simi

reality motion systems

Concept for clinical motion analysis & applied biomechanics

MEDICINE

SPORT

Dear Sir or Madam,
Thank you for placing your confidence in us. We are delighted that you intend to use our clinical motion analysis system as an integral part of diagnostic and therapy procedures in your institute.

Simi has been developing and marketing image-based motion analysis systems for medicine, sports and scientific research since 1992. We utilize industrial video technology for motion capture and our state-of-the-art recognition and image processing technologies for kinematic analysis are at the forefront of innovation in the fields of clinical and image-based motion analysis. We offer an extensive set of motion analysis tools for applications ranging from simple outpatient assessments to comprehensive scientific analyses. All processes are based on a standardized platform and thus provide a modular system for flexible use in the development of a motion analysis center.

When patients suffer from movement disorders and restricted mobility, motion analysis is an essential element in the application of high-quality and reliable diagnostics and therapy in a clinical environment. Biomechanics plays an important role in recognizing causality, rather then just treating symptoms and also allows succesful treatment methods to be documented clearly.

Yours faithfully,

Simi Reality Motion Systems GmbH

Philipp Ruß

Contents

About
Simi Reality Motion Systems

Simi Reality Motion Systems GmbH is a software technology company which has been successful in the development and use of technology for capturing and analyzing motion and behavior patterns for many years. "Reality Motion" stands for the digital capture of real movements and behavior in three-dimensional space. Human motion is recorded by video cameras, captured and converted into digital format and then analyzed using application-specific software. This data enables an objective, reproducible and highly accurate documentation of the movements performed and is then available for further digital processing. All types of movements, whether made by objects, living creatures, individuals or groups can be captured. Simi products are suitable for all user groups who want to capture, display and evaluate data for subsequent digital presentation, comparison and optimization.

All Simi products are state-of-the-art and at the very forefront of this technology. This can be seen, for example, in our new markerless system, SIMI Motion Shape, the development of which will mean that the company will be one of the first suppliers in the world to offer such a system.

Example applications of Simi products are:

- in **biomechanics** for research into the human musculoskeletal system
- in **medicine** for making diagnoses involving the musculoskeletal system, for surgery and rehabilitation, when brain damage has occurred, prostheses are required, for monitoring progress and providing quality management
- in **sports** for optimizing techniques and tactics and preventing injury
- in **industry** for optimizing production processes and ergonomics
- in **media and entertainment** for the creation of realistic animations
- in **cell research** for tracking cell divisions

Today SIMI's business model concentrates on the following four market areas:

- life sciences/medicine: objective monitoring of the success of treatment and diagnoses,improvements to therapy
- sports: improvement in and monitoring of performance
- industry: analysis and optimization of production processes
- media & entertainment: tools for the computer game, animation and film industries

Sports	Medicine	Industry	Entertainment
· Performance monitoring · Performance optimization · Displays of performance · Injury prevention	· Monitoring treatment · Diagnosis · Documentation · Improving treatments	· Human-machine interaction · Machine analysis · Ergonomics	· Film and game production

At the moment the major focus of the company (approx. 80%) is on medicine and sport.

Our main application areas and customers have traditionally been in research and development at universities and clinics. Customers in clinics and rehabilitation centers for medical applications are currently among the most important of our target groups, as we hope that the full potential of motion analysis in medicine will be realized and will lead to the improved treatment of patients. The field of applied biomechanics will play an important role in the future tp help identifying the causes of problems, rather than just treating the symptoms which occur as a result of faulty movement patterns. For this reason, biomechanics has a major influence on our society's health and is also an important cost factor in our health systems.

More than 1000 customers from all over the world use Simi products for a wide variety of applications. These include key customers from universities, research facilities and clinics; many of whom have scientifically verified the system time and time again.

Simi supplies its software products on a licensing basis. In the majority of cases, all hardware and laboratory equipment are supplied with the software.

The company's owners take a hands-on role in development, sales, marketing and production proceses which are managed directly by Simi in Germany and through partnerships and co-operating companies worldwide. Solutions are sold on every continent for the following markets: medicine, research and sports.

Suitable training programs in movement analysis are also available in cooperation with Simi. These are advertised on our website or feel free to contact us to find out when the next event will take place.

Simi was founded in 1992 by Andreas Ruß.

Classification of Motion Analysis Methods

Balancing clinical and scientific demands

Products required for clinical applications can be divided into three main categories, as shown in the practicability function below. These categories are determined by the correct balance between the parameters **data quality** and **practicability** of the system. This is of fundamental relevance to clinical institutions. In everyday medical applications it is not only the quality of the data obtained which plays an important role, but also the compatibility with daily routine in a clinical environment, especially with regard to the parameters of **time required** for analysis, **user-friendliness** and what is demanded of the patient with regards to **preparation** for analysis and time. It is therefore necessary to achieve an optimal balance between data quality, complexity and the parameters:

- time required for the analysis
- training requirements of staff
- time required for preparing the patient

Practicability function

These parameters are illustrated in the diagram in **Figure 1.**

Movement analysis systems and methods have a wide range of application. Not only can they be employed in fields such as medicine, sport and industry, but they can also be distinguished by their extensive capabilities and integration for daily use. The graph shown in Figure 1 has been created to aid you in your decision as to which system would best suit your purpose.

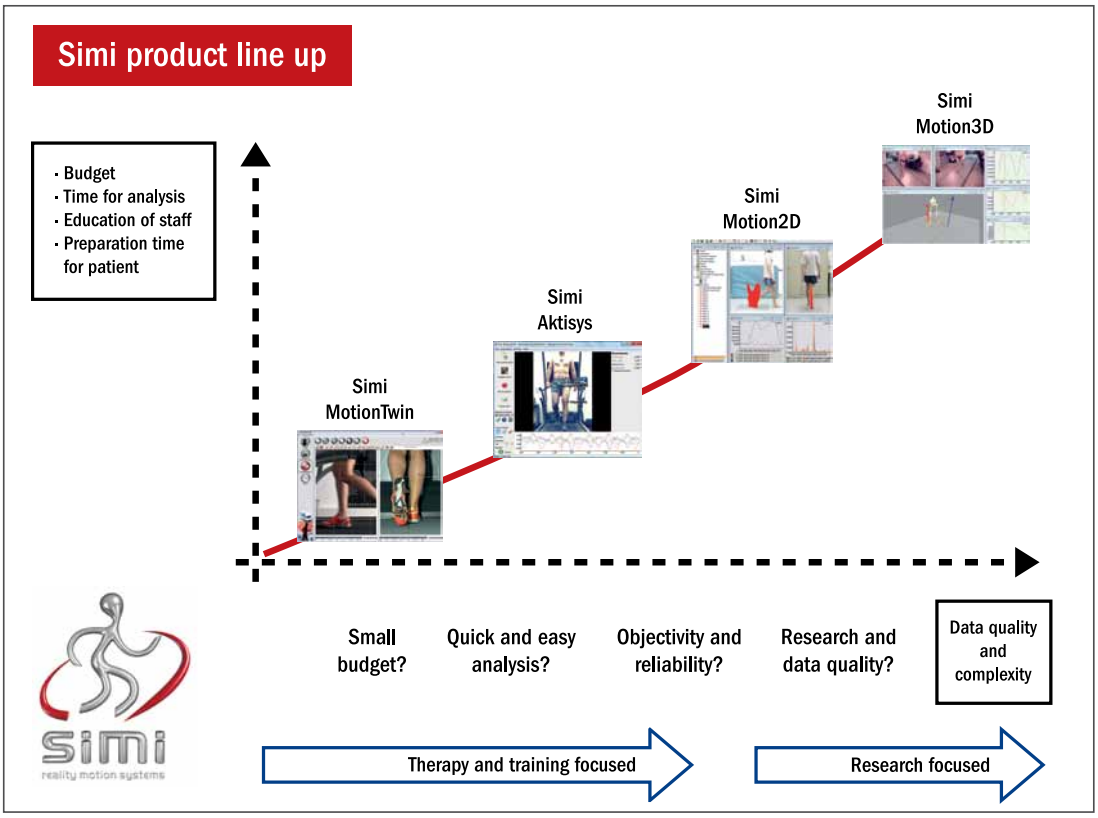


Figure 1: Analysis scenarios

The requirements of the user with regards to the complexity and precision of the data being examined is displayed on the horizontal axis. The vertical axis represents what is required of the user i.e. the amount of training needed to operate the system, the time which would need to be invested in both the collection and analysis of data and the price of the systems.

In order to select the optimal system for your requirements, you should identify which factors are most important for your purpose, considering factors such as measurement precision, task complexity and how often the software would be used. The following examples should help you in your decision but if you're unsure, we're happy to advise you about which product might be most suitable.

Scenario 1: If your priority is to examine complex tasks or problems, and the data has to be of high scientific worth, the appropriate system can be found at the very right of the horitzontal axis. Your purposes require a comprehensive Motion 3D System, which appears high on the vertical axis, indicating a high budget, increased training needs for both users and analysts, and also a greater time demand.

Scenario 2: If you give precedence to the fast analysis of data and a straightforward operating system, the necessary system can be found at the bottom of the vertical axis. MotionTwin is offered at a lower cost, and requires the least amount of training and analysis time. It is unable to offer an objective, quantitative measure, but it does allow for the simultaneous comparison of videos.

Scenario 3: Aktisys and simpler configurations of SimiMotion 2D/3D offer a compromise between the two software packages described previously. They can be integrated into every day use with ease but also record objective measures of data with scientific data quality, allowing direct feedback to both therapists and patients. Very little training is required for operation and the data produced is reliable.

Please see the information above, as well as the documentation in the appendix for more detailed information on individual solutions.

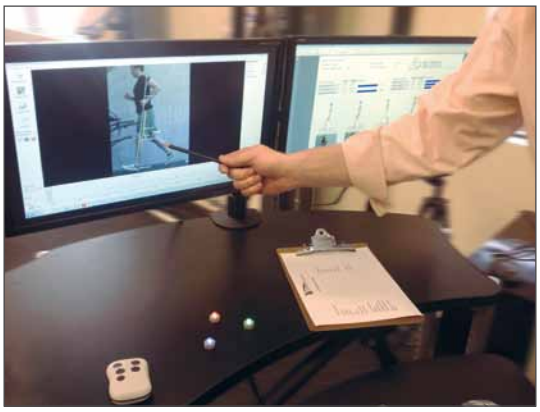
Demand on Clinical Motion Analysis and Applied Biomechanics

We define applied biomechanics as the utilization of biomechanical knowledge and methods in applied cases. One of these cases, probably the most relevant, is clinical biomechanics. Applied biomechanics has to transfer complex biomechanical knowledge and methodology into clinical concepts which, through interpretable feedback, are both easy to use and share with patients and other professionals. Simi offers a motion analysis platform which fulfills the various requirements and demands for such a system, including research demands.

