



3D gait analysis system for a treadmill

KinemaTracer ***for animal***



KISSEI COMTEC

KinemaTracer®

The simple and compact treadmill system for objective gait analysis.

- Simple architecture just using 4 cameras connected to 1 PC.
- Gait analysis of various size of animals, using suitable size of color markers. (small~big animal)
- Speedy calculation of 3D coordination using color marker tracking function.
- Auto detection of heel on / toe off the ground to gain gait parameters.
- Various types of graph expression for suitable purposes

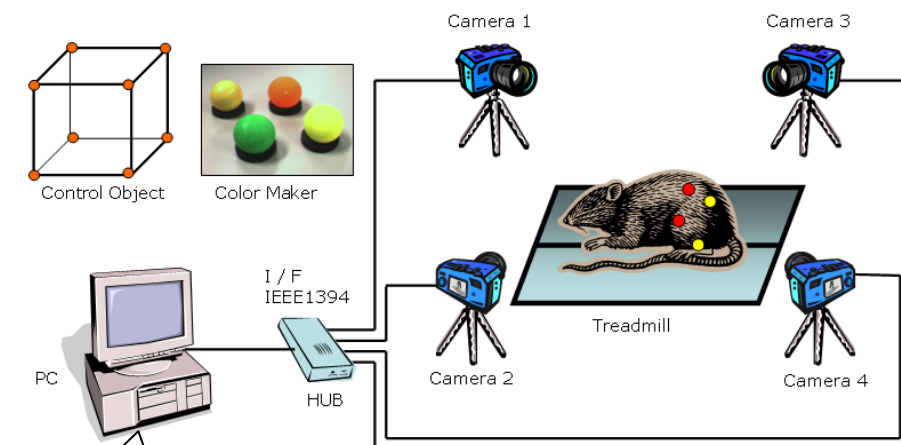
Software • Hardware

Simple connection using IEEE1394 cables between cameras and PC for synchronized recording.

Control Object is used for calibrating camera positions and lens distortion

Various sizes of makers can be provided for being suitable to many animals.

The software consists of 3 sub-software, including Recording,, 3D calculation, Analysis (Compare) functions.



