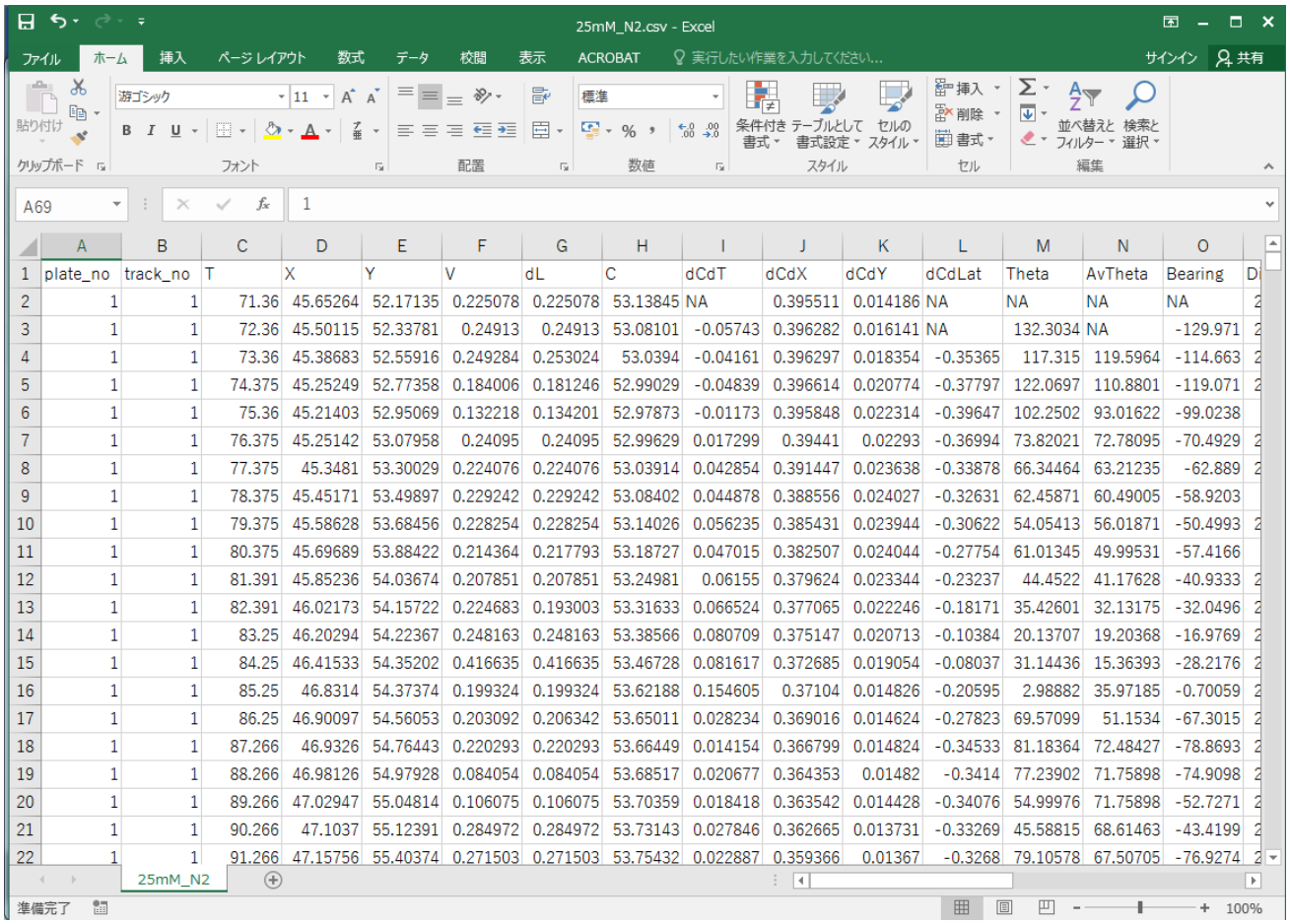
Examples of internal data (variables) in track_analyzer.r (or its previous version wt.r)