The system has to fulfill three important goals to be fully applicable for clinical use.

Diagnostics

The system has to be a resource for the objective assessment of a patient's condition, movement ability and motion patterns, providing quantitative data about movement performance. Without measurement, clinical assumptions can not have an objective basis and patients will therefore suffer from diagnoses which are less suitable and which vary significantly between professionals.

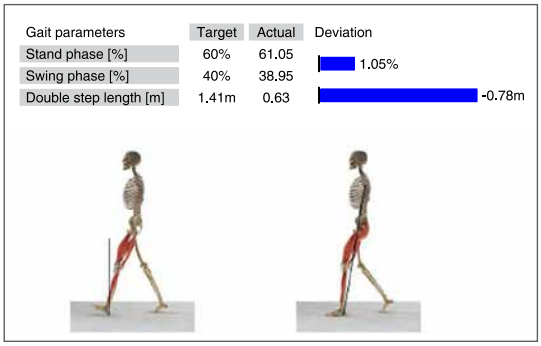


Improved treatment

Feedback is provided to patients during therapy to stimulate communication, motivate patients and therefore maximize treatment results. In this way the system is a direct help for treatment and the patient can directly profit from the technical support. For this task an easy to understand visualization and direct feedback is necessary.

Documentation

The system provides objective documentation of therapy progress and results. Based on a quantitative quality control, treatment success can be evaluated from an early stage and be documented.



System scenarios

Taking clinical conditions and analysis procedures into account, three different solutions are possible.

1. A simple video recording for comparative analysis and archiving very fast and flexible (+), no reliable quantitative measurement (-) - MotionTwin
2. A simple kinematic 2D analysis carried out on a mobile basis and providing immediate results very fast (+), quantitative 2D results (+), external devices can be integrated (+,optional), only suitable for simpler problems in certain planes (-) - Aktisys, Motion 2D
3. Comprehensive analysis for accurate 2D/3D evaluation of all kinds of complex analyses and scientific research possible (+), high training requirement for analysis and interpretation (-), more time-consuming (-) - Complex Motion 3D Systems

Clinical motion analysis must primarily be geared towards routine problems. Practicality and clarity are important elements for Simi, the world's leading company for image based motion analysis. Different applications place diverse demands on a motion analysis laboratory.

Analysis Scenarios of Applied Biomechanics

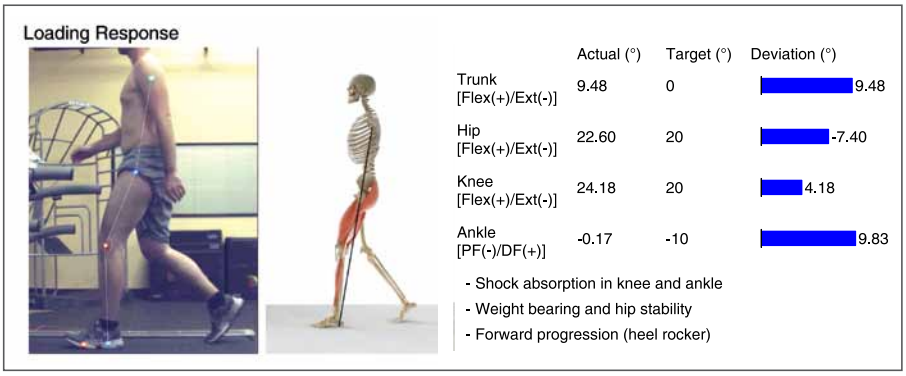
The general aim of clinical movement analysis is the identification and understanding of injury mechanisms. The majority of people will at some point in their lives see a doctor because of pain related to movement or activity. This level of prevalence highlights the importance of movement analysis, as identifying and altering pathological movement patterns will lead to improvements in quality of life and performance. Using biomechanical approaches and movement analysis leads to the treatment of underlying mechanisms of dysfunction versus treating symptoms. In clinical and applied biomechanics, methods are required which are easy to apply and are helpful for both patients and therapists from the first treatment session onwards. In addition to this, many neurological diseases or illnesses which affect the elderly (eg. Parkinson's) can be diagnosed and treated through the assessment of movement. The following analysis scenarios are typical approaches when using applied movement analysis in a clinical setting.

Gait Analysis

In gait analysis in particular, the methodical examination of primary causality is an important determinant of treatment success. The search for this causality however, demands a structured and clearly defined procedure. The identification of causality often requires precise analysis, as patients frequently present a plethora of compensatory movement patterns in an attempt to maintain locomotion. Compensatory deficits and impairments are often more noticeable than the underlying cause (Perry, 1992) and numerous pathological causes such as strokes, spinal injury, amputation, degenerative joint conditions, rheumatoid arthritis or multiple and complex traumas make diagnosis yet more challenging. Both obvious and less obvious movement patterns need to be observed and examined. Without the application of video analysis and instrumented methods, it is impossible to conduct a thorough examination, as important details can escape the naked eye.

In clinical gait analysis it must be possible to attain reliable, descriptive data, which can provide quick and simple results for therapeutic feedback on a day to day basis. Aktisys and Simi Motion 2D with force vector and EMG feedback are two products which are particularly well suited for this purpose. Aktisys is a less complex piece of software which focuses on the kinematics of motion whereas Simi Motion 2D with force vector and EMG feedback can offer a more comprehensive data set, including information pretaining forces (kinetics) and muscle activation. This allows analysts to infer the demands placed on various muscle groups, and therefore also the causes of injury; an important tool for diagnostics as well as therapeutic feedback. In contrast to clinical analysis the key feature of scientific gait analysis is the precision and complexity of data rather than its suitability for daily use; a factor which has greater importance in clinical analysis. In an attempt to determine the most extensive and precise picture possible of the gait cycle, scientists have created complex biomechanical models through the use of a multitude of cameras and synchronized equipment. These methods often have a considerably greater time requirement than the clinical analysis method, but are critical in complex scientific analyses.

The conventional terminology for gait analysis is based upon the phase model of Perry and defines physiological gait in 8 stages. In her work, Perry defines muscle activation, joint kinematics, joint kinetics and functional relevance, meaning that deviances from the norm can now be more easily observed and as a consequence, a well-grounded approach has been formed for gait therapy.



Recommended Products:
- *Simi Aktisys*
- *Simi Motion with Force Vector and EMG*
- *Simi Motion 3D (for scientific purposes)*

Running Analysis

Injuries which emerge as a result of excessive strain being placed upon individual segments, joints or muscle groups can often be observed in runners. With the application of biomechanical analysis, injury causality can be identified and the faulty movement pattern can be targeted and altered in therapy. Some of the most common complaints in runners are chronic injuries such as patellofemoral pain, iliotibial band dyndrome or plantar Fasciitis. It is often necessary to look for causality in abnormal movement strategies and to help the patient make deliberate alterations to muscle activation and movement patterns. In the case of Patellofemoral joint pain for example, proximal movements can exert a powerful influence (Powers, 2003), and with Plantar Fasciitis, a medial tilting of the hip can play a decisive role. The communication and assessment of pathological movement deficits is of particular importance, as is gathering quantitative data for these conditions.

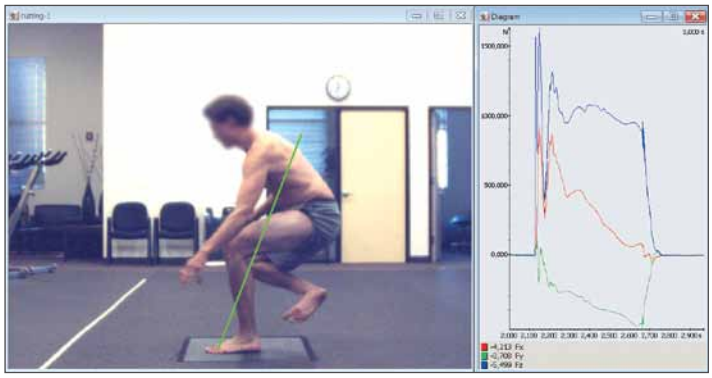
Peak stance knee flexion

Joint	Actual value	Deviation from previous phase
Trunk [Flex(+)/Ext(-)]	1.47	-7.27°
Hip [Flex(+)/Ext(-)]	21.47	4.94°
Knee [Flex(+)/Ext(-)]	44.09	36.23°
Ankle [PF(-)/DF(+)]	15.79	9.49°

Recommended Product:
· Simi Aktisys

Back to Sports Screening

The aim of a 'Back to Sports Screening' is to identify the risk of injury or re-injury on an individual basis through the application of biomechanical kinematics and kinetics. The screening is able to do this by assessing the body's ability to counterbalance joint moments during complex movements. If joints appear unstable and the assessment deems the body to be incapable of this, then this supports practitioners in making recommendations to patients about what course of action should be taken to improve stability sufficiently for a return to sport. These recommendations should be designed specifically around the cause of the problem; whether it be muscle weakness or faulty technique. The exact cause can however be difficult to identify with the naked eye and this is why the screening process plays such an important role. For athletes who participate in sports where the body is placed under particularly large strains, i.e. sports that require quick changes in direction or where joints undergo large accelerative forces, the test is particularly key; a misjudgement in diagnosis for these athletes is much more likely to result in problems and serious injuries or re-injuries. In addition to this function, the screening is also ideal for the identification of causes of chronic and reoccurring injuries.



Recommended Products:
· Simi Aktisys
· Simi Motion with Force vector overlay

Biofeedback Training

An Important factor for treatment success is the enhanced learning curve of a patient. Biofeedback attempts to engage with regulation bodily procedures by (in most cases) generating a signal which can be transmitted via computer screen or loudspeaker, to provide the patient with direct feedback about their execution of the movement in question.

By doing this it is possible to increase a subject's awareness of their body's actions (mostly joint angles or muscle activity), as the patient can immediately see or hear what the body has done. The necessary proprioceptive awareness to alter habitual movements without some form of outside help is often not present in patients suffering from long term movement disorders. This is where biofeedback is particularly useful, as it increases a patient's awareness of their movements using external stimuli.

Movement expert Schmidt said that "Motor memory is the product of learning". We have found that this learning process can be accelerated through the use of sports technology and biofeedback.

Motor learning is the use of strategies in developing and acquiring new movements, in consolidating familiar ones, or in combining the two (Rieder). It is therefore an active process, in which bodily awareness can be increased by the subject themselves (Neubert et al., 2001). The objective of research therefore has been to reinforce the 'inner perspective' of the subject (Freynet, 2008). For the coach this means that they simply have to instigate and aid the learning process. Technology can help this process by giving the coach more possibilities for the design and portrayal of movements and therefore the possibility that the person might understand a movement pattern better and increase his quality of movement.

Recommended Products:
· Simi Aktisys
· Simi Motion with Force vector and EMG

Spine Analysis

A dynamic spine analysis is an examination in which posture and the spine, vertebral positioning and muscle weaknesses are measured and documented, without the use of any kind of radiation or contact.