3 types of software

① **Recording**

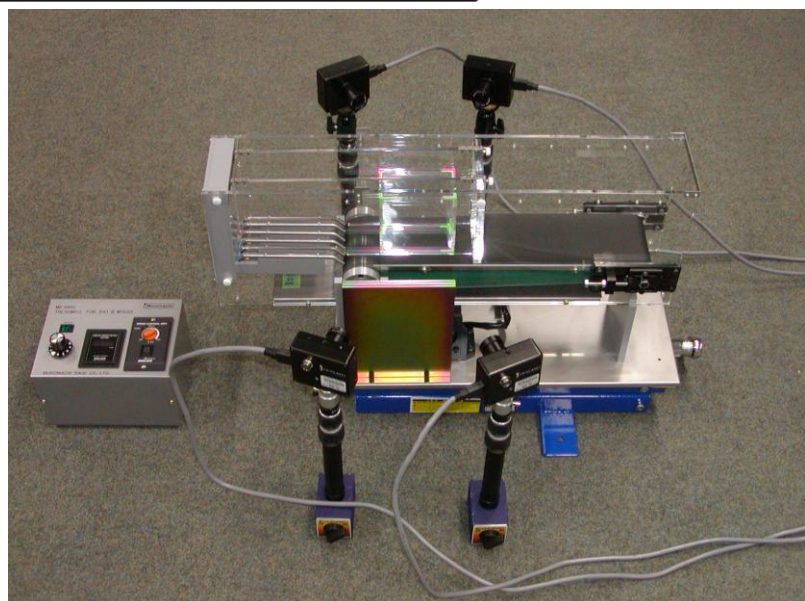
4 cameras simultaneously

② **3D calculation**

Color marker tracking for calculating 3D coordination

③ **Analysis function**

Gait Analysis, Graph disp., Comparison functions



Explanation

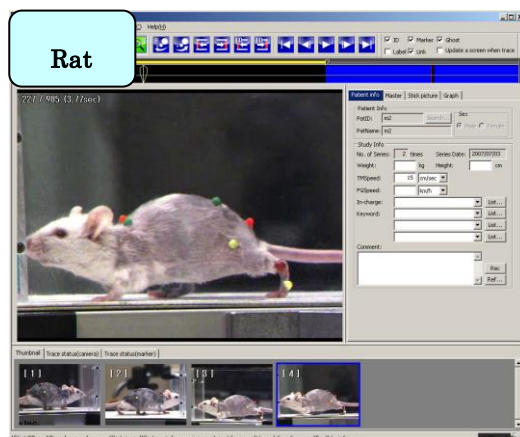
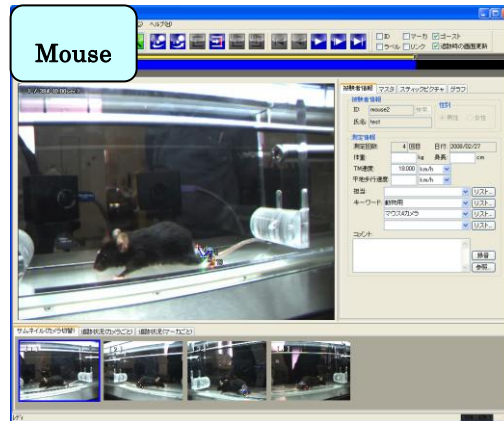
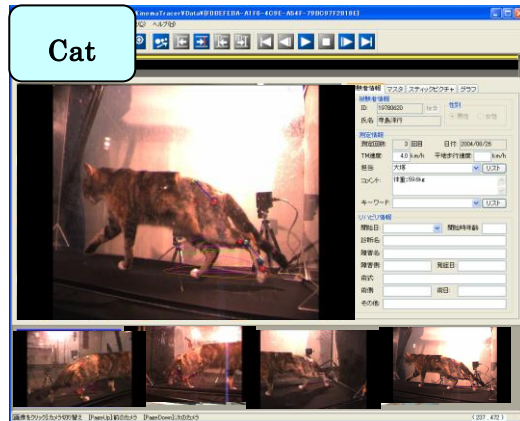


Monitoring and Recording function using several cameras.

Synchronization accuracy is around error 1μ second.

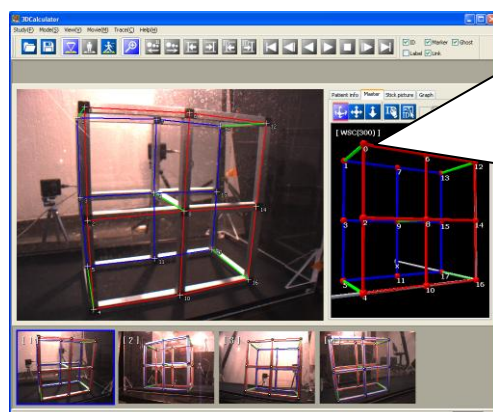
On the software, you can adjust shutter speed, gain and other parameters for shooting.

Recording software : MotionRecorder



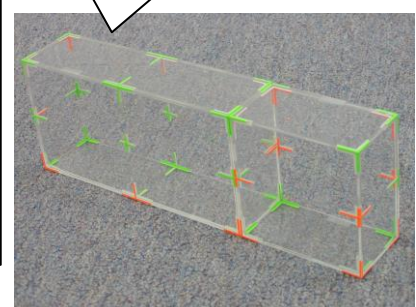
3D coordination can be calculated from the control object information with adjusting lens distortion. Click the color marker point to recognize the color for detecting color marker tracking.

XYZ calculation : 3DCalculator



Known coordination size of the control object is used for calculating the matrix of DLT method. Using the matrix, 3DCalculator calculate XYZ coordinations from 2D movies.

You can use acryl case as the control object.



Click the marker

Marker master template is used to assign the joint points of stick picture to the image.

