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Visualization and quantitative analysis of animal locomotion using Wintrack

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History and objectives

What did we miss in available software?

- rapid data exploration, seamless interface with statistics software
- flexible definition of custom analyses at different levels of detail
- automated analysis of large volumes of data
- Integration of data from different tracking systems
- Integration of track data with other types of data

History

1988 TrackAnalyzer, DOS-based precursor
1993 WinTrack 1.0
1996 interface with EthoVision DOS
2000 Wintrack available on the Web
2002 interface with EthoVision 2.3

Wintrack is not a product, but a tool that we are happy to share with others

http://www.dpwolfer.ch/wintrack

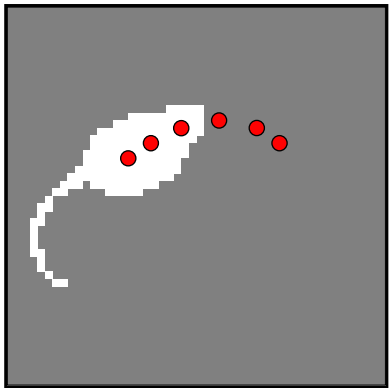
You may

- Download a free copy
- Run it on Win 9x/NT/2000/xp
- Get tips and help from the website

Do not

- Use it for commercial purposes
- Expect a printed documentation
- Expect error free operation
- Expect professional support

Video-tracking



- Video image, frame grabber
- Object separation (contrast)
- XY coordinate of object center

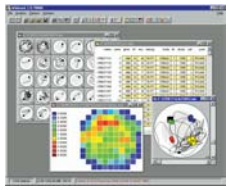
Raw data:
- Stream of XY coordinates

Optional:
- Time stamps
- Object surface area
- Keyboard recorded events

Wintrack analyzes animal paths offline

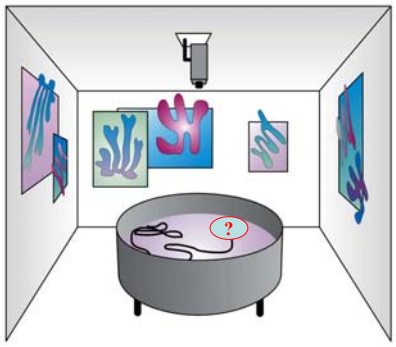
Noldus EthoVision 1.9x – 2.3
HVS Image 2020 Plus tracking System
TSE VideoMot2
Imétronic Freezing
u-blox GPS-MS1

arena definition
path/event data
variable definitions



numeric output
graphs

Place navigation in the watermaze



Morris RGM,
Learn Motiv, 12:239-260, 1981

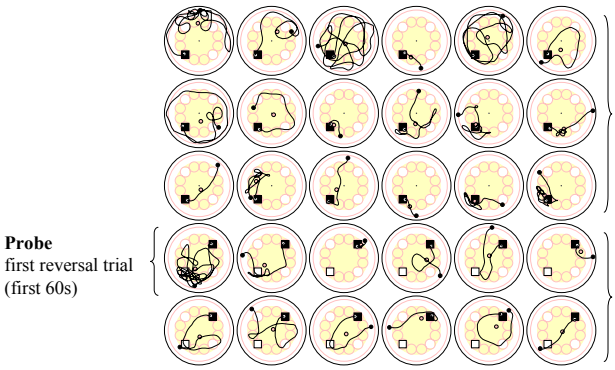
Morris RGM et al.,
Nature, 297:681-683, 1982

Morris RGM,
J Neurosci Meth, 11:47-60, 1984

Morris RGM et al.,
Nature, 319:774-778, 1986

Parameters
- escape latency (training)
- time in quadrant (probe trial)
- annulus crossings (probe trial)

Place navigation protocol in Zurich



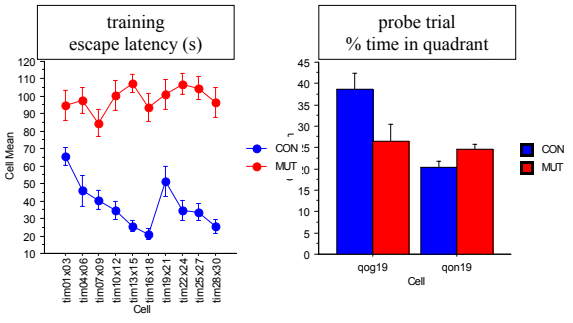
Acquisition
3 days x 6 trials
30-60 min ITI

Probe
first reversal trial
(first 60s)