This allows numerous clinical problems to be approached objectively such as structural analysis, posture, skoliosis, and spinal deformities. Due to the rotational component of movement in the spine, its examination demands the use of a 3D analysis. Observations which do not give due consideration to this plane of motion can often misdiagnose or leave problems undetected, making the inclusion of the third dimension of upmost importance.

Flexion

Recommended Products:
· Simi Aktisys 3D
· Simi Motion 3D

Lateralflexion

A 3D spine measurement can be conducted to clarify the following conditions:

- Discomfort in the spine and pelvis regions
- Discomfort in the hip and knee joints.
- Discomfort in the maxilla joint
- Head and neck pain
- Muscle fibre tension

Customer example MPI Los Angeles

An example of where these methods have been utilized is the Movement Performance Institute in LA. “The purpose of the Movement Performance Institute (MPI) is to provide expert biomechanical evaluations for persons with musculoskeletal complaints. The basic philosophy behind MPI is that movement dysfunction is the root cause of many overuse injuries of the musculoskeletal system.

Through the attainment of objective assessments of motion, forces/pressures, muscle activation patterns and muscle strength, more effective interventions can be designed and better long-term outcomes achieved” (Christopher Powers).

For further references please check **www.simi.com**

See more testimonials and videos at
www.simi.com

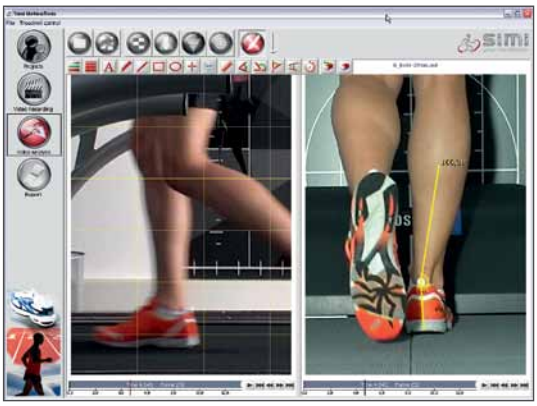
Simi Products

The different products serving the above described needs are the Simi Motion Analysis Products Simi MotionTwin, Simi Aktisys and Simi Motion. More detailed descriptions for each product are provided below.

Simi MotionTwin

Simi MotionTwin is an entry-level product for motion analysis which can be upgraded in functionality towards Simi Motion as required. It is a static 2D measuring tool for simple video analysis. The set-up used in Simi MotionTwin means that it is primarily suitable as a tool for visual comparison and documentation. It allows for the fast and simple recording and processing of video sequences.

Compared with other Simi analysis methods, MotionTwin places less emphasis on exact and objective measurement results. The focus is on very fast and simple operability and on visual presentation. Its use, for example in routine orthopaedic treatment, is very quick, clear and simple and provides qualitative analysis.



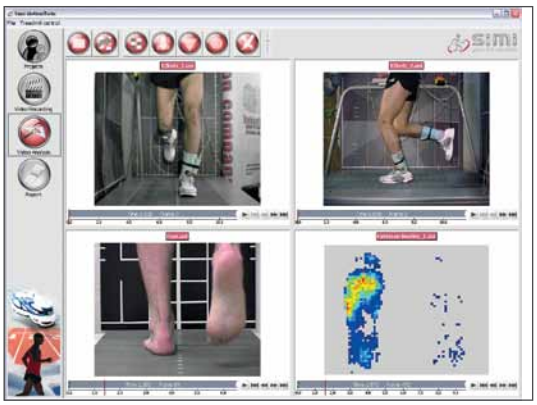


Figure 2/3: Simi MotionTwin screen data

The options for comparing video clips as well as for the simple right-left-comparison of two movements make Simi MotionTwin indispensable when carrying out simple motion analyses.

Producttype: *Twin, static frame measurement, 2D, no analogue system integration*
Price: *1.000 – 7.000 EUR*
Usability: *can be used by everybody*
Analysis duration: *few minutes*

Simi Aktisys

Simi Aktisys is the new world-leading product which provides fast clinical analyses and biofeedback during the treatment of patients. With Aktisys it is possible to carry out a variety of clinical 2D/3D analyses.

The software uses colored LED markers to calculate measurements on live-stream videos, automatically and in real-time. Aktisys provides standardized and objective motion analyses for every-day clinical use and the best possible conditions for carrying out fast motion analysis as part of a patient's assessment. A detailed report is produced with data and images from the video for documentation and archiving purposes, displaying results clearly for patient understanding. The measured data drawn in the videos can be saved with the video. Results can also be exported in text format. An example report can be found in the appendix.

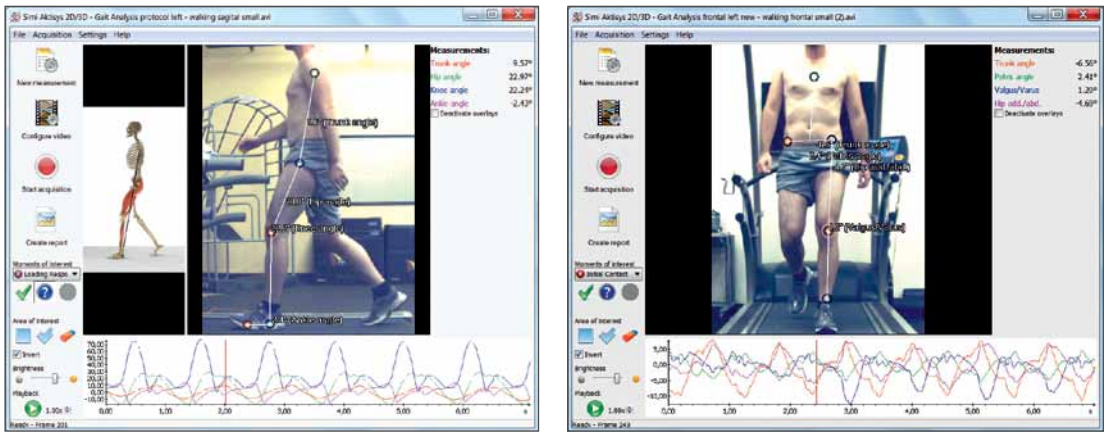


Figure 4: Simi Aktisys screen data

Simi Aktisys is thus especially suitable for clinical motion analyses, since it is easy to use but at the same time supplies valid and quantitative results very quickly and simply. Particularly noteworthy is the therapeutic benefit for the patient provided by fast biofeedback.

Producttype: *Aktisys, dynamic kinematics in real time on video live stream, 2D/3D, maximum 5 markers, no analogue system integration*
Price: *7.000 – 20.000 EUR*
Usability: *can be used by everybody, easy to use predefined protocols*
Analysis duration: *real time*

Simi Motion 2D / 3D

Simi Motion is our most comprehensive and precise analysis tool, which is also highly suitable for **scientific use**. The modular design of Simi Motion enables it to be specifically customized to meet your requirements and interests. Automatic tracking and subsequent manual assignment of passive markers make it equally possible to configure simple systems for fast analyses as well as very complex systems for highly demanding scientific requirements.

Simi Motion is normally used in larger gait / motion laboratories where at least 6 cameras are in operation. Scientific and highly detailed analyses of a wide variety of sequences of movements can therefore be carried out with a high degree of accuracy and reliability.

In addition, it is possible to integrate and display data from a number of **external devices** from various manufacturers into our system (EMG, EEG, ECG, force plates, pressure measuring plates). Detailed patient-orientated qualitative and quantitative follow-up examinations can thus be easily carried out and documented within the framework of a rehabilitation program. The data acquired will satisfy all data quality requirements.

The system provides scientifically exact motion data (position, speeds, accelerations, angles, distances etc.) and the opportunity to synchronize data from, for example, EMG or force plates. This data is then processed by Simi Motion according to the user's requirements and further analysis parameters are calculated (angles, arithmetical calculations, filters and smoothers, phases, events etc.).

All measurement results and calculations can be printed out as standard reports or using customized templates and can also be exported to other programs as ASCII files. For 3D animations there is the additional possibility to export data in special 3D formats, e.g. bvh, maya, lws, filmbox.

Simi Motion is a complex scientific solution for motion analysis which in many respects, can be ideally suited to the day-to-day treatment of patients with musculoskeletal disorders.

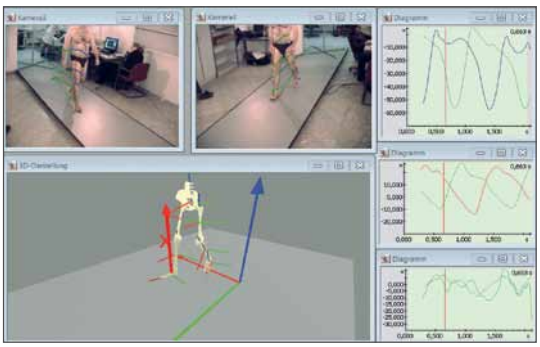


Figure 5. Simi Motion gait analysis

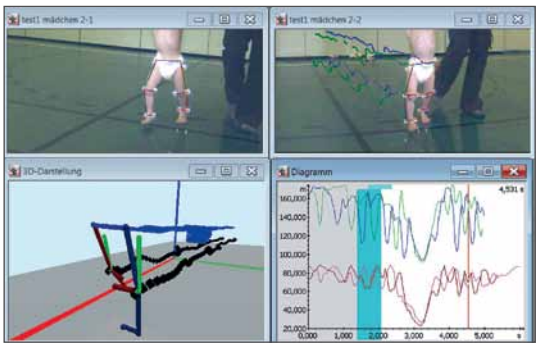
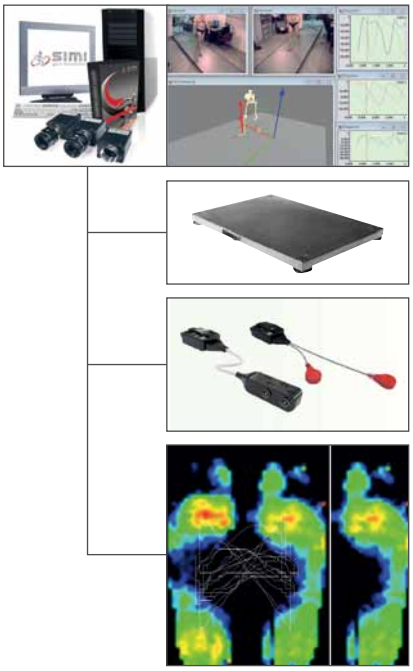


Figure 6. Children's hospital and prostheses development

Producttype: *Motion 2D, dynamic kinematics in 2D, integration of any analogue system, unlimited markers*
Price: *8.000 – 30.000 EUR**
Usability: *skilled user necessary*
Analysis duration: *short time*

Producttype: *Motion 3D, dynamic kinematics in 3D, complex scientific questions, integration of any analogue system, unlimited markers*
Price: *15.000 – 150.000 EUR**
Usability: *skilled and experienced user necessary*
Analysis duration: *depending on type of analysis*



Simi Motion combining

Video and Kinematics 2D/3D

Force (Kinetics)

Muscle Activity (EMG)

Foot pressure

* depending on configuration

Simi Shape – Full-body 3D motion capture without any markers!