検出条件のプロパティ

マーカーID: 3
色空間

色相(H): 204.7 ~ 290
彩度(S): 24 ~ 105.7
輝度(B): 42.4 ~ 216.1

最小面積(L): 10 ~

このマーカーの検出に背景差分を使用する(D)

Auto Tracking

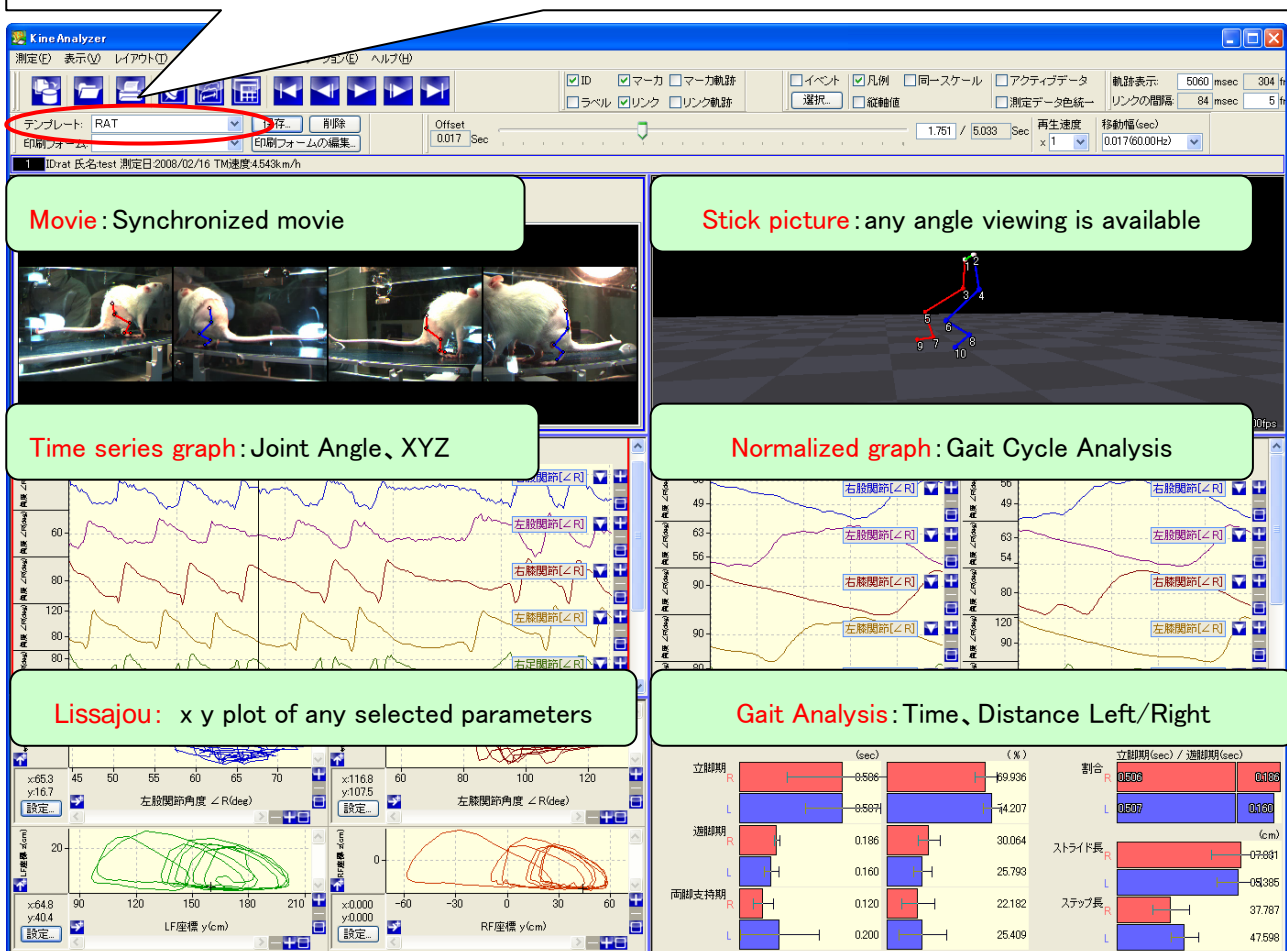
※ interpolation function for hidden marker tracking is available. Manual digitizing is also available.