Here is an example of csv output of track_analyzer.r



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	plate_no	track_no	T	X	Y	V	dL	C	dCdT	dCdX	dCdY	dCdLat	Theta	AvTheta	Bearing
2	1	1	71.36	45.65264	52.17135	0.225078	0.225078	53.13845	NA	0.395511	0.014186	NA	NA	NA	NA
3	1	1	72.36	45.50115	52.33781	0.24913	0.24913	53.08101	-0.05743	0.396282	0.016141	NA	132.3034	NA	-129.971
4	1	1	73.36	45.38683	52.55916	0.249284	0.253024	53.0394	-0.04161	0.396297	0.018354	-0.35365	117.315	119.5964	-114.663
5	1	1	74.375	45.25249	52.77358	0.184006	0.181246	52.99029	-0.04839	0.396614	0.020774	-0.37797	122.0697	110.8801	-119.071
6	1	1	75.36	45.21403	52.95069	0.132218	0.134201	52.97873	-0.01173	0.395848	0.022314	-0.39647	102.2502	93.01622	-99.0238
7	1	1	76.375	45.25142	53.07958	0.24095	0.24095	52.99629	0.017299	0.39441	0.02293	-0.36994	73.82021	72.78095	-70.4929
8	1	1	77.375	45.3481	53.30029	0.224076	0.224076	53.03914	0.042854	0.391447	0.023638	-0.33878	66.34464	63.21235	-62.889
9	1	1	78.375	45.45171	53.49897	0.229242	0.229242	53.08402	0.044878	0.388556	0.024027	-0.32631	62.45871	60.49005	-58.9203
10	1	1	79.375	45.58628	53.68456	0.228254	0.228254	53.14026	0.056235	0.385431	0.023944	-0.30622	54.05413	56.01871	-50.4993
11	1	1	80.375	45.69689	53.88422	0.214364	0.217793	53.18727	0.047015	0.382507	0.024044	-0.27754	61.01345	49.99531	-57.4166
12	1	1	81.391	45.85236	54.03674	0.207851	0.207851	53.24981	0.06155	0.379624	0.023344	-0.23237	44.4522	41.17628	-40.9333
13	1	1	82.391	46.02173	54.15722	0.224683	0.193003	53.31633	0.066524	0.377065	0.022246	-0.18171	35.42601	32.13175	-32.0496
14	1	1	83.25	46.20294	54.22367	0.248163	0.248163	53.38566	0.080709	0.375147	0.020713	-0.10384	20.13707	19.20368	-16.9769
15	1	1	84.25	46.41533	54.35202	0.416635	0.416635	53.46728	0.081617	0.372685	0.019054	-0.08037	31.14436	15.36393	-28.2176
16	1	1	85.25	46.8314	54.37374	0.199324	0.199324	53.62188	0.154605	0.37104	0.014826	-0.20595	2.98882	35.97185	-0.70059
17	1	1	86.25	46.90097	54.56053	0.203092	0.206342	53.65011	0.028234	0.369016	0.014624	-0.27823	69.57099	51.1534	-67.3015
18	1	1	87.266	46.9326	54.76443	0.220293	0.220293	53.66449	0.014154	0.366799	0.014824	-0.34533	81.18364	72.48427	-78.8693
19	1	1	88.266	46.98126	54.97928	0.084054	0.084054	53.68517	0.020677	0.364353	0.01482	-0.3414	77.23902	71.75898	-74.9098
20	1	1	89.266	47.02947	55.04814	0.106075	0.106075	53.70359	0.018418	0.363542	0.014428	-0.34076	54.99976	71.75898	-52.7271
21	1	1	90.266	47.1037	55.12391	0.284972	0.284972	53.73143	0.027846	0.362665	0.013731	-0.33269	45.58815	68.61463	-43.4199
22	1	1	91.266	47.15756	55.40374	0.271503	0.271503	53.75432	0.022887	0.359366	0.01367	-0.3268	79.10578	67.50705	-76.9274

In the csv format, all data points from each plate (depicted by plate_no) and each track (depicted by track_no) are vertically stacked. Please note therefore that there is no continuity of data between rows with different plate_no or track_no. Also, note that there are many “NA”s that may require special care.

In track_analyzer.r, most of these data are kept in variables of the “list” type.

Following variables are basic values read from output file of worm tracker. However, it is modulated by “adjust position” when it is executed (small adjustment is made so as to align different plates based on mark points, also read from worm tracker output). So make sure not to execute “adjust position” multiple times.

T (dT in track_analyzer): Time (sec)

X (dX in track_analyzer): X coordinate of worm centroid (mm) (roughly 0-100 in our case)

Y (dY in track_analyzer): Y coordinate of worm centroid (mm)

- Generated by calc.dL:

V (dV in track_analyzer): velocity of worm (mm/s), calculated from (X, Y, T) between two consecutive time points.

dL: Distance (mm) worm proceeded between time points. Calculated as distance between (X, Y) positions in consecutive time points.