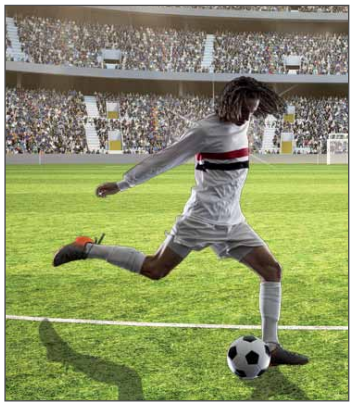
Silhouette tracking!

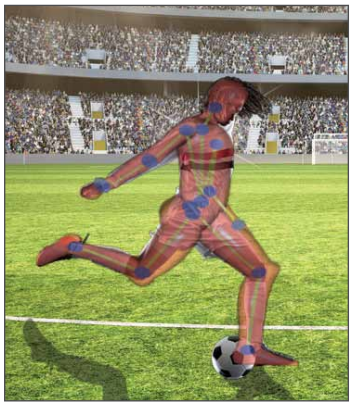
- **Faster** – no time loss and failure due to marker placement
- **Everywhere** – indoor, outdoor, competitions, no preparation
- **Natural** – no disturbance of movement

Maximize your Motion capture capabilities with Simi Shape!

High accuracy with Simi Shape hybrid multi sensor architecture:
- Combined markerless tracking with additional sensors (i.e. markers)
- Optimize certain rotation axes
- Validate different methods
- Improve speed and results

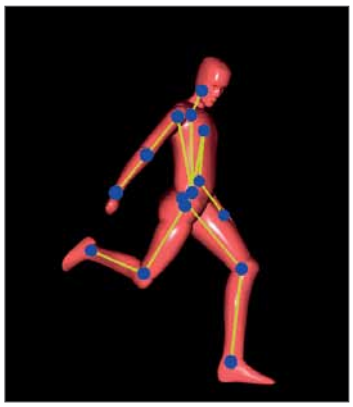
Recording → **Segmentation** → **Model Fitting**

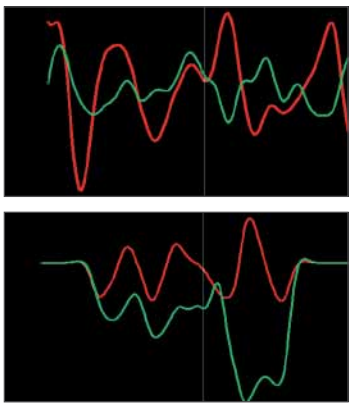




Simi Shape integrated with Simi Motion
- Real-time synchronized multi camera recording
- Kinematics, force, EMG, pressure, etc. with extensive data analysis
- Validated accuracy

3D data → **Data analysis**





Simi – worldwide leading image based motion capture systems

Price Overview

The following table shows an overview of price ranges for the different solutions. All solutions are upgradeable. The hardware can be used for all systems, so that costs incurred for upgrading or changing system are reduced.

Simi Movement Analysis Solutions

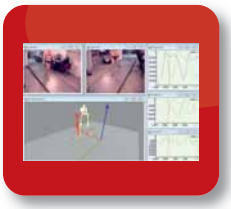
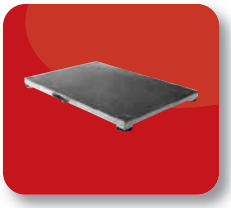
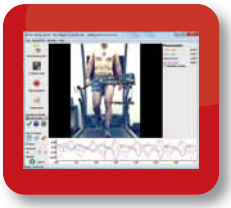
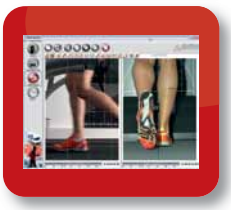
Productline	Price range[1] (standard)	Hardware (standard)	Upgrade possibility
 **Simi Motion 3D** Fully instrumented scientific 3D analysis	15.000 – 150.000 € (incl. Hardware 6 synchronized cameras)	* optional · Additional high speed camera sets · A/D converter · Silhouette tracking	* yes · More cameras (Price per type) · More protocols · More modules See Simi Motion overview
 **Analogue devices** Integration of further biomechanical Devices	Standard ca. 5.000 € + price of device *Only with Simi Motion*	* Optional (price depending on device and manufacturer) · EMG 4 channel wireless ca. 8.000 € (muscle feedback) · Force plate 3D ca. 12.000 € (force vector) · Foot pressure 1,5m ca. 9.000 € (foot pressure distribution)	
 **Simi Motion2D** Video based analysis with 2D kinematics, option for force vector overlay and EMG feedback	8.000 - 30.000 € Standard system (incl. PC with 2 sync. high speed cameras training, external integration possibility)	* optional add on · Any Video camera · Additional high speed camera sets · A/D converter	* Upgrade possible: yes · More cameras (Price per type) · More protocols · 3D Option · Integration of EMG, force plate
 **Simi Aktisys 2D/3D** Simple quantitative real-time feedback on kinematics, using high speed cameras. Immediate results and easy handling	7.000 - 20.000 € Standard system (incl. PC with 2 high speed cameras, LED markers + training)	* always inclusive · Simi System: 1 High-speed camera, Laptop, Accessories, active LED Markers * optional · Additional high speed camera sets	* Upgrade possible: yes · More cameras (different types) · More clinical Protocols · 3D Option
 **Simi MotinTwin** Visual video comparison Very quick and easy	1.000 – 7.000 € Standard System: (incl. PC with 2 high speed cameras)	* optional add on · Any video camera · Additional high speed camera sets	* Upgrade possible: yes · Other Simi systems · More cameras (different types)

Figure 7: Simi price evolution

[1] all prices are just orientation, non binding and can differ in each country. Prices need to be confirmed with Simi or local distributors

Room Conditions for System Setup

In general the systems can be set up **very flexibly**. There are of course a small number of room condition requirements that should ideally be complied to in an analysis scenario. If your room however does not meet these standards, we are happy to work out an individual solution with you.

Two scenarios are named below: A scenario for a small room and one for a mid-sized room for gait analysis.

Small lab scenario

A Motion Analysis Lab can be set up in very small rooms as well. It is however of course recommended that there should be sufficient space for patients to move freely within the room. Gait and Running Analyses on a treadmill can take place in a room of about 4x5 meters. The cameras need to be placed roughly 2m away from the treadmill (minimum) to be able to record an average person's height. Tasks which don't require additional space can also take place in a room of this size, such as spine analyses, drop jumps, squats, balance tests and others. Tests that involve more movement however, will require more space. For gait analysis which is not on a treadmill but on the ground, a room of at least 9m in length and 5m in width should be available.

Medium lab scenario

The following is an example set up for a permanent laboratory.

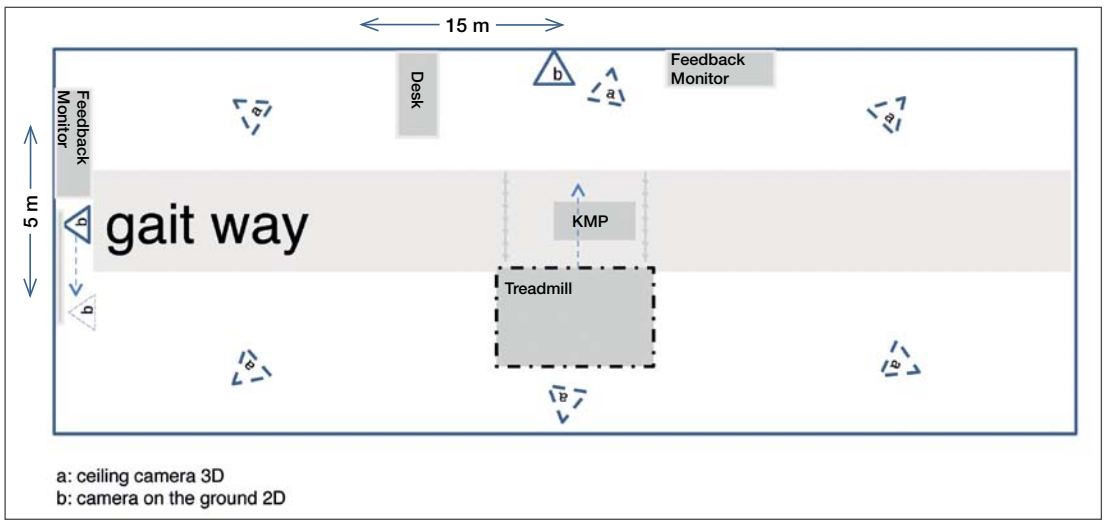


Figure 8: Example of a laboratory plan

Figure 8 shows an example layout of a motion analysis laboratory. This includes a running track with integrated force plate (KMP), ceiling cameras which can be used flexibly for 3D analyses and ground cameras for 2D analyses. All the cameras can be mounted flexibly or are for mobile use. The laboratory should be large enough to include a running track for gait analysis. For running analysis even more is needed. In addition, there are two large feedback monitors to give patients direct biofeedback, thus providing an important therapeutic stimulus. Live biofeedback can be, for example, kinematic biofeedback with Aktisys, kinetic feedback using a live force vector or feedback about muscular activity from a telemetry EMG system. These layouts are purely an example of a relatively typical design for a biomechanical evaluation and therapy facility. The running track, treadmill and feedback monitors are not included in regular quotations. If structural alterations have to be made, we recommend the installation of a double floor in which the force plate can be embedded. This is particularly advisable for sports medicine as well as neurological examinations, since the patient can move more freely. We would also recommend that ceiling tracks be installed to which the ceiling cameras can be clipped for flexible use.

We hope we have given you all the information you require in a comprehensive and understandable form and that this will provide you with a good basis for making viable long-term decisions.
If you have any questions or would like any further information please do not hesitate to contact us.
We would also like to invite you to a demonstration in Simi's Biomechanical Center. We have a laboratory set up, in which we can show you all the options provided by our systems. Smaller demonstrations to show the system principles can be organized on site any time.

The following documents and information are included below:

- Specification list
- Additional general information
- Simi contacts
- Examples of Aktisys and Simi Motion analysis reports
- Brochures about our products
- References

We look forward to meeting you and discussing our products with you,
as well as conducting further negotiations.