Various analysis data can be shown on just one window. You can use the template for setting up the location of your preference. You can compare the data showing multiple data on overlay drawing, displaying simultaneously to see the difference of before/after injection drug to the animal. You can output screen as movie image file such as AVI file.

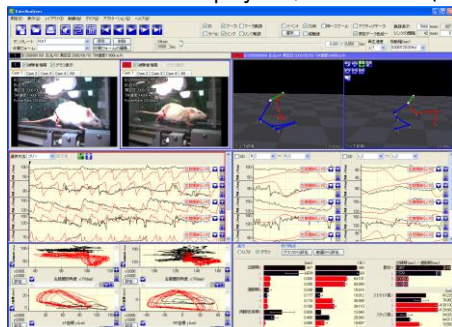
Analysis Program : KineAnalyzer

6 areas are available for display graphs. You can register your suitable graph patterns as the template. Once you register the template, you just select the template for showing your favorite graphs.



Display multiple data simultaneously

Display red/black lines (Compare image: **Maximum 4**)



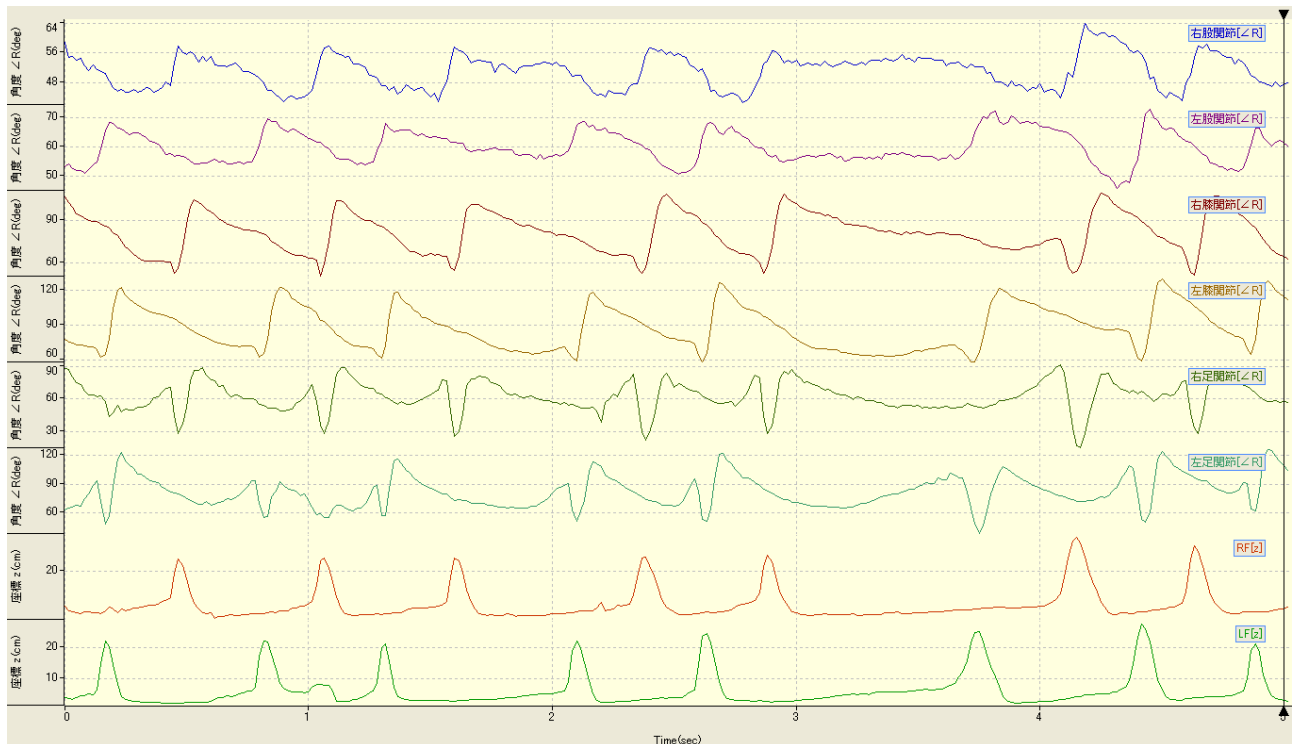
**Movie (AVI)
files**

For your presentation or slide document
to play movie on it.

