TrackAnalysis - Manual

Software version : 2.1

TrackAnalysis analyses the track in a data file. The parameters it calculates depends on which experimental **paradigm** is defined in the **.dat** file header, and which options are enabled. TrackAnalysis was designed for **batch processing** of .dat files, which contain a time series of the coordinates of the tracked object, events, and states of various devices.

TrackAnalysis requires the user to design their **analysis** by specifying which .dat files will be analysed together. The data corresponding to the list of files in an analysis are collected into a tabular format file (.tbl) for importing to spreadsheet or statistical software.

Note : *Each analysis is called a Task in the Track Analysis application.*

1. Analysis output

Three types of output files are generated by TrackAnalysis. They are suffixed by **.ps**, **.tbl** and **.sum**. Each file contains essential the same information but the data are organized in different formats. Each is considered in turn.

Examples of these files are provided. For simplicity, the same file was analysed repeatedly as if it were several files.

1.1 PostScript files (.ps)

These are postscript files containing graphical depictions of the data in one file. The data are represented as vector graphics and can be imported into standard graphics software for further editing and figure construction.

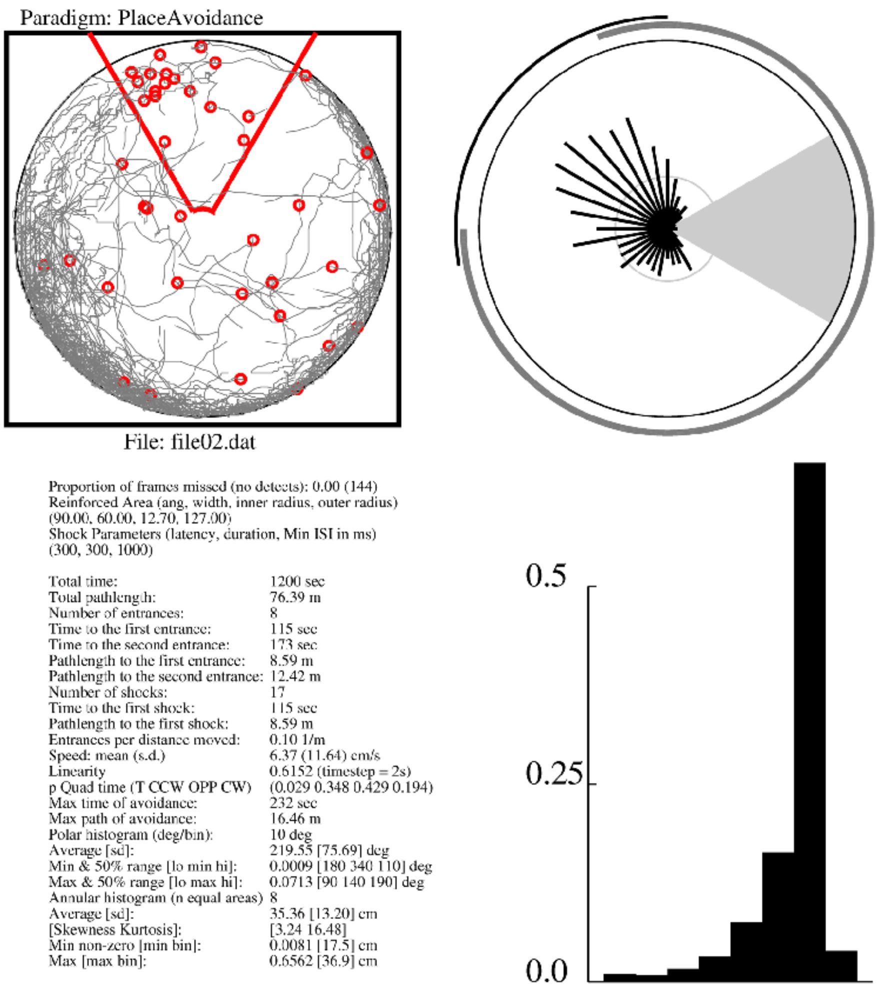

Figure 1 : PostScript output from TrackAnalysis

The file has four parts :

1) A 2-D plot of the subject's track (top lert on the figure above). If one or more "**sectors**" (arbitrarily defined regions of the environment) was defined in the .dat file then these are drawn too (an annulus-sector was defined in the example that is provided). If **events** were registered in the .dat file, then they are marked in the track representation (red circles in the example provided). Events are user-defined and will depend on the particular experiment. For example, shock, food delivery, lever presses, user-defined key presses etc.