Yours faithfully

Simi Reality Motion Systems
Philipp Russ

Specification list*

	Motion	Aktisys	MotionTwin
Cameras			
Working with High Speed cameras	●	●	●
Integration of GigE Cameras	●	●	●
Hardware Trigger possibility	●	●	●
Integration of Camera Link cameras for high data rates	●	●	●
Maximum number of synchronized cameras	unlimited	4	4
Data type			
Working with 2D data	●	●	●
Working with 3D data	●	●	●
Working with dynamic data	●	●	●
Tracking options			
Tracking of coloured LED markers	●	●	●
Tracking of reflective markers	●	●	●
Pattern matching (markerless object tracking)	●	●	●
Silhouette Tracking	●	●	●
Maximum number of markers	unlimited	5	1
Real-time tracking	●	●	●
Display of real-time results on high speed videos	●	●	●
Trial time	depending on trial	realtime results	depending on trial
Available marker size	1mm-25mm diameter	Active markers	–
External devices			
Force Plate integration and calculations	●	●	●
EMG integration and analysis methods	●	●	●
Measure muscle activity	●	●	●
Foot pressure integration and analysis (plates & insole systems)	●	●	●
Integration of any analogue signal	●	●	●
Display of force vector overlay on high speed videos	●	●	●
Ground reaction vector to visualize joint rotation moments	●	●	●

● = yes, ● = no

*Only important characteristics listed, all systems provide more functions than listed, not binding product characteristics

	Motion	Aktisys	MotionTwin
External devices			
Calculate joint forces based on kinematics and ground reaction force	●	●	●
Complex triggering of different systems	●	●	●
Operations			
Working with velocities and accelerations	●	●	●
Phase models and event marking	●	●	●
Pre-defined reports available	●	●	●
Centre of Mass calculations	●	●	●
Inverse Dynamics calculations	●	●	●
Complex calculations and filters	●	●	●
Working with dynamic 2D, 3D data (angles, distances, etc...)	●	●	●
Static frame measurements 2D	●	●	●
Static frame measurements 3D	●	●	●
Videomix	●	●	●
Videosplit	●	●	●
Calculation with moving calibrated 3D cameras (Pan, Tilt, Zoom)	●	●	●
Compare trials (i.e. left and right)	based on data, videos and reports	based on videos and reports	based on videos
Number of possible calculation methods	>300	>20	–
Export			
Export of results as video	●	●	●
Export of results as PDF	●	●	●
Export of raw data	●	●	●
Export of c3D	●	●	●
Export for animation software	●	●	●
Export of results in Word	●	●	●
Gait Analysis Data			
Step width	●	●	●
Step length	●	●	●
Stride length	●	●	●
Angles for foot, ankle, knee, hip, spine, trunk, shoulder, arm, head	●	●	only static
Gait Velocity	●	●	●
Duration of cycle	●	●	●
Stance/Swing Phase	●	●	●
Cadence	●	●	●
Range of Motion of joint angles	●	●	●

● = yes, ● = no

Only important characteristics listed, all systems provide more functions than listed, not binding product characteristics

Information about the system environment/application

Simi systems are applications (.exe) which can be installed on one or more workstations. The software is protected by a hardware key (license dongle) which can either be connected via USB to the computer on which the software is installed or managed by a server.

The recording systems work with videos from high-speed cameras and are therefore subject to particular requirements. These systems are normally supplied by Simi. The use of own recording system is not recommended, due to functionality and support reasons.

Since all our systems save videos for further analysis, it is important that there is sufficient space for these on the network and that suitable data transfer rates are available so that work within the organization is not affected.

Data from the measurements are saved and managed in video files with the recorded results, PDF examination reports and .smp files, which can then be exported to database and storage systems. The analysis systems themselves are not database systems.

System Structure

The Simi system has a very open design. All types of movements can be analyzed and any type of desired hardware can be integrated. You are not even tied to a certain type of analysis and analysis models for different applications do not have to be acquired separately (e.g. Gait analysis, spine analysis etc.)

The advantage of the flexible hardware assembly with commercially available, industrial, high speed cameras leads to a better price-performance ratio. Not only is the initial acquisition of the Simi system more price efficient than competing systems, but the overall costs of the product life cycle are also cheaper due to the integration of standard hardware. Defective parts can be repaired and replaced by any one of our suppliers meaning that should hardware be defective out of warranty, no high repair or logistics costs are incurred.

The Simi system works with a Windows operating system and has a simple user interface. This makes initial training easier. Previously defined analysis protocols can also be carried out in Simi Motion by importing previously templates from old projects. Contained in the program itself are all the essential advanced calculations like angles, distances, inverse kinematics/dynamics, arithmetic functions, filters, derivations, body focal points and many others. Should you require a calculation which is not already built in to the software, motion allows you to add your own functions for analysis calculations or export all raw data.

Comparability

An important characteristic for a motion capture system is the possibility to compare data. The correlation between data from different tests and patients is a very important indicator for analysis.

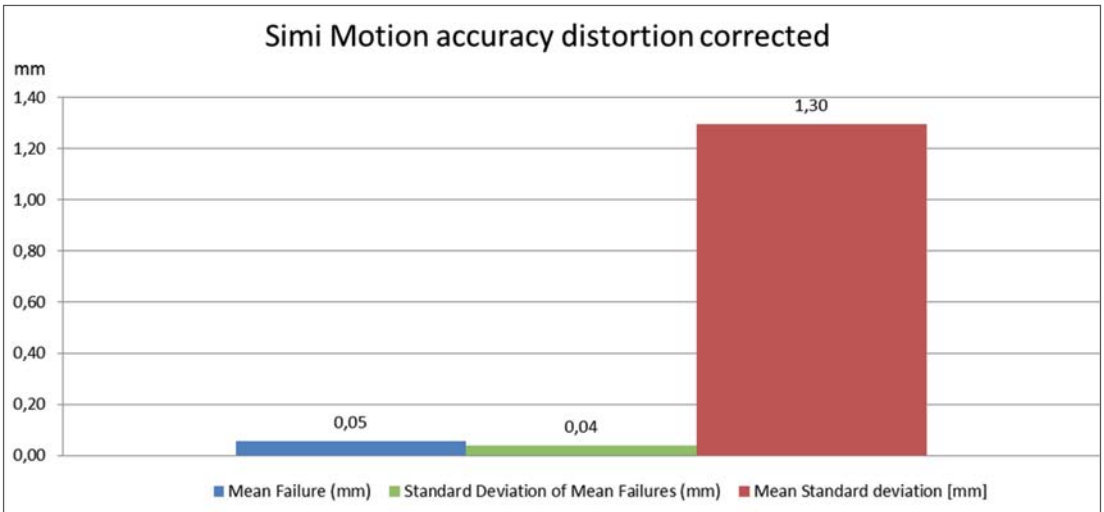
Simi Motion allows the comparison of several analyses from the same patient or inter-subject comparisons. Data and recordings can also be compared with standardized values Reiterating video analysis can help to consolidate understanding, even if tests were conducted at a much earlier date. Video based data simplifies the working and examination of the data, thereby helping to organize information and facilitate diagnosis.

Accuracy

The accuracy of the system is an important factor in your decision regarding the most suitable technology for your analysis demands. The accuracy of every movement analysis system on the market is dependent on two factors; theoretical accuracy and the practical accuracy.

Theoretical Accuracy

The physical accuracy of a system is mainly determined by the cameras' resolutions in relation to the layout of the laboratory. Other factors, if not correctly implemented, such as room calibration, marker recognition, or the camera angle can influence accuracy as well. Simi offers standard cameras and can therefore offer different camera types and resolutions for your needs. Depending on the individual needs for analysis we can flexibly configure the necessary hardware at any time. Higher camera resolutions usually lead to higher costs. The below table shows data accuracy for a sample system with 8 cameras.



Data shown are mean failure values of measured distance in Simi Motion against real distance , the standard deviation of mean failures and the mean of standard deviation from all single trials. Data are based on 10 calibrations with a mean of 4.663 samples. Control device has been moved highly dynamic through the complete calibration volume. Distortion in images has been corrected. Mean calibration volume was approx. 4x2,5x2m. System consisted of 8 cameras with 0,3MP resolution and 100fps

Practical Accuracy

The practical accuracy and application of a system can sometimes be limited by the examination setup. System markers rely on attachment to the skin. Accuracy can be lost due to skin movement in relation to the skeleton as certain calculations rely specifically on skeletal kinematic data. Another perhaps more important factor is that the comparison of different tests can only be completely accurate when the markers are placed in the exact same position. Since marker placement may vary between professionals, and even between different test occasions conducted by the same person, this cannot always be guaranteed, and some accuracy may be lost.

These factors apply to all systems which use markers and this must be considered when selecting a product to guarantee an appropriate price-performance ratio. A new attempt to minimize errors due to marker placement is markerless tracking by silhouettes with Simi Shape.

Speed of Use

Time is often a limited resource in clinics, making not only the quality of the system but also the time used for analysis crucial factors. Since the time for attaching markers, preparing the laboratory and starting the recording are independent of the system, the critical factor here is the time taken in the recognition and tracking of markers and the cleaning and analyzing of data, especially in the complex scientific trials. Simi offers automatic recognition of markers on recorded video images. The recognition of the data occurs on the video recording automatically and the data adjustment is simple and accurate, since it can be performed with visual feedback directly from the video. These qualities make Simi products perfect for clinical use. Not only can complex tasks of movement analysis be realized in a time comparable with other systems, but even simple configurations can be processed in a few minutes.

Service Information

These somewhat complex systems for movement analysis can sometimes require assistance in their use. Simi is a service orientated company, not only at purchase for initial system constructions, but throughout.

Since support is a critical factor in the guarantee of the permanent usability of the product, it is very important to have this service to rely on. Our support team will always try to help with problems and are therefore reachable by telephone and email. Our team of technicians collaborates closely to solve any issues that should arise when working with Simi systems. Assistance is readily accessible. In addition, even after the warranty has expired on external devices you can expect lower repair and replacement costs, as we use standard hardware. Simi has been in operation for over 20 years and has always worked closely with its customers. We have a worldwide presence and constantly work with research teams in universities to develop and integrate the newest technologies. Video technology and computer graphics are constantly improving. In the hardware sector (newer, better, cheaper cameras) as well as the software sector, there is constant progress. You can be certain that the continued progress in these areas will increase Simi's performance ability, a factor which you will be sure to benefit from.

Simi offers technical support in the following forms:

- Instruction and training: Product specific courses and general educational courses are offered.
- Support line: Ask our support team about your problems via telephone.
- Email Support
- Remote support: We connect to your account and try to solve your problem with you.
- On site support: A technician helps with all your problems in person.

All support times and problems
are logged in our system so that
we can improve our service.

For further questions, please do not hesitate to contact one of our sales representatives.

sales@simi.com
+49 89 3214590

Additional Documents and Information about our Products

– Aktisys and Simi Motion gait analysis example reports with protocols –

Simi Motion 3D Gait Analysis Protocol

A minimum of 6 high speed cameras should be used in scientific gait analysis. These synchronize to chart the gait of the patient and analyze joint movements in three dimensions. In addition, EMG and force plate data can be synchronized and displayed so that kinematic data, reaction forces and muscle activation can be analysed together.