Analysis

① Time series graph

Display various time series graph marker coordination (X/Y/Z value)、angle、marker distance which is synchronized with movie and stick picture windows. EMG data can also be shown on the same graph when recording the EMG data.



Example: left/right thigh, knee, leg of joint angle, the height of toe (Z value)

Display

マーカーマスタの変更 - データ1

マーカーマスタ: ラット下腿用

名前をつけて保存...

名称	Vector A	Vector B	演算
右股関節	1 → 3	3 → 5	
左股関節	2 → 4	4 → 6	
右膝関節	5 → 3	5 → 7	
左膝関節	6 → 4	6 → 8	
右足関節	7 → 9	7 → 5	
左足関節	8 → 10	8 → 6	
左足-Y軸	8 → 10	y	
右足-Y軸	7 → 9	y	

追加 編集

角度の設定

名称: Angle 9

Vector A

☒ ベクトル ☐ 面に垂直なベクトル ☐ 座標軸

From: 2 To: 4

Vector B

☒ ベクトル ☐ 面に垂直なベクトル ☐ 座標軸

From: 4 To: 6

角度演算

☒ 演算なし ☐ 定数+α ☐ 定数-α 定数: 度

適用 取り消し

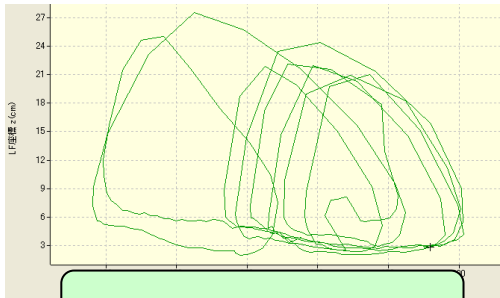
* スティックピクチャ上でクリックしたマーカーのIDが にセットされます。

閉じる

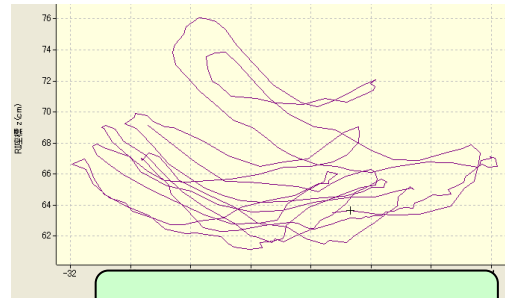
Angle is defined by using 4 points (2 vectors) from any joint points.

②Lissajou graph

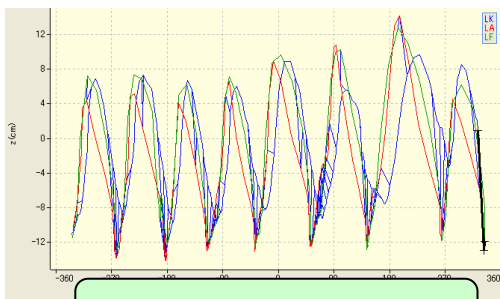
The software displays movie from four cameras, stick picture, gait parameter, normalized graph, XYZ coordination, timeline of joint angle.