2) Polar histogram of the subject's locations (top right on the figure above). The **histogram** is plotted in a standardized coordinate system such that if a sector was defined, then its angular center is the origin of the **polar coordinate system**. The sector's angular location is represented as a gray region. The environment is divided into **10° bins**. The proportion of time the subject was in each bin is represented by the length of the corresponding radial black line. Chance (on the assumption of homogeneity, i.e 1/36) is marked by the thin gray circle in the center of the plot. The thin black circle represents the indicated proportion of the time (in the example provided it is 0.1). Two additional arcs are on the figure. The black arc represents the more preferred region and the gray arc represents the less preferred region. These regions are determined as follows: To find the more preferred region, the most visited bin is identified. Then the adjacent flanking bins are compared. The larger of the two is selected and added to the previously selected preferred bin. Then the two bins that flank the preferred set of bins are compared and the larger is selected again. This construction of the preferred region continues until the region accounts for 50% or more of the recording time. The analogous process is performed for the less preferred region. The least visited bin is selected and at each iteration, the lesser of the two flanking bins is selected until 50% or more of the recording time is accounted for.

3) Histogram of the annular distribution of the subject's locations (bottom right on the example above). The environment is divided into **8 equal area concentric annuli**. The central region is represented at the left of the histogram and the peripheral region at the right.

Various experimental parameters and measures are also provided on the page. Most are self explanatory, but some need further explanation.

<u>Measures from the 2-D track:</u>

Path length: The path length measures are calculated by measuring distance between successive 1 second samples.

Speed: Speed is calculated as the distance traveled in each 1second interval. The average and s.d. are given.

Linearity: linearity is the average ratio of the linear distance / integrated distance calculated each 2 seconds. The linear distance is the distance between coordinates sampled 2 seconds apart. The integrated distance is the integral of the distance between the successive coordinates in the 2 seconds. The successive coordinates were sampled each 16.7 ms. When Linearity = 1 the subject moved in a straight line. The closer to zero the more crooked the path.

P Quad time: These are the proportions of time in each quadrant of the environment. When a sector is defined within one quadrant, then the proportion represents the proportion of time in the sector compared to the corresponding regions centered in each quadrant. The target (T), clockwise (cw), counter clockwise (ccw) and opposite quadrants are defined with respect to the sector, if it is defined.

Max time of avoidance: Maximum time without entering the sector.

Max path of avoidance: Maximum path moved before entering the sector.

<u>Measures from the polar histogram :</u>

Deg/bin: Indicates the resolution of the plot.

Average [s.d.]: The average vector and the angular s.d. of the histogram.

Min & 50% range [lo min hi]: These values describe the less preferred region. Min is the value of the least preferred bin, which is 'min'. 'lo' and 'hi' are the bins that define the limits of the less preferred region.

Max & 50% range [lo max hi]: These values describe the more preferred region. Max is the value of the most preferred bin, which is 'max. 'lo' and 'hi' are the bins that define the limits of the more preferred region.

Measures from the annular histogram:

Average [s.d.]: The average annulus and the s.d. of the distribution. The skewness and Kurtosis of the histogram are given.

Min non-zero [min bin]: ‘min’ is the proportion of time spent in the lowest non-zero bin. The location of the center of the bin is given by ‘bin’

Max non-zero [max bin]: ‘max is the proportion of time spent in the largest non-zero bin. The location of the center of the bin is given by ‘bin’

1.2 Tbl files (.tbl)

These files contain the **quantitative data in tabular form** for import into **spreadsheet** or **statistical software**. Each data file is represented by entries in one row. The various measures are in columns. By organizing which files are processed by TrackAnalysis and in what order, the organization of the data for analysis of an experiment can be accomplished in batch mode with a single command.

filename	frame	total	# of	time to	path to	entr.	# of	time to	path to	speed
		time	entr.	first	first	per	shocks	first	first	
				entr.	entr.	dist.		shock	shock	
		[s]		[s]	[m]	[1/m]		[s]	[m]	[cm/s]
file01.dat	?	1200	12	40	3.35	0.19	29	40	3.35	5.31
file02.dat	?	1200	8	115	8.59	0.1	17	115	8.59	6.37

(NOTE : table has been truncated on the right side)

1.3 Sum files (.sum)

These files contain the **quantitative data as text**. The data from all the data files submitted to TrackAnalysis for analysis are represented in the file. These files summarize an experiment and are convenient for inserting into a laboratory notebooks.