In order to achieve a more extensive kinematic database, multiple marker sets can be placed upon the patient. This differs from clinical practice where the number of marker sets is often limited to the lower extremities. Around 15-20 markers are typically used in scientific analyses. The marker model complies with a specific biomechanical model which can be computed with in situ joint coordination systems, as well as inverse force calculations. Latest possibilities also allow analysis based on markerless tracking. Data incorporation and analysis can be adjusted and configured according to your specific requirements as individual advice and planning is an integral component in the design of a scientific gait analysis laboratory.

Simi Motion 3D Gait Analysis Report

Examination Data

Patient	,	**Gender**	male	**Date of Birth**	..
Weight	81.0 kg	**Height**	1.81 m	**Date**	..

Author: Simi Reality Motion Systems GmbH

Anamnesis:

Data is only calculated correctly for patient walking in positive Y-Direction.

Data is only displayed correctly if "relative to static trial" is unchecked in Inverse Dynamics.

Range of Motion

Range of Motion (ROM) [°]		Left	Right	Ref. value	Deviation from ref. value
Ankle joint	flexion/extension	26	20	30	
	ad-/abduction	13	15	7	
	internal/external rotation	9	7	13	
Knee joint	flexion/extension	58	63	70	
	ad-/abduction	9	6	14	
	internal/external rotation	12	15	23	
Hip joint	flexion/extension	42	43	50	
	ad-/abduction	7	11	15	
	internal/external rotation	17	12	13	
Pelvis	anterior/posterior tilt	5	5	0	
	superior/inferior tilt	8	6	12	
	rotation	14	19	12	

Legend
- Left
- Right

Analysis parameters

Gait parameters	Left	Right	Ref. value	Deviation from ref.
Velocity [m/s]	1.07		1.47	
Step length [m]	0.72	0.71	0.73	
Stride length [m]	1.43	1.33	1.46	
Cadence [Steps/min]	93.16		111	
Step width [m]	0.04		0.10	
Cycle duration [s]	1.34	1.24	1.08	

Gait phase parameters [%]	Left	Right	Ref. value	Deviation from ref.
Stancephase duration	63	65	60	
Swing phase duration	37	35	40	
Double support during stance phase	48	39	33	
Single support during stance phase	52	61	67	

Anthroprometrics [m]	Left	right	Difference
Thigh length	0.47	0.47	0.001
Shank length	0.43	0.42	0.008
Leg length	0.90	0.89	0.007

* Reference values according to Jim Richards - Biomechanics in clinic and research (2008) and Jacquelin Perry - Gait: Normal and pathological function (2003)

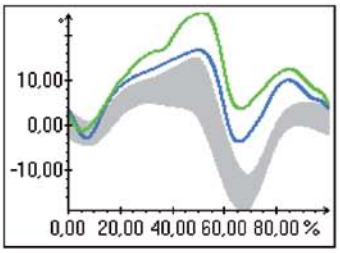
<

Local joint angles (inverse kinematics)

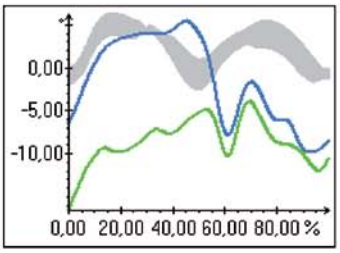
Legend: green: left ■; blue: right ■; grey: reference ■

Sagittal Plane | **Frontal Plane** | **Transverse Plane**

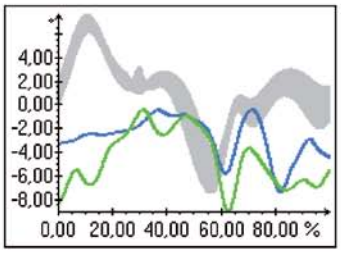
Ankle joint flexion/extension (+/-)



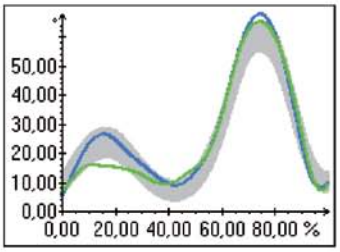
Ankle joint adduction/abduction (+/-)



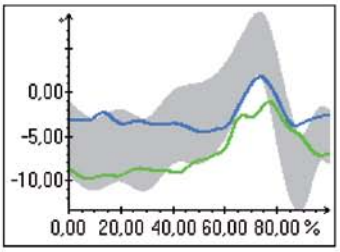
Ankle joint internal/external rot. (+/-)



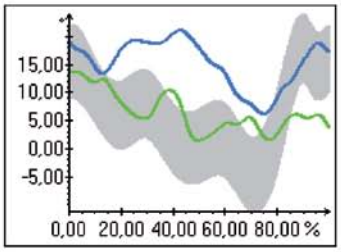
Knee joint flexion/extension (+/-)



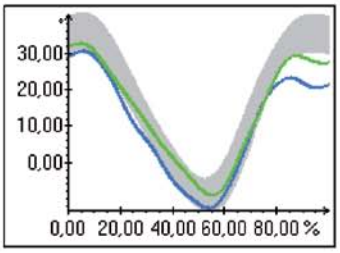
Knee joint adduction/abduction (+/-)



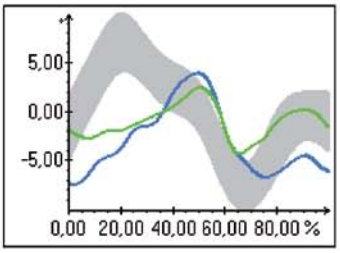
Knee joint internal/external rot. (+/-)



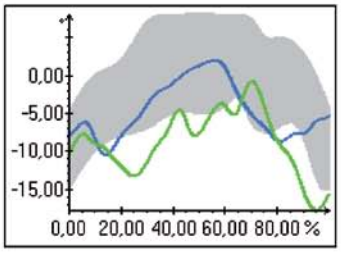
Hip joint flexion/extension (+/-)



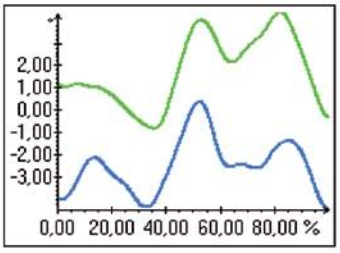
Hip joint adduction/abduction (+/-)



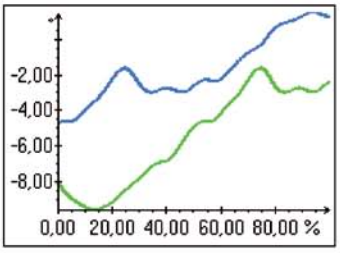
Hip joint internal/external rotation (+/-)



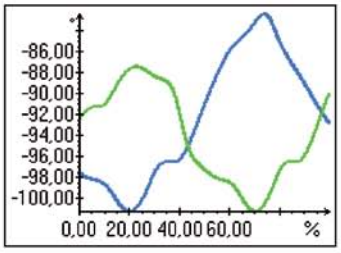
Pelvis anterior/posterior tilt



Pelvis superior/inferior tilt



Pelvis rotation



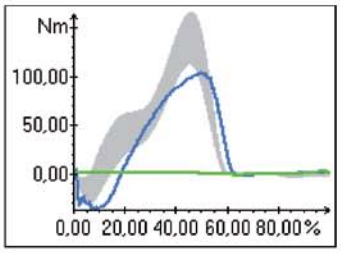
* Reference values according to Jim Richards - Biomechanics in clinic and research (2008) and Jacquelin Perry - Gait: Normal and pathological function (2003)

Kinetics and force plate data

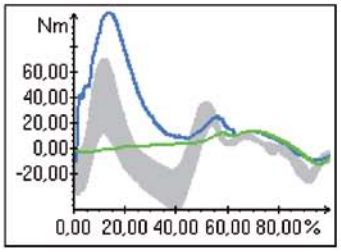
Legend: green: left ■; blue: right ■; grey: reference ■

Sagittal plane moments

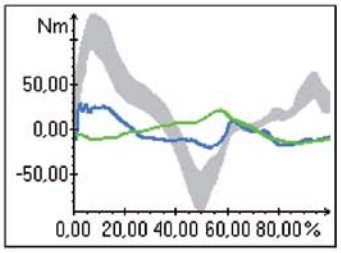
Ankle joint extension/flexion (+/-)



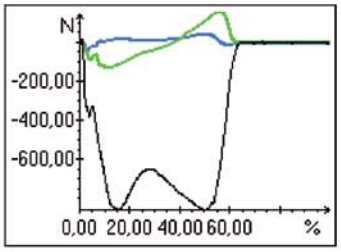
Knee joint extension/flexion (+/-)



Hip joint extension/flexion (+/-)

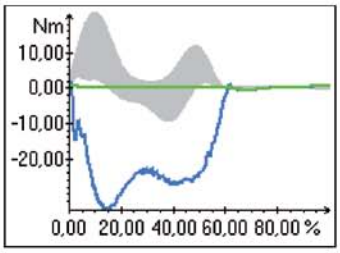


Ground reaction force right leg

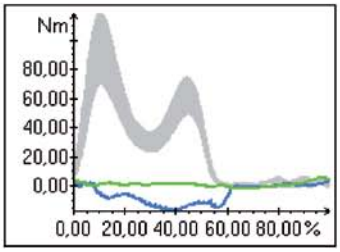


Frontal plane moments

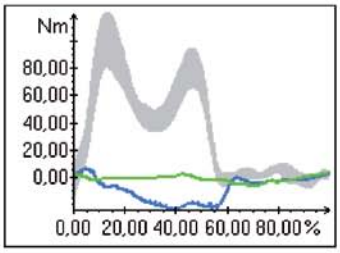
Ankle joint abduction/adduction (+/-)



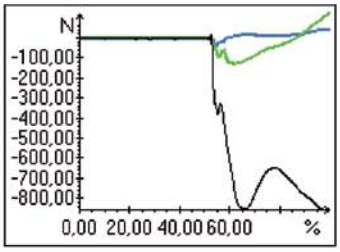
Knee joint abduction/adduction (+/-)



Hip joint abduction/adduction (+/-)

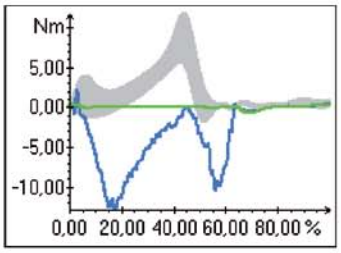


Ground reaction force left leg

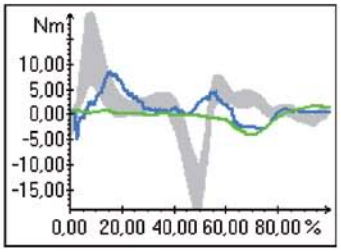


Transverse plane moments

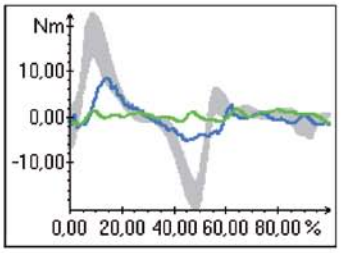
Ankle joint external/internal Rotation (+/-)



