

Sophisticated Life Science Research Instrumentation



# MotoRater

Fully Quantitative Kinematic Analysis



MotoRater: Unbiased Automation



# Comprehensive Kinematic Analysis

**With the TSE Systems MotoRater, detailed automated analysis of a multitude of locomotor behaviors and mechanics becomes possible**

## YOUR BENEFITS

- **Comprehensive analysis: large number of measurement parameters**
- **Unique: fully automated kinematic analysis**
- **Flexible : suitable for many animal species**
- **Ease of use: minimum experimenter interference necessary**
- **Reliable data: natural behavior measured & standardized measurement and analysis protocols**

## Literature Reference

### CNS damage recovery

*Zörner et al., Nature Methods 2010*

The report describes the reasoning behind the development of an automated, comprehensive kinematic analysis system, using the example of rodents with spinal cord injuries, stroke, or transgenic animals.

## Background

Motor behavior is a complex task, involving multiple organ systems such as the central and peripheral nervous system (CNS/PNS), joints, muscles, or tendons. Control mechanisms are manifold and often redundant.

- Rodents are popular model organisms for CNS damage studies
- To detect mostly effects, a large set of experimental setups may be necessary, with accompanying difficulties in standardizing and generalizing results
- Standalone paradigms often suffer from subjectivity, non-linearity, or low sensitivity issues and focus on specific motor aspects only
- Current automated motor analysis systems only focus on gait analysis as viewed from below by footprint analysis

underside, right and left side

- System can be configured to analyze
  - Overground Walking
  - Ladder Walking
  - Skilled Walking
  - Wading
  - Swimming
- In any locomotor behavior a large set of parameters can be measured (see table on reverse)
- Standardized measurement and analysis protocols ensure highest data reproducibility
- Biomechanical assessment of all body parts possible
- High efficiency and throughput: single operator can measure a large number of animals within a short time
- System specified either for mice-sized or rat-sized test animals (see separate data sheet for details)

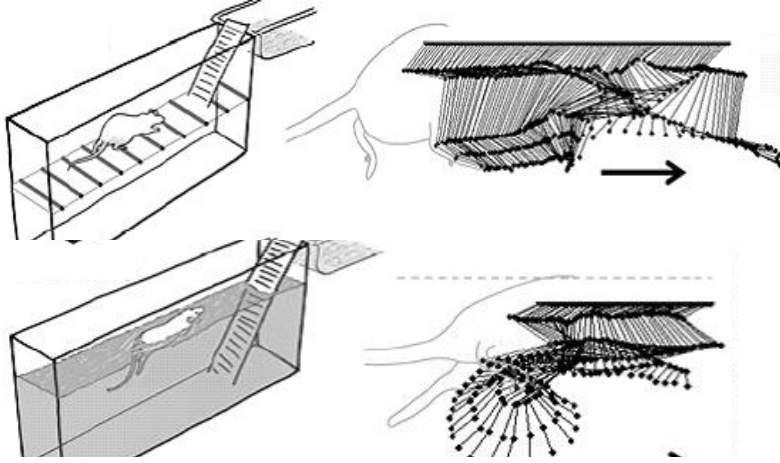
## System Description

The MotoRater was designed to offer fully automated, comprehensive kinematic analysis in a variety of natural locomotor behaviors.

- Animals move unforced in a long motility compartment towards a target box (the home cage)
- Every movement is automatically tracked by a high-speed color camera on a motorized sled
- Through a system of mirrors, three viewing angles are achieved: animal

## Applications

- Damage to CNS due to trauma, ischemia, neuro-degenerative or inflammatory diseases
- Locomotor recovery and evaluation of treatment efficacy
- High-throughput screening of rat /mice for locomotor deficits
- Neurological / neuromuscular diseases
- Peripheral nerve injury
- Aging
- Pain/arthritis models
- Spasticity and ataxias



## Software Features & Exercise

**The MotoRater software offers unmatched variability, ease-of-use and data quality**

### Automated Tracking

- Animal movement is captured by a low resolution lead camera, causing the camera sled to follow the animal and the high-speed camera to constantly focus on the center of the animal
- A long locomotor compartment favors the development of a natural motility pattern and minimizes artifacts
- An unlimited number of color spots on significant body parts of the animal, such as joints or other anatomical landmarks, can be tracked
- EMG recordings may be combined with the kinematic analysis (special set-up, please enquire for details)
- Linear displacement
- Angular displacement
- Velocity/acceleration of displacement
- Toe clearance
- Paw position/rotation
- Joint position/angles
- Intralimb coordination
  - Timing of joint excursions
  - Limb motion pattern (see stick diagram)
  - Timing of muscular activity (with EMG recording)
- Whole body coordination
  - Forelimb-hindlimb coordination
  - Right/left limb coordination
  - Cycle ratios
  - Phase dispersion
- Tail coordination
  - Motion timing in tail segments
  - Tail-limb coordination

### Parameters measured (selection)

- General locomotor function
  - Velocity of locomotion
  - Trunk instability
  - Body height
  - Body angle
  - Tail drag duration
  - Abdominal drag duration
  - Paw distance
  - Forelimb activity (swimming)
  - Tail position, height, movement pattern, oscillation, motion velocity
- Basic and skilled limb movement
  - Accurate stepping/paw placement
  - Cycle duration

### Analysis

- All data suitable for analysis with standard statistics packages (Excel, SPSS, GraphPad)
- Objective, unbiased analysis
- Meaningful stick figure graphics

### Exercise

- Analysis of motor function recovery can be used to devise CNS injury regeneration exercise

### YOUR BENEFITS

- **Wide range of applications**
- **Minimized measurement or result calculation errors through standardized procedures**
- **TSE Two (2) Years ALL-IN Premium Warranty and Service Package**

### Literature Reference

#### Motor deficit recovery

*Filli et al., Brain 2011*

The paper describes the use of the MotoRater for the analysis and recovery of spinal cord hemisection injuries. This investigation may open up new therapeutic approaches in human conditions such as the Brown-Sequard syndrome.