2. Running TrackAnalysis

TrackAnalysis can be started from the Windows Start menu (**Start – Programs – Bio Signal Group Corp – Track Analysis**). When you start the application, you will see the main screen :

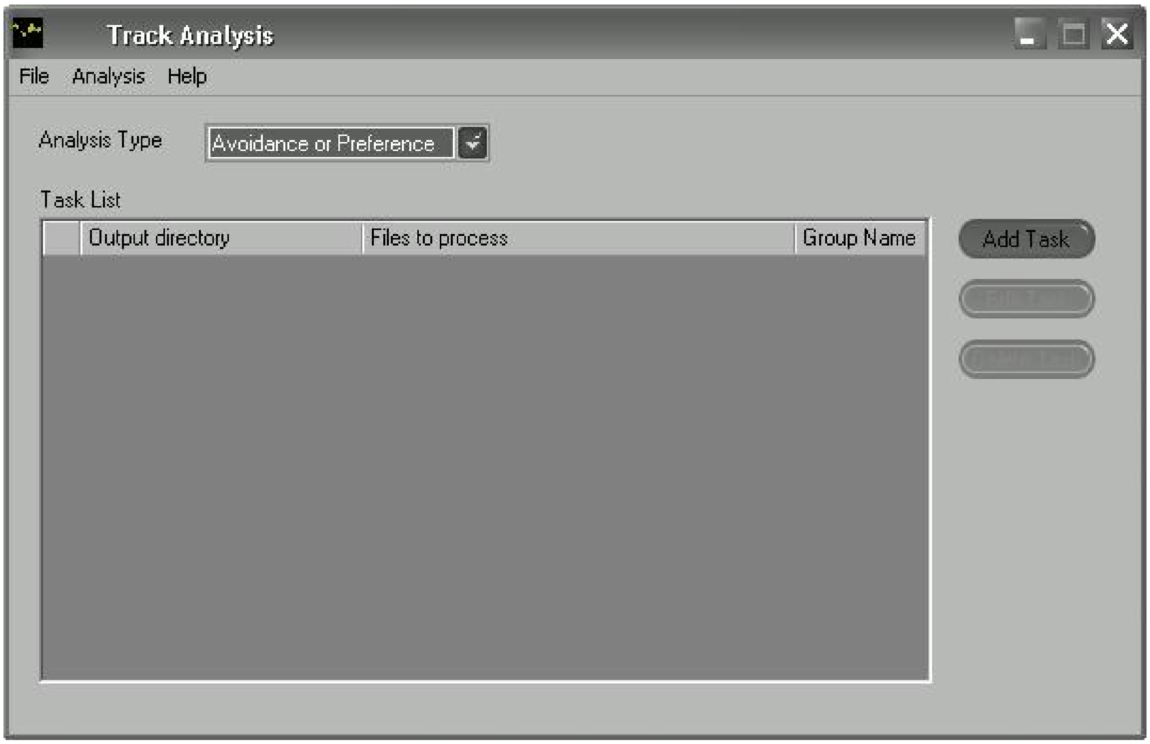

Figure 2 : TrackAnalysis main window.

The main concept of the TrackAnalysis is based on setting up the **Tasks**. **Each task is an 'analysis' comprising a list of files to analyze**. Each task is specified by a single output directory, where the output files from analysis are stored as well as the list of files for analysis. This way you can set up multiple tasks for each experimental day, each with several analyzed files (e.g. different experimental objects).

On the previous figure you can see the main application window with several controls :

- **Analysis Type** – sets type of the analysis (paradigm), choose "Avoidance or Preference" for Place Avoidance or Place Preference type of experiments, "Open Field" for Open Field experiments and "Watermaze" for Watermaze experiments.
- **Add Task** – adds single tasks with single or multiple analyzed files
- **Edit Task** – edits selected task on the cursor position
- **Delete Task** – deletes selected task on the cursor position

2.1 Adding a Task

When you press the **Add Task** button, a new window is opened :