Knee joint external/internal Rotation (+/-)



Hip joint external/internal Rotation (+/-)



Key
blue: X
green: Y
black: Z

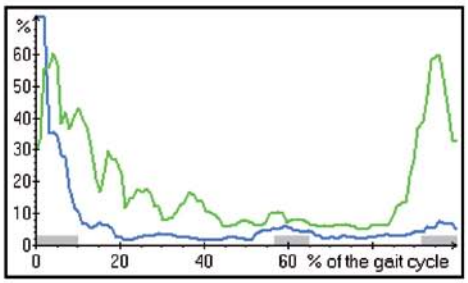
* Reference values according to David A. Winter - Biomechanics and Motor control of Human Movement (2009)

EMG Data

Legend: blue: right ; green: left ; grey: Reference-Data

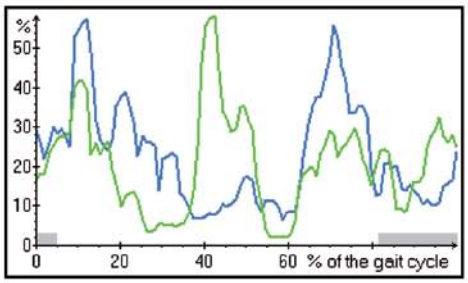
Channel 1 and 2 M. rectus femoris

active at 57-65% und 92-10%



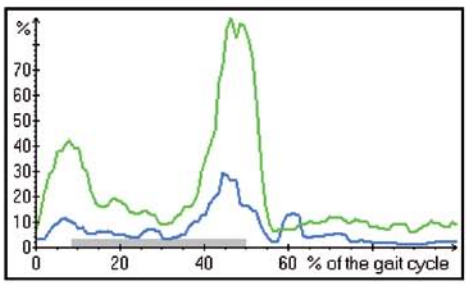
Channel 3 and 4 M. biceps femoris c. longum

active at 82-5%



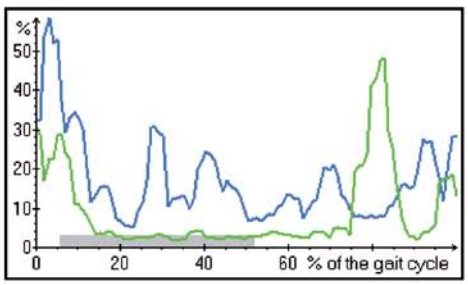
Channel 5 and 6 M. gastrocnemius

active at 9-50%



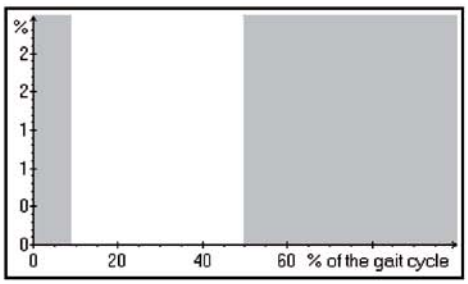
Channel 7 and 8 M. soleus

active at 6-52%



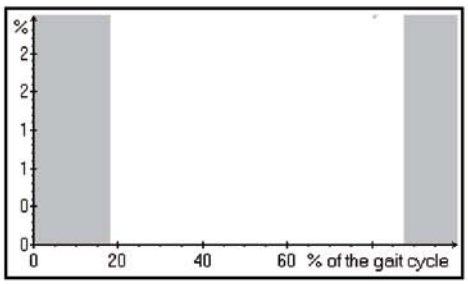
Channel 9 and 10 M. tibialis antertior

active at 50-9%



Channel 11 and 12: M. semitendinosus

active at 88-18%



* The EMG-Signals were normalized only if you have executed the correct calculation template *

* Reference values according to Jacquelin Perry - Gait: Normal and pathological function (2003) *

Simi Motion analysis protocol for quick clinical testing

The clinical assessment of gait needs a quick but meaningful data acquisition. With the Simi report for clinical gait assessment all parameters needed for clinical judgement can be recorded in very short time. The report provides 3D tempo spatial parameters, force data analysis, force vector overlay and EMG data with reference values. By this all information are provided to the clinician to judge deviation from norm in the gait pattern, joint moments and muscle activation patterns.

Simi Motion analysis protocol for quick clinical testing

Examination Data

Patient	,	**Gender**	female	**Date of Birth**	..
Weight	0.0 kg	**Height**	0.00 m	**Date**	..

Author: Simi Reality Motion Systems GmbH

Anamnesis:

Data is only calculated correctly for patient walking in positive Y-Direction for the right cycle, and walking in negative Y-Direction for the left cycle .

Data is only displayed correctly if you have selected two consecutive cycles

Analysis parameters

Gait parameters	Left	Right	Ref. value	Deviation from ref.
Velocity [m/s]	1.03		1.28	
Step length [m]	0.63	0.62	0.64	
Stride length [m]	1.24	1.18	1.28	
Cadence [Steps/min]	102.09		117	
Step width [m]	0.00		0.10	
Cycle duration [s]	1.19	1.16	1.03	

Legend
- Left
- Right

Gait phase parameters [%]	Left	Right	Ref. value	Deviation from ref.
Stancephase duration	59	57	60	
Swing phase duration	41	43	40	
Double support during stance phase	29	27	33	
Single support during stance phase	71	73	67	

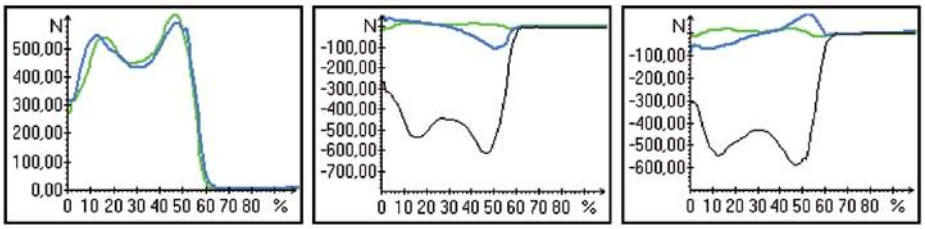
force plate data

Resulting ground reaction force

Ground reaction force left leg

Ground reaction force right leg

green: Left blue: Right



Key
green: X
blue: Y
black: Z

* Reference values according to Jim Richards - Biomechanics in clinic and research (2008) and Jacquelin Perry - Gait: Normal and pathological function (2003)

Left Leg: negative Y-Component is generated by negative moving direction

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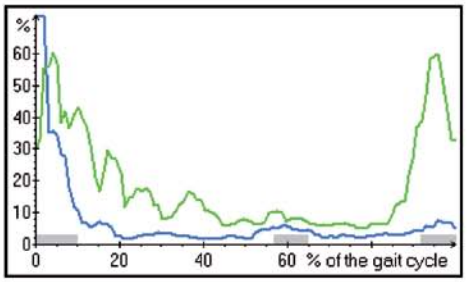
EMG Data

Legend: blue: right ; green: left ; grey: Reference-Data

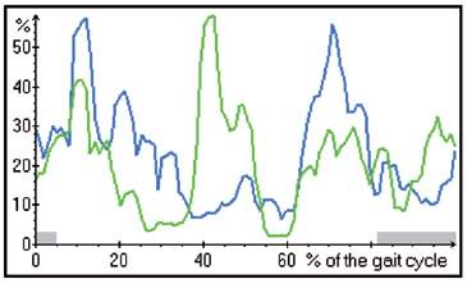
Channel 1 and 2 M. rectus femoris

active at 57-65% und 92-10%



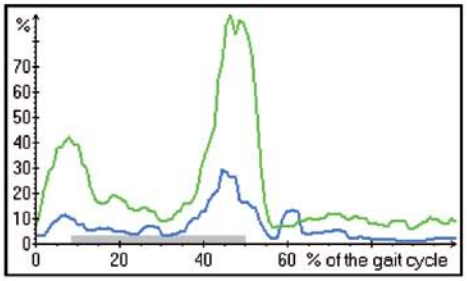
Channel 3 and 4 M. biceps femoris c. longum

active at 82-5%



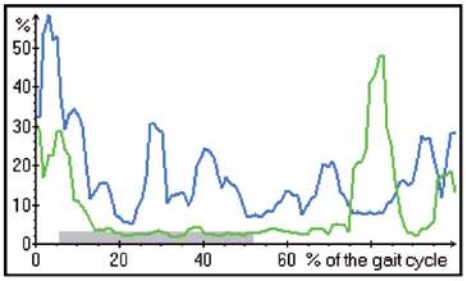
Channel 5 and 6 M. gastrocnemius

active at 9-50%



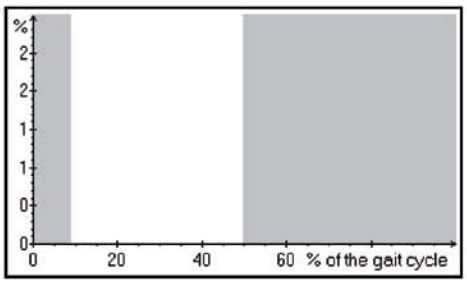
Channel 7 and 8 M. soleus

active at 6-52%



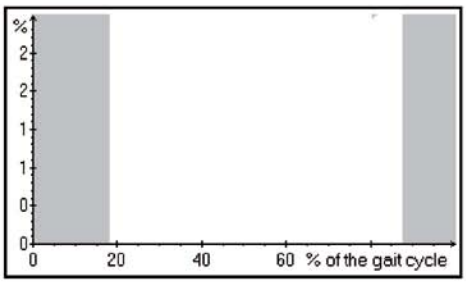
Channel 9 and 10 M. tibialis antertior

active at 50-9%



Channel 11 and 12: M. semitendinosus

active at 88-18%



* The EMG-Signals were normalized only if you have executed the correct calculation template *

* Reference values according to Jacquelin Perry - Gait: Normal and pathological function (2003) *

Simi Motion analysis protocol for quick clinical testing

Moment 1

Right Leg

Left Leg

Sagittal plane

Frontal plane

Moment 2

Right Leg

Left Leg

Sagittal plane

Frontal plane

Moment 3

Right Leg

Left Leg

Sagittal plane

Frontal plane

Simi Motion 3D movement report for any movement task

The Simi movement report is based on inverse kinematic or marker less data. This report provides data for all joints and planes and can be used for any movement to compare left and right side or to overlay data with reference values.

Simi Motion 3D movement report for any movement task

Examination Data

Patient	,	**Gender**	male	**Date of Birth**	..
Weight	81.0 kg	**Height**	1.81 m	**Date**	..