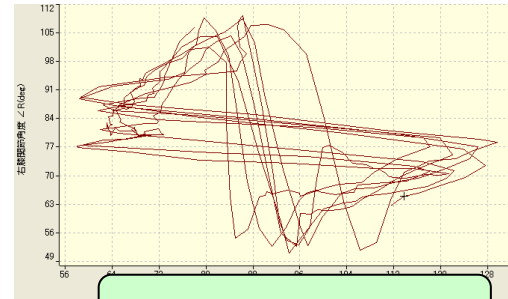
Toe orbit (sagittal plane)



Waist (frontal・VC)



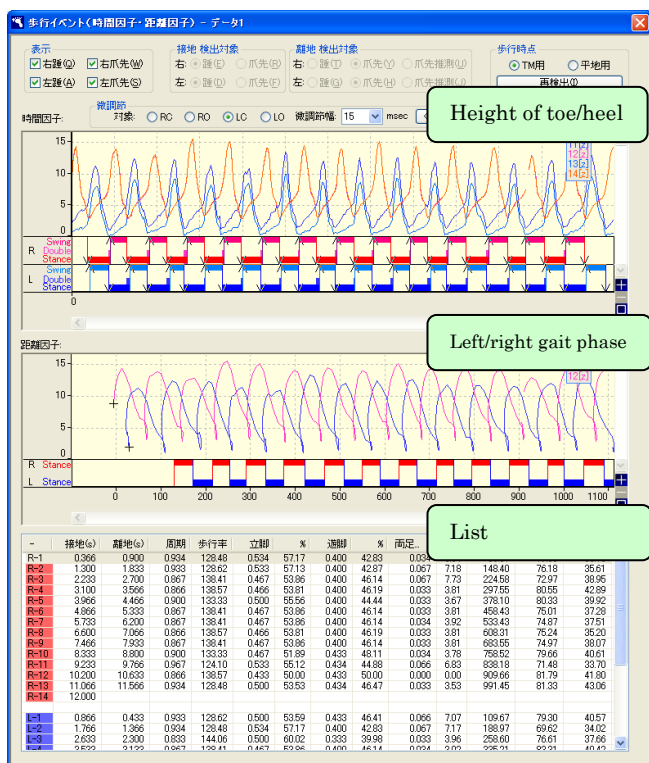
Left leg (sagittal plane)



Left/right knee angle plot

② Gait Analysis

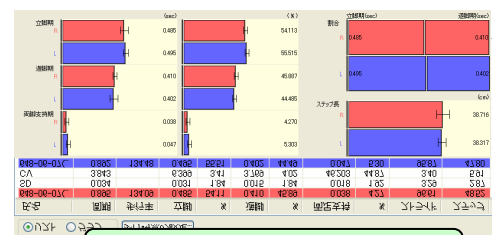
Heel contacts events and toe off events are automatically detected from 3D coordination. The software calculates temporal factors (swing, stance, double support) and distance factors (step, stride), and show variance and difference between both feet.



Height of toe/heel

Left/right gait phase

List



Bar graph display (left/right)

