Tutorial for TipTracker evaluation scripts

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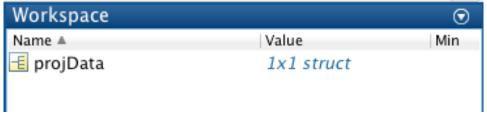
Procedures

1. Load the saved .mat workspace file. For example, use:

```
cd ~/Documents/MATLAB/20140919_002_MCAK;
load('roi_1/meta/projData.mat');
```

It is recommended to stay in the current working directory while running the scripts, i.e. `MATLAB/20140919_002_MCAK`. You should see a variable named `projData` in your current MATLAB session if the loading is successful:



Name	Value	Min
projData	*1x1 struct*	

2. Use `plots_custom` to visualize the results.
This script takes all the (x, y) coordinates, calculates the speeds and distances of each track between each 2 neighboring frames, calculates the averaged speed and displacement (total) of each track over all frames, and reports life time span (number of frames) of each track.

   a. Arguments needed as input:
      i. (x, y) coordinates of each track at each frame. These are available in projData.mat;
      ii. Microscopy parameters: seconds per frame, and pixel size. Default is set to 5 seconds per frame and 150 um/pixel.

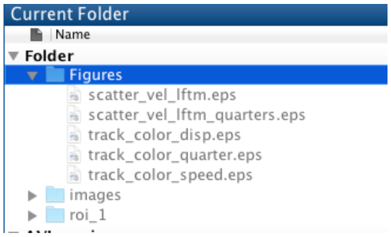
   b. An easy hands-on would be just type the following

```
plot_customs(projData.xCoord, projData.yCoord,
projData.secPerFrame, projData.pixSizeNm);
```

   c. For advanced usage, all calculation results can be pulled out. Use `help plots_custom` for full details.

```
[vel_all, vel_means, dist_all, dist_sum, life_times] =
plot_customs(projData.xCoord, projData.yCoord,
projData.secPerFrame, projData.pixSizeNm);
```

There will be 5 figures displayed on the screen, and they are automatically saved to `Figures/` folder for future reference.



Current Folder

Name

Folder

Figures

scatter_vel_lftm.eps

scatter_vel_lftm_quarters.eps

track_color_disp.eps

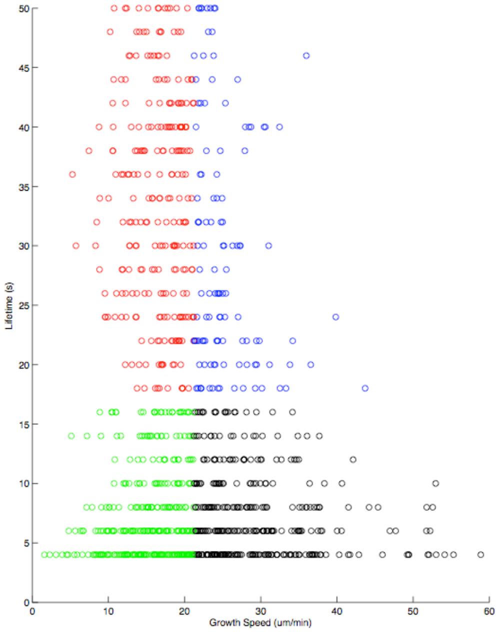
track_color_quarter.eps

track_color_speed.eps

images

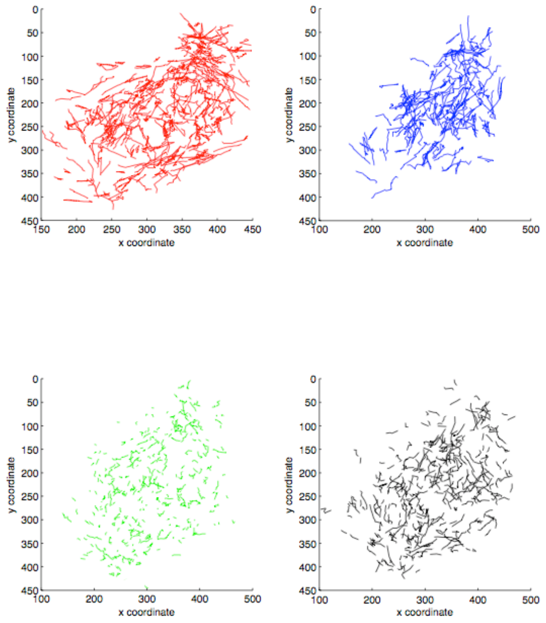
roi_1

1. **Figure 1** (`scatter_vel_lftm.eps`) is a scatter plot of speed vs. lifetime for all the tracks identified. Data points are classified into 4 categories by mean speed and mean lifetime.