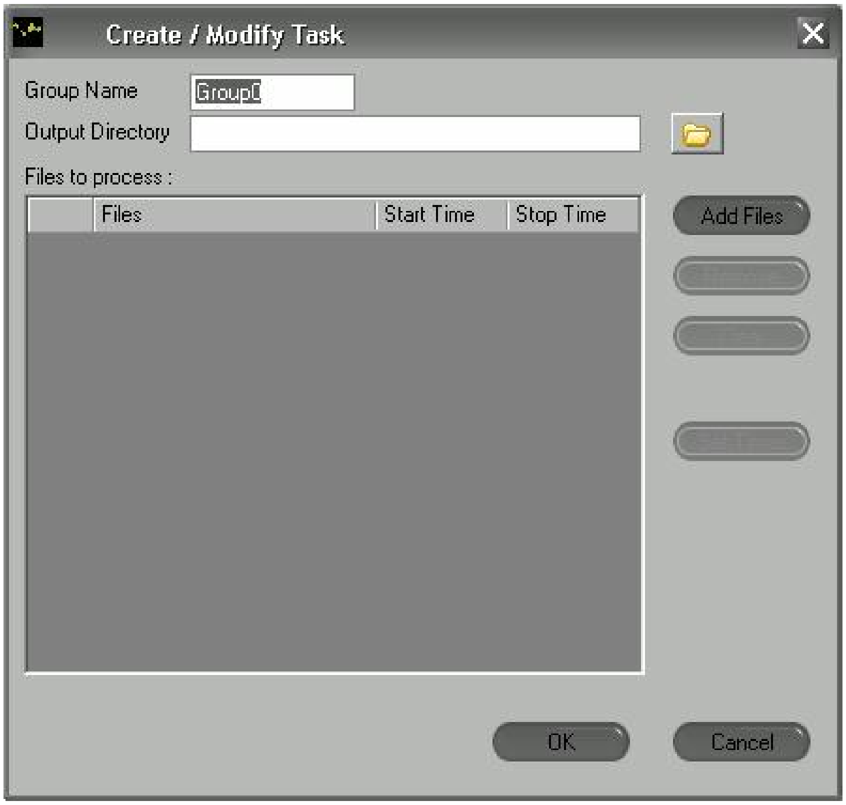

Figure 3 : Add Task window

First you edit the **Group Name**, if you don't like the one being automatically set. Each task needs to have its name which helps you navigate between output files, when you process multiple tasks. You may choose any string with small or big letters and numbers (e.g. "day1"). Please do not use special characters as (/ < > . ? : ; ' " \ | [{] } ` ~) to avoid problems with analysis.

Now you need to set the **Output Directory** for the output files from the analysis (PostScript files, SUM files, TBL files and LST files with list of files being analyzed).

You may choose any directory in your computer (or at a network volume); you should only make sure that you have **permissions** to write to such a directory. After analysis is started, multiple folders will be created to hold different types of the output files.

Click the Folder icon to choose the output directory. Browse for the existing directory or click Create New Folder icon to create a new folder for the output files.

Now you are ready to add file(s) for the analysis. Click **Add Files** to browse for the files and select one or many of them. (NOTE : you may choose multiple files by drawing a selection rectangle above those files when holding the left mouse button (or right if you are right-handed), another possibility is choosing only some of the files by holding the CTRL key on your keyboard and clicking those files. Another option is to hold the CTRL key on your keyboard, clicking the first file you want to add, then pressing also the SHIFT key on your keyboard while still holding the CTRL key and click the last file you want to add. All files between the first and the last files will be added into the task.

When you add the files, Task setup will look something like this :