Time factor

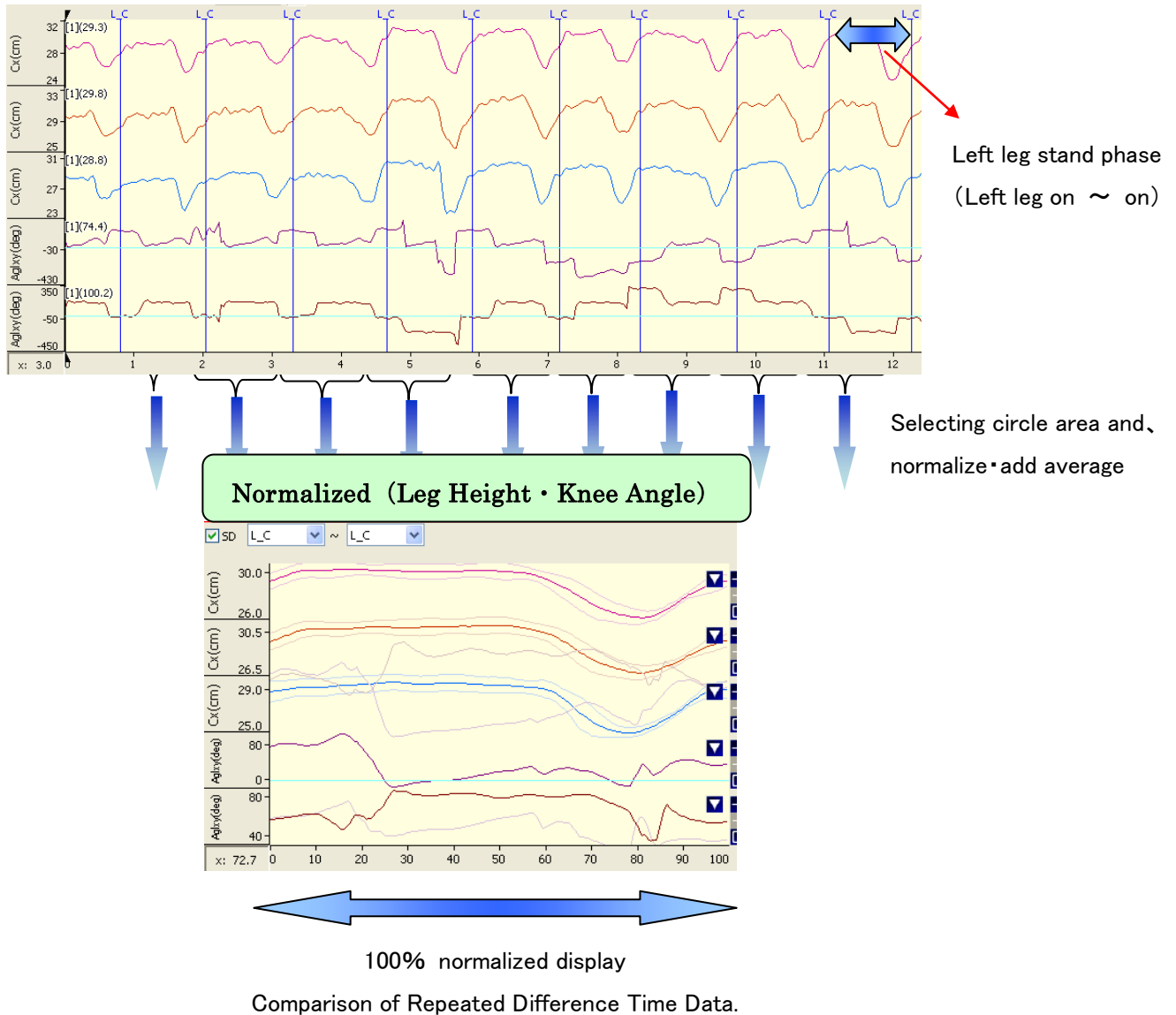
- Stance phase
- Swing phase
- Double support phase
- Gait cycle
- Cadence