- Generated by findPir

AvTheta: Averaged direction of movement (degrees). For each centroid position at each time point, centroids are selected that lie within a distance of gauge (0.3 mm in default) from the centroid point in question. A regression line is drawn on these points. AvTheta is defined as an angle of this regression line (directional, in line with time progress) relative to the positive direction of the X axis, positive angle corresponding to rotation toward positive direction of Y axis, negative towards negative direction of Y axis. In a range between -180 deg and +180 deg.

TurnRun: Detection of sharp turns ("T"= turn, or "R"= run). For each centroid point at each time point, select one centroid point each, forward and backward, that are separated by a distance of gauge from the point in question. Link these points, and if the angle of forward and backward lines makes an angle smaller than pirangle (default, 80 deg), the point is labeled "T". (See Iino and Yoshida, J. Neurosci., 29(17):5370, 2009, Fig. S1C).

- Generated by calc.PirRun

PirRun: Detection of Pirouettes ("P"=Pirouette, "R"=Run). Points labeled "T" in TurnRun are always labeled "P". In addition, if the time difference between two "T"s are smaller than Tcrit, all points in this time span are labeled "P". Other time points are all labeled "R". (See Shimomura, Morse and Lockery, J. Neurosci., 19(21):9557, 1999, Figure 5B and C)

TurnStart, TurnEnd, PirStart, PirEnd: Starts or ends of turns or pirouettes are TRUE, otherwise FALSE. Generated based on TurnRun and PirRun.

Pirsurround: Time points within the distance of gauge22+gauge are labeled "P" in addition to those labeled "P" in PirRun.

- Generated by calc.TurnRate

TurnRate: Curving rate of centroid movement (deg/mm) at each time point during Run. For each centroid point, forward and backward guide points are selected that are separated by a distance of gauge2 (1 mm in default) from the point in question. Determine the difference between AvTheta angles at forward and backward guide points, divide it by the distance worm proceeded between these two time points (sum of dL) (See Iino and Yoshida, Fig. S1D)

- Generated by findPirA

Theta: Instantaneous direction of worm centroid movement (deg): Direction of the vector made by two centroid positions at consecutive time points. Theta is defined as an angle this vector makes relative to the positive direction of X axis. Positive angle is toward positive direction of Y axis; in the rage between -180 deg and +180 deg.

TurnRunA: Detection of Turn ("T") and Run ("R"). Unlike TurnRun, here each centroid point is linked with centroid points at previous and next time point. The centroid point is labeled "T" if the angle made by these links is less than 90 deg.

- Generated by calc.PirRunA

PirRunA: Detection of Pirouette ("P") and Run("R"). Similar to PirRun but based on TurnRunA. If interval between Turns are less than Tcrit, points in the interval is labeled "P".

TurnStartA, TurnEndA, RunStartA, RunEndA, PirStartA, PirEndA: Starts or ends of turns or pirouettes are TRUE, otherwise FALSE. Here based on TurnRunA and PirRunA.

PirSurroundA: Time points within the distance of gauge22+gauge are labeled "P" in addition to those labeled "P" in PirRunA.

- Generated by findShortTurn

ShortTurn: Turn ("T") and run ("R"). Same as TurnRun, but uses gauge3 (0.1 mm in default) thereby detecting short reversals.

- Generated by calc.C

C: Concentration of chemical that a worm senses. In calc.C under the "plug" option, the data obtained by diffusion simulation are used. In the "12point" option, calculates by diffusion equation.

dC/dT, dC/dX, dC/dY, dC/dLat: Time- or spatial-differential of C. dC/dX and dC/dY are spatial gradients at the position of worm centroid. dC/dT is calculated based on the time spent between two consecutive centroid points. dC/dLat is a concentration gradient in the direction perpendicular to the direction of centroid movement defined by AvTheta.

- Generated by calc.Bearing

Theta : Same as above under calc.Bearing

Bearing: Angle (deg) of direction of chemical gradient relative to the instantaneous direction of centroid movement: Direction of chemical gradient is determined depending on the setting of the parameters "plate_format" and "odor_direction".

Dist: Distance (mm) of worm centroid from the chemical concentration peak.