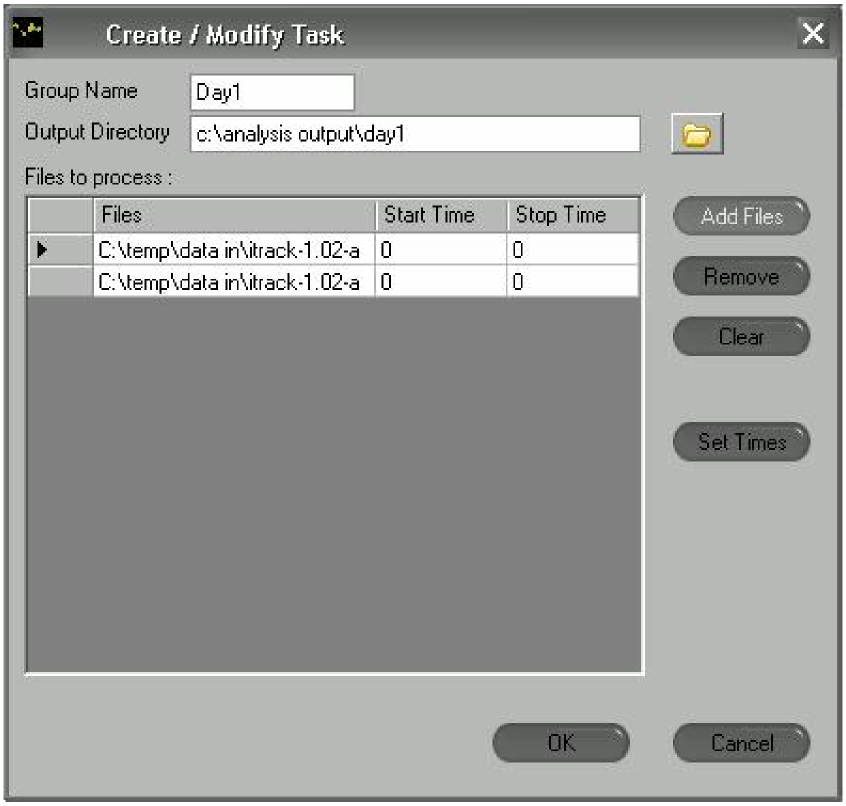

Figure 4 : Adding task

You can set the **Start Time** and the **Stop Time** for each file, where the analysis is made. E.g. when you set Start Time as “0” and Stop Time for “600” for the file, only the first 600 seconds (10 minutes) will be analyzed from this file. If you wish to set global Start and Stop Times for all the files in the task, press **Set Times** button to set them.

If you set the Start Time and Stop Time both for 0, no limitation will occur and files will be analyzed completely.

After you press the OK button, the task is added into the **Task List.**

2.2 Running the Analysis (batch job)

After you set all the tasks you want to run in a batch job, choose **Analysis – Run Analysis** from the main window to start the analysis.

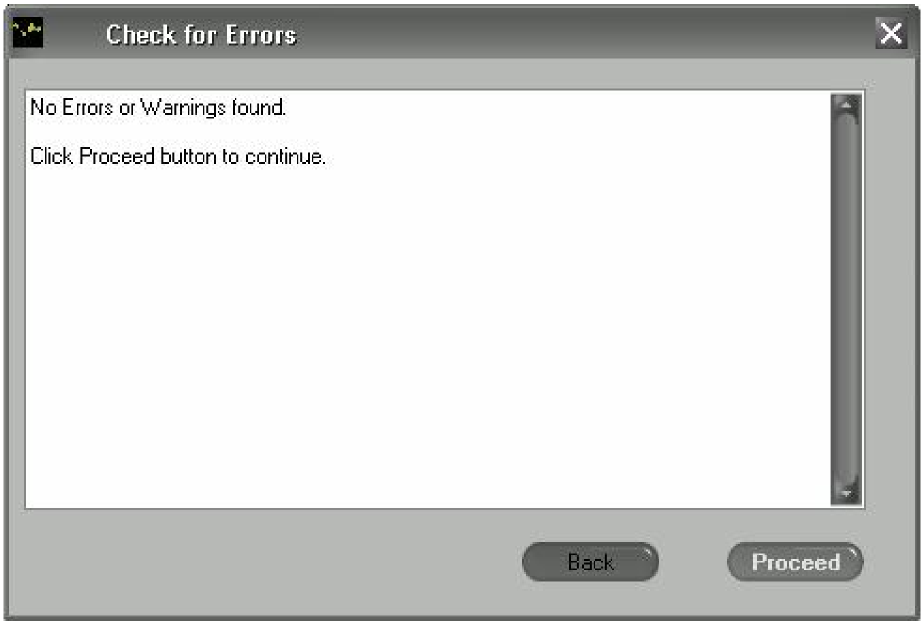

Figure 5 : Running the batch job

Before you can proceed with the analysis, several tests are done to avoid the possible errors, those tests include checking for the existence of the files and folders, checking the writing permissions and checking for the file overwriting.

If there is some serious problem e.g. the output directory doesn't exist, it is not writable or the input files don't exist, it is reported as an **error**. In this case, you are not able to continue running the task, and you need to solve the issue first and then run the analysis again.

If only some files are being overwritten, they are reported only as warnings, so if you don't care about files being overwritten, you may continue running the batch.

If no errors are reported, you may continue to run the analysis by clicking to the **Proceed** button. TrackAnalysis will proceed to all the tasks and create the outputs exactly as you set.

2.3 Storing Analysis Configuration

Sometimes it may be useful to store the analysis configuration (tasks you set up for the analysis). One example may be adding some new files to the analysis at a later time and then running the analysis again or changing analysis properties (i.e. how much of the files are analyzed, etc.).

Functions for opening and saving the analysis configuration are located under the File bookmark in the main application menu. Configuration is stored in **.tac** files (which stands for "Track Analysis Configuration").