Distance factor

- Stride length
- Step length

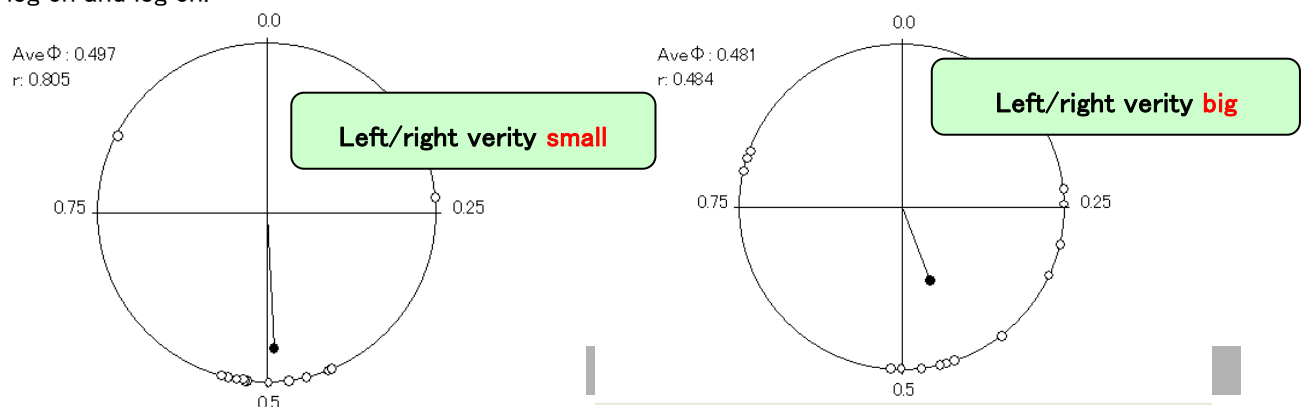
④ Normalized graph

After selected time period by detecting gait event (toe off/heel strike), the data is added and average calculating. You can see representative gait pattern and variety from multiple gait cycles. All line graph is calculated to notarized data.



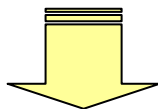
⑤ Secular phase plot

This plot shows evaluation of relative relations (Variety) or synchronized movement in the cycle between Left leg on and leg on.



Simple hardware setup with four (or two) cameras connected to a PC. Automatic detection of heel contact events and toe off events of both feet. Calculation of standard gait parameters (swing, stance, double support etc) Speedy 3D tracing by color marker recognition.

Assessment tool of spinal cord injury, arthritis for animal gait model



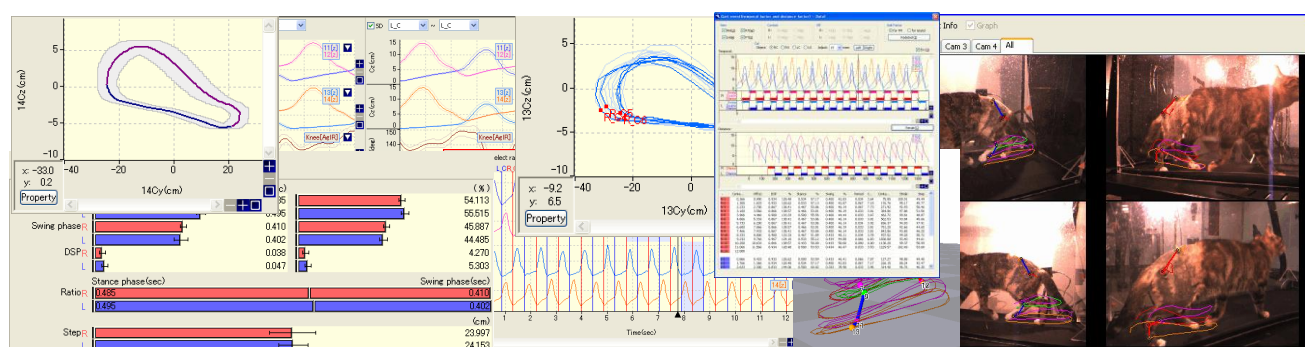
Gait assessment and Static analysis

■ Hardware specification

Cameras	Interface	Firewire (IEEE1394)
	The number of units	4 or 2 units
	Synchronization method	Automatic
	Resolution of images	VGA (640x480)
	Frame rates	30 / 60 fps
Markers	Type / Shape	Colored / Spherical
Calibration	Method / Shape	DLT method, modified DLT method (lens distortion correction) /

■ Software specification

Basic analysis	XYZ plot, Speed, Acceleration, Angle of joints, Angular velocity of joints, Angular acceleration of joints
Gate analysis	Normalization, Average, SD, and CV of Stride length, Step length, Stance phase, Swing phase, Double support phase, Gait cycle, Cadence, Body-sway
Rendering	Stick picture, Tracking, Super impose, Time series graph, Lissajou graph, Normalization graph, Numeric list, Rendering items configuration (Template)
Comparison	Overwrite graphs, Motion images, Parallel rendering of stick pictures, Simultaneous playback of multiple data
Output data	XY plot, XYZ plot, Graphs, Numeric lists
Digitize	Auto-tracking, Reverse auto-tracking, Multiple maker auto-track, Position anticipation, Auto-interpolation, Manual-digitize



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