Author: Simi Reality Motion Systems GmbH

Anamnesis:

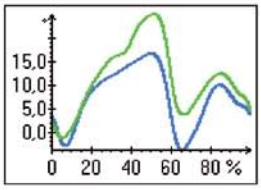
Data is only calculated correctly for patient moving in positive Y-direction

Local joint angles (inverse kinematics)

Legend: green: left ■; blue: right ■;

Ankle joint

dorsal-/plantarflexion (+/-)

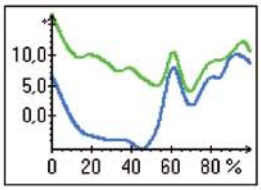


ROM le: 26.2°; ROM ri: 20.5°

Max le: 25.0°; Max ri: 16.7°

Min le: -1.2°; Min ri: -3.8°

inversion/eversion (+/-)

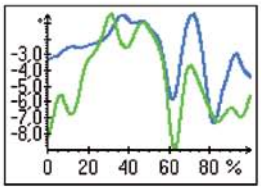


ROM le: 12.7°; ROM ri: 15.3°

Max le: -3.9°; Max ri: 5.4°

Min le: -16.6°; Min ri: -9.9°

abduction/adduction (+/-)



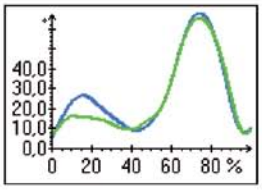
ROM le: 8.6°; ROM ri: 7.0°

Max le: -0.4°; Max ri: -0.4°

Min le: -9.1°; Min ri: -7.4°

Knee joint

flexion/extension (+/-)

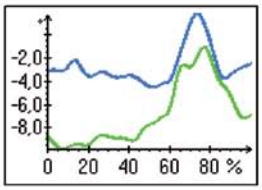


ROM le: 58.4°; ROM ri: 62.6°

Max le: 65.2°; Max ri: 67.9°

Min le: 6.8°; Min ri: 5.3°

adduction/abduction (+/-)

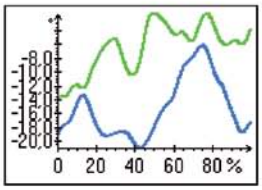


ROM le: 8.7°; ROM ri: 6.3°

Max le: -1.1°; Max ri: 1.7°

Min le: -9.8°; Min ri: -4.5°

internal/external rot. (+/-)



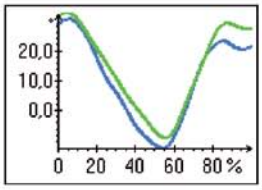
ROM le: 12.4°; ROM ri: 14.9°

Max le: 13.8°; Max ri: 21.1°

Min le: 1.4°; Min ri: 6.2°

Hip joint

flexion/extension (+/-)

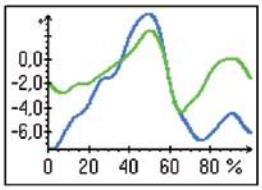


ROM le: 41.5°; ROM ri: 43.1°

Max le: 32.5°; Max ri: 30.5°

Min le: -9.0°; Min ri: -12.6°

adduction/abduction (+/-)

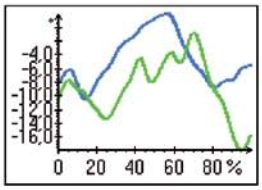


ROM le: 6.8°; ROM ri: 11.4°

Max le: 2.4°; Max ri: 3.8°

Min le: -4.4°; Min ri: -7.5°

internal/external rot. (+/-)



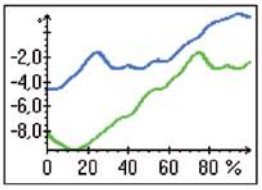
ROM le: 17.1°; ROM ri: 12.4°

Max le: -0.8°; Max ri: 1.9°

Min le: -17.9°; Min ri: -10.5°

Pelvis

superior/inferior tilt (+/-)

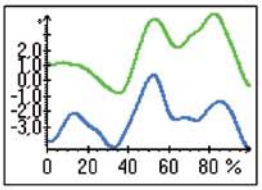


ROM le: 8.0°; ROM ri: 6.2°

Max le: -1.6°; Max ri: 1.5°

Min le: -9.6°; Min ri: -4.7°

posterior/anterior tilt (+/-)

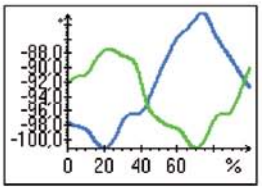


ROM le: 5.2°; ROM ri: 4.9°

Max le: 4.4°; Max ri: 0.4°

Min le: -0.8°; Min ri: -4.5°

rotation clockwise/counterclockwise (+/-)



ROM le: 13.8°; ROM ri: 18.9°

Max le: -87.4°; Max ri: -82.4°

Min le: -101.2°; Min ri: -101.2°

Anthroprometrics [m]	Left	right	Difference
Thigh length	0.47	0.47	0.001
Shank length	0.43	0.42	0.008
Leg length	0.90	0.89	0.007

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Simi Motion 3D sports report based on hanavan center of mass data

The Simi Hanavan report is a movement report based on a Hanavan markerset or markerless data. This report is dedicated to analyze movement and compare with reference data inter or intra subject. The report shows joint angles, center of mass data, velocities and acceleration of segment center of masses and their relation in time. By this the report is especially suitable to judge sport movement from a biomechanical perspective.

Simi Sports Report

Examination Data

Name: , Date of Birth: ..

Date: ..

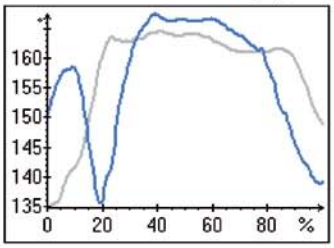
Author: Simi Reality Motion Systems GmbH

simi reality motion systems

Joint angles

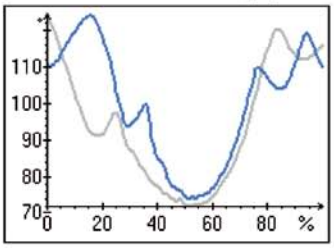
Legend: blue: measured value ; gray: reference value

Left thigh to torso



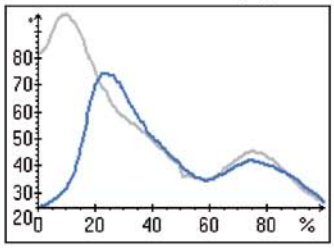
Max: 167.6°; Min: 135.3°

Right thigh to torso



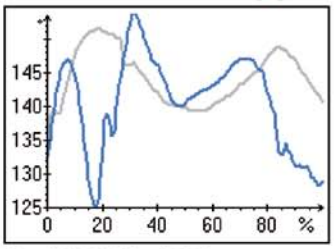
Max: 124.3°; Min: 74.1°

Left upper arm to torso



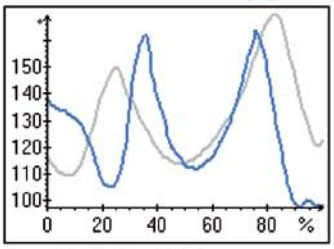
Max: 74.5°; Min: 24.3°

Left knee



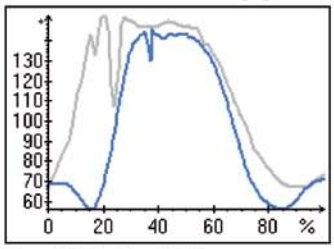
Max: 153.8°; Min: 124.9°

Right knee



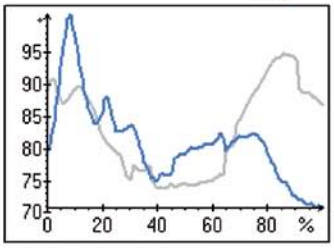
Max: 163.8°; Min: 97.5°

Left elbow



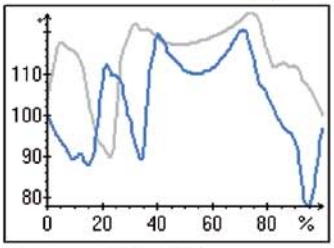
Max: 146.9°; Min: 56.1°

Left ankle joint



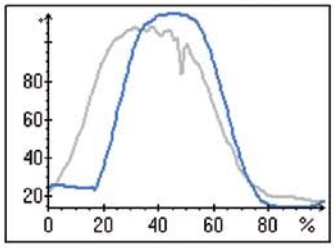
Max: 100.9°; Min: 70.8°

Right ankle joint



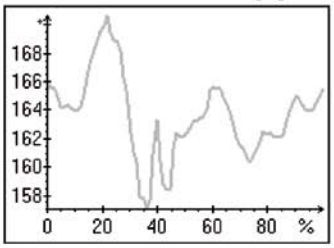
Max: 120.6°; Min: 77.8°

Right upper arm to torso



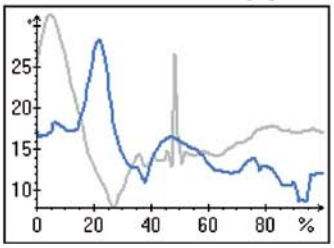
Max: 114.8°; Min: 14.0°

Spine



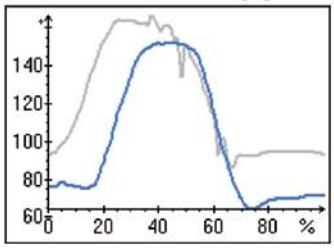
Max: -1000000000.0°; Min: -1000000000.0°

Shoulder axes to hip axes



Max: 28.4°; Min: 8.6°

Right elbow



Max: 151.8°; Min: 64.4°

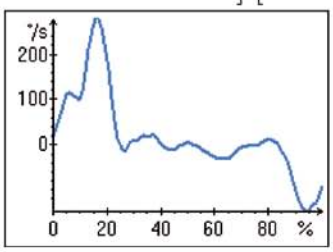
Phase duration

	total	phase 1		phase 2	
Phases duration	1.19 s	0.63 s	52.8 %	0.56 s	47.2 %
reference value	0.83 s	0.42 s	50.6 %	0.41 s	49.4 %

Angular velocity

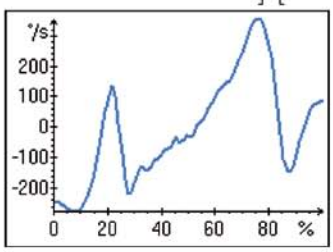
Legend: blue: measured value ; gray: reference value

Left thigh to torso



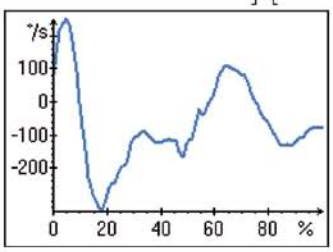
Max: 282.1 °/s; Min: -148.2 °/s

Right thigh to torso