Reversal
2 days x 6 trials
30-60 min ITI

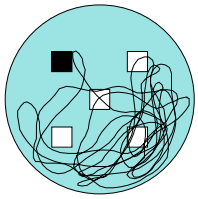
Pool 1.5m, platform 14x14cm, water 24-25°

Forebrain TrkB receptors essential for learning

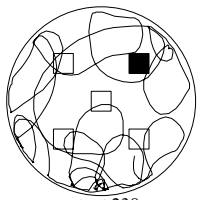


Genotype p<.0001
Time p<.0005
Interaction p<.0001

Genotype p<.0324
Time p<.0089
Interaction p<.0324



control 244

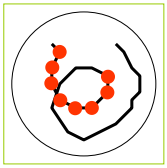


mutant 238

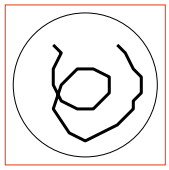
Wintrack has two levels of operation

	basic **- greater ease**	**advanced** **- more power**
provides	- easy interface - predefined arenas - predefined analyses - instant export	- custom & open arenas - custom analyses - event analysis - time line view - automation
requires	- tracking system - standard setup	- tracking system - setup scripts (WSP) - analysis scripts (VDF) - macros (MAK)

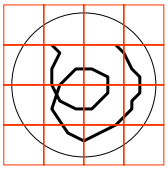
Levels of detail in analysis



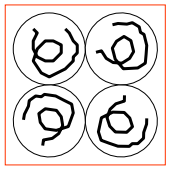
Single point, Episode
- profile variable
- bullet plot



Single trial
- trial variable



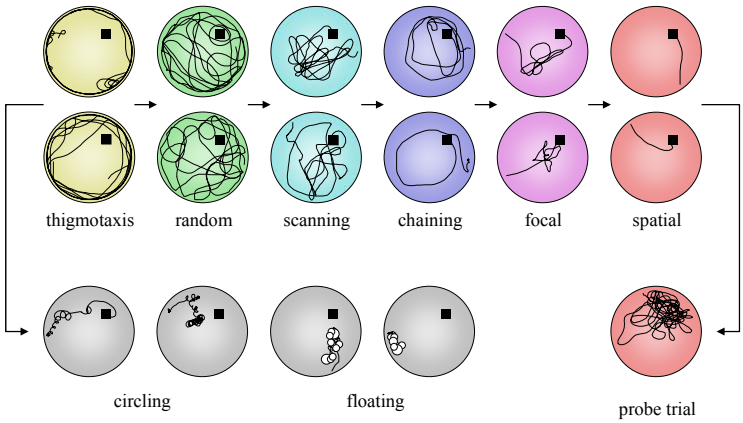
Tile in space
- surface variable
- surface plot