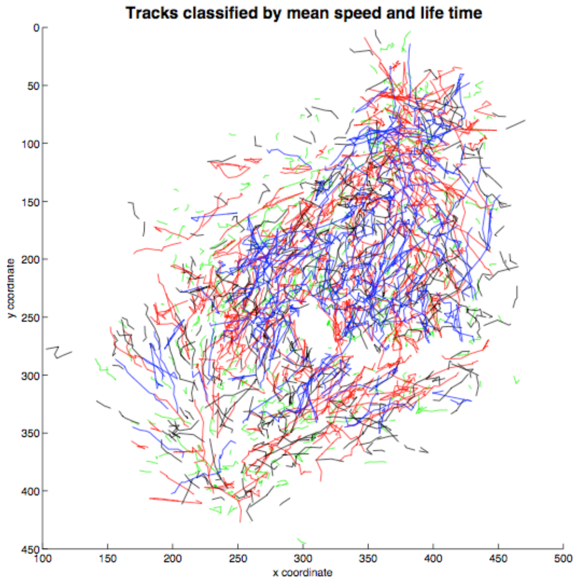


Quarters are color coded by red, green, blue and black.

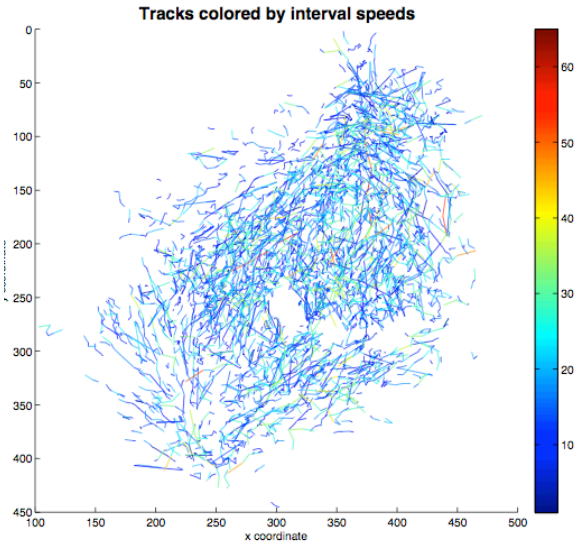
2. **Figure 2** (`scatter_vel_lftm_quarters.eps`) separates all tracks into 4 panels according to the classifier of **Figure 1**, and have the traces of all tracks drew in 2D space. Color is same as **Figure 1**, and the x,y-axes are same as original images.



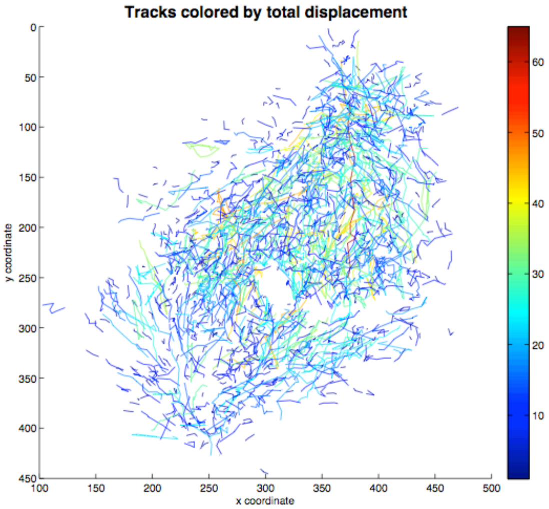
3. **Figure 3** (`track_color_quarter.eps`) plots all tracks in one panel using same color code as **Figure 1&2**. It's basically overlaying all 4 panels from **Figure 2**.



4. **Figure 4** (`track_color_speed.eps`) plots all tracks in on panel, using speed as color code. The color is scaled from min (blue) and max (red) of all observed speeds in the dataset. Each interval is colored independently and is not averaged.



5. **Figure 5** (`track_color_disp.eps`) plots all tracks in on panel, using displacement as color code. The color is scaled from min (blue) and max (red) of all observed displacements in the dataset. Each track is plotted as one trace using its total displacement.



3. Use `check_tracks` to manually evaluate tracking quality.
   This script randomly pick a number of tracks from the saved data, and label the picked ones by colored circle in the original movie, enabling manual evaluation of the tracking performance.