## MOTORATER TECHNICAL DATA

| SPECIES                    | MOUSE                            | MOUSE / RAT                       |
|----------------------------|----------------------------------|-----------------------------------|
| PRODUCT NUMBER             | 303030-M                         | 303030-RM                         |
| DIMENSIONS (CM/IN)         | 202 x 62 x 158<br>80 x 24.5 x 62 | 270 x 80 x 174<br>106 x 31.5 x 68 |
| LOCOMOTOR DISTANCE (CM/IN) | 120<br>47                        | 170<br>67                         |
| CAMERA RESOLUTION          | 1280 x 1024                      |                                   |
| FRAMES (SEC)               | Up to 300                        |                                   |
| MAX. DURATION OF RECORDING | 250                              |                                   |

## PARAMETERS OF LOCOMOTOR FUNCTION

| PARAMETER                                   | MEASURE   | HORIZONTAL<br>LADDER | WALKING | WADING | SWIMMING |
|---|---|----------------------|---------|--------|----------|
| <b>General locomotor function</b>           |   |                      |         |        |          |
| Velocity of locomotion                      | m s <sup>-1</sup>   | +                    | +       | +      | +        |
| Trunk instability                           | s, cm   | +                    | +       | +      | +        |
| Body height, body angle                     | cm, degrees   | +                    | ++      | ++     | +        |
| Duration of tail or abdominal dragging      | s   | +                    | +       | +      | -        |
| Base of support (distance between paws)     | cm  | +                    | ++      | +      | +        |
| Forelimb activity, swimming                 | no. FL strokes per run  | -                    | -       | -      | ++       |
| Tail position                               | cm, s <sup>-1</sup> , cm s <sup>-1</sup>  | +                    | +       | +      | ++       |
| <b>Basic &amp; skilled limb movement</b>    |   |                      |         |        |          |
| Correct stepping, paw placement             | % plantar or functional steps   | ++                   | +       | +      | -        |
| Step or swim cycle duration                 | s   | +                    | +       | +      | +        |
| Linear displacement                         | cm  | +                    | ++      | ++     | +        |
| Angular displacement                        | degrees   | +                    | +       | ++     | +        |
| Velocity or acceleration of displacement    | cm s <sup>-1</sup> , radian s <sup>-1</sup> , cm s <sup>-2</sup> , radian s <sup>-2</sup> | +                    | +       | +      | ++       |
| Toe clearance (paw dragging)                | % steps with paw dragging   | +                    | ++      | ++     | -        |
| Paw position and rotation                   | cm degrees  | +                    | ++      | +      | +        |
| <b>Forelimb-hindlimb coordination</b>       |   |                      |         |        |          |
| Placement of fore- and hindpaws             | % identical rungs targeted  | ++                   | -       | -      | -        |
| Ratio of FL and HL cycle duration           | s s <sup>-1</sup>   | +                    | ++      | +      | -        |
| Phase dispersion, footfall diagram          | % deviation   | +                    | +       | +      | -        |
| <b>Left-right coordination</b>              |   |                      |         |        |          |
| Ratio of left and right limb cycle duration | s s <sup>-1</sup>   | +                    | +       | +      | +        |
| Phase dispersion, footfall or phase diagr.  | % deviation   | +                    | ++      | +      | ++       |
| Timing of muscle activity (EMG rec.)        | s   | +                    | +       | +      | ++       |
| <b>Intralimb coordination</b>               |   |                      |         |        |          |
| Timing of joint excursions                  | s   | +                    | +       | +      | +        |
| Limb motion patterns                        | cm, degrees   | +                    | +       | +      | ++       |
| Timing of muscle activity (EMG rec.)        | s   | +                    | +       | +      | ++       |
| <b>Tail-hindlimb coordination</b>           |   |                      |         |        |          |
| Timing of hindlimb exc. in relation to tail | s   | +                    | +       | +      | ++       |
| <b>Intratail coordination</b>               |   |                      |         |        |          |
| Timing of motion of different tail segments | s   | -                    | -       | -      | +        |

(-) parameter not applicable or measurable; (+) param. measurable; (++) recommended outcome parameter. HL, hindlimb; FL, forelimb;

EMG, Electromyogram. Specifications subject to change without notice.

## Service & Warranty

TSE Systems offers an outstanding, global 24/7 premium customer service. Our experienced experts are dedicated to complete customer satisfaction and will solve your problem by e-mail, phone or an on-site visit.

- 24/7 technical hotline
- Remote maintenance and update function
- On-site visits upon necessity
- Free replacement parts

After the expiry of the warranty period, TSE Systems offers comprehensive extensions of the warranty or economical maintenance and repair contracts to ensure the continued smooth running of your instruments. Please contact us for further details.

[www.TSE-Systems.com/contact](http://www.TSE-Systems.com/contact)