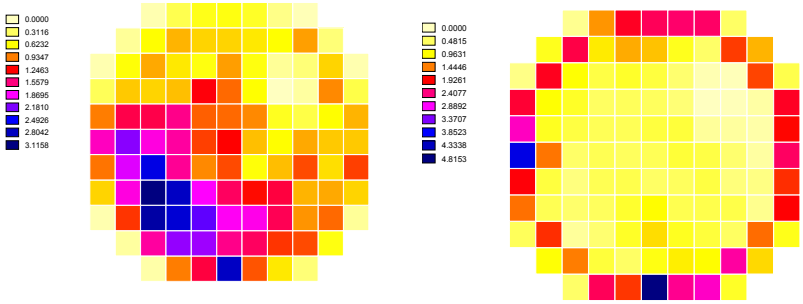
Range of trials
- case variable

Strategies and swim patterns of mice in the watermaze

Exp Physiol 85:627, 2000

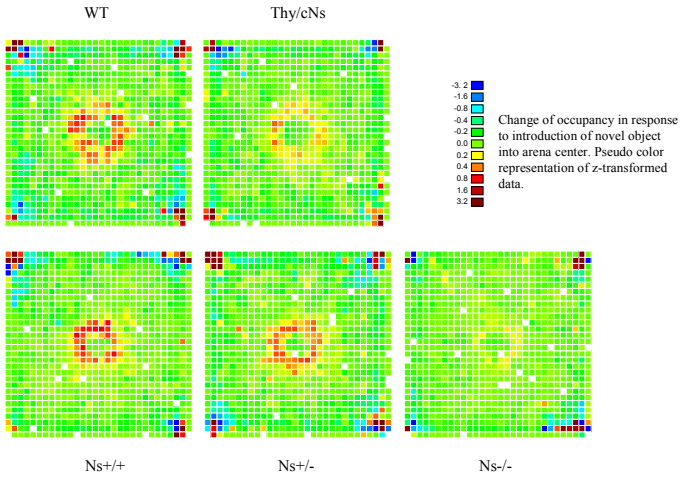


Forebrain TrkB KO mice fail on watermaze transfer test

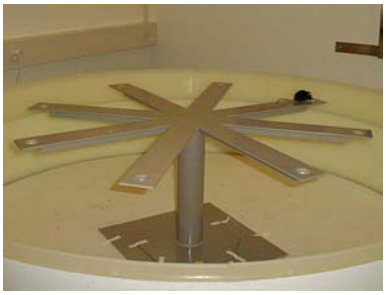


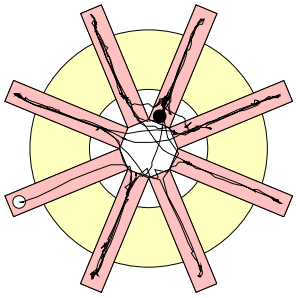
controls mutants

Object exploration in mice with altered expression of neuroserpin



8-arm radial maze



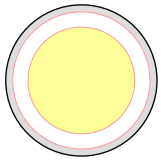


Collect 8 baits without repeated arm entries
(spatial working memory)
2 days adaptation, 10 days x 1 trial training

logical arms
choice zone

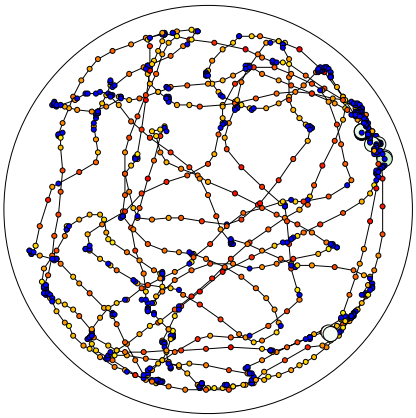
Openfield exploration test

Arena 1.5m
Light 12 lux diffuse
2x 10min on consecutive days



exploration zone
transition zone
home zone

Motion states in exploration tests



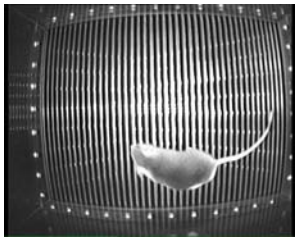
Progression
Episodes above speed threshold and covering minimal distance, minus acute decelerations

Speed threshold	0.085 m/s (OfSD, QuEM, QuNV) 0.040 m/s (NmSD, LdSD)
Distance threshold	0.05 m (OfSD, QuEM, QuNV) 0.03 m (NmSD, LdSD)
Deceleration threshold	0.15 m/s (OfSD, QuEM, QuNV) 0.08 m/s (NmSD, LdSD)

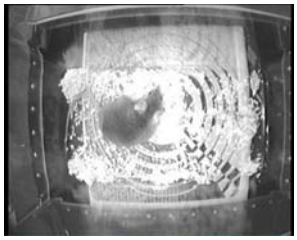
Scanning
Episodes not qualifying as progression or resting

Resting
Episodes lasting >2 s with movements <0.025 m/s (system noise threshold, 2 s smoothing frame)

Cued and contextual fear conditioning



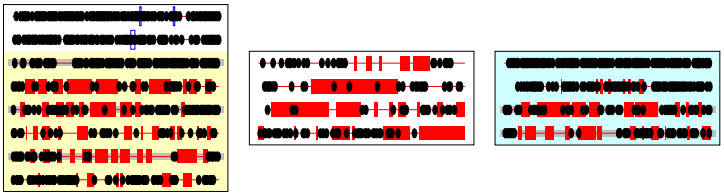
Training chamber



New context

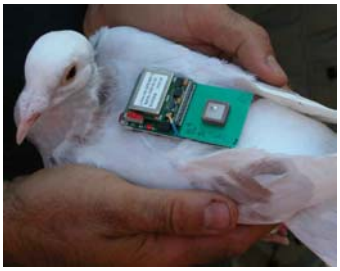
1. Training = 3 pairings: 10s tone co-terminating with 2s current
2. Context test after 24h: 2min, no current, no tone
3. Tone test 24h after training: 1min baseline + 1min tone

Correlation between manual and automatic freezing detection



training context test tone test

Analysis of GPS data with Wintrack



Download of LOG file to PC

1. *Data extraction & filtering of artifacts:*
   - time stamp
   - longitude, latitude
   - altitude
   - speed
   - number of satellites
2. *Coordinate conversion to Cartesian XY:*
   - Swiss Grid
   - Universal transverse Mercator
3. *Analysis:*
   - numerical
   - graphical

Scaled output of GPS data from Wintrack