Day_number_list =['79','80','81','82','83','84','85','86','87','88','89','90']
         #Distance_over_days(list_of_days, list_of_days2, Day_number_list)

         def Speed_over_days (list_of_fs1_days,list_of_fs2_days,list_of_number_of_days) :
             """this function takes lists of days for each animal and plots the averge speed f

             LT_distance_fs1 = []
             for day in list_of_fs1_days:
                 LT_distance_fs1.append (100*60 * 100*calculateSpeed(list(day[1]),list(day[3])

             LT_distance_fs2 = []
             for day in list_of_fs2_days:
                 LT_distance_fs2.append (100*60 * 100*calculateSpeed(list(day[1]),list(day[3])

             x = np.arange(len(list_of_number_of_days))  # the label locations
             width = 0.35  # the width of the bars

             fig, ax = plt.subplots(dpi= 250)
             FS1 = ax.bar(x - width/2, LT_distance_fs1, width, label='FS1')
```

```
    FS2 = ax.bar(x + width/2, LT_distance_fs2, width, label='FS2')


    ax.set_ylabel('centimeters/minute')
    ax.set_xlabel('Day')
    ax.set_title('Total average speed by animal')
    ax.set_xticks(x)
    ax.set_xticklabels(list_of_number_of_days)
    ax.legend()


    def autolabel(rects):
        """Attach a text label above each bar in *rects*, displaying its height."""
        for rect in rects:
            height = rect.get_height()
            ax.annotate('{}'.format(int(height)),
                        xy=(rect.get_x() + rect.get_width() / 2, height),
                        xytext=(0, 3),  # 3 points vertical offset
                        textcoords="offset points",
                        ha='center', va='bottom')


    autolabel(FS1)
    autolabel(FS2)

    fig.tight_layout()
    plt.savefig(figures+'speed_over_days_'+Day_number_list[0]+'-'+Day_number_list[-1]
    plt.show()

Speed_over_days(list_of_days, list_of_days2, Day_number_list)
```



1 DISCLAIMER: Probably will need to cut off the first little bit to get a better average, due to the recording starting when the rat is being placed inside the arena, ALSO times counted with numpy every .01sec - not taking the recording times - hence imprecise

```
In [ ]:
```