   6 different tracks will be circled in one movie file with colors `{'red','blue','green','yellow','magenta','cyan'}`. Movie files named as `check_picks_#.avi` will be saved to current directory.

   a. Arguments needed as input:

i. (x, y) coordinates of each track at each frame. These are available in projData.mat;
ii. Number of tracks to pick. Default is set to 30;
iii. Name of directory of TIFF files. Default is set to `'images/'`;
iv. Shape parameters: circle size and movie fps. Default is set to radius of 5 pixels, and 3 frames per second (slow);
v. Microscopy parameters: seconds per frame, and pixel size. Default is set to 5 seconds per frame and 150 um/pixel.

b. An easy hands-on would be just type the following

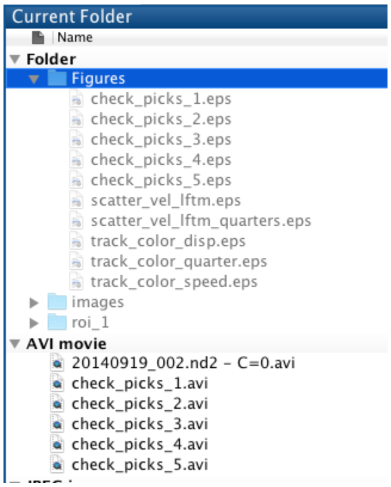
```
check_tracks(projData.xCoord, projData.yCoord);
```

c. For advanced usage, statistics of picked tracks can be calculated and visualized. This is helpful for comparison between automatic and manual annotations. Use `help check_tracks` for full details.

To enable this feature, microscopy parameters (section 3.a.v above) are required. Example usage (specifying `deltaT` and `microns`, but bypassing others using `[]`):

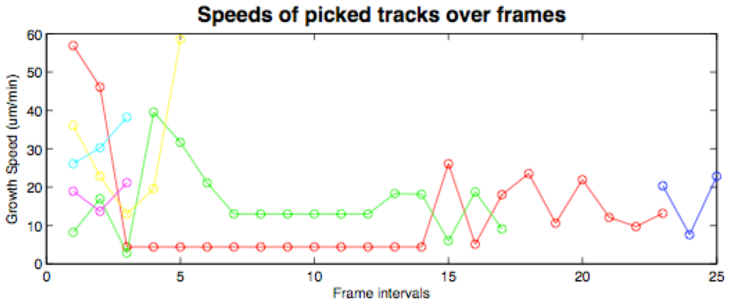
```
check_tracks(projData.xCoord, projData.yCoord, [], [], [],
[], 5, 150);
```

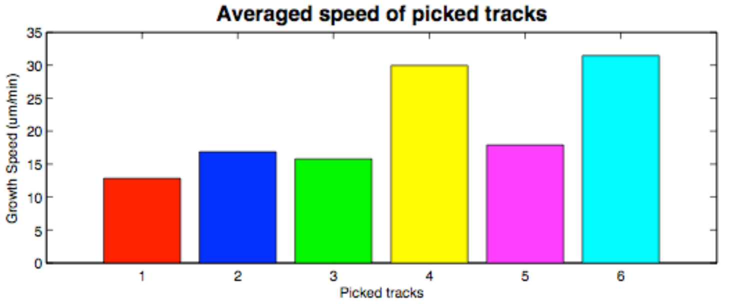
For each movie file, there will be a figure displayed on the screen, and automatically saved to `Figures/` folder for future reference.

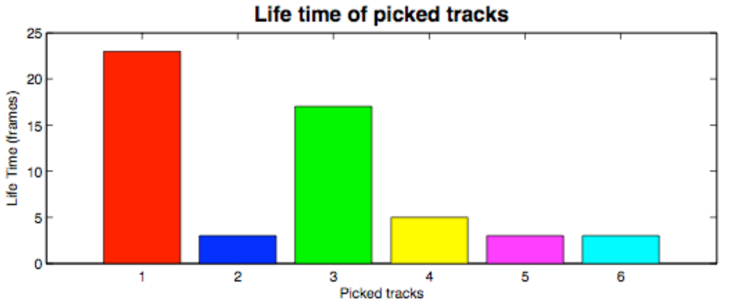


Current Folder
Name
Folder
Figures
check_picks_1.eps
check_picks_2.eps
check_picks_3.eps
check_picks_4.eps
check_picks_5.eps
scatter_vel_lftm.eps
scatter_vel_lftm_quarters.eps
track_color_disp.eps
track_color_quarter.eps
track_color_speed.eps
images
roi_1
AVI movie
20140919_002.nd2 - C=0.avi
check_picks_1.avi
check_picks_2.avi
check_picks_3.avi
check_picks_4.avi
check_picks_5.avi

In this figure, the 1st panel plots the speed of picked tracks (total of 6) over all frames in their corresponding color in the movie. The 2nd and 3rd panels display their averaged speed over all frames, and their life time span, respectively.







Notes:

1. Due to video quality, the contrast and brightness of output video files are adjusted. It makes the tips easier to see, but also increases the overall background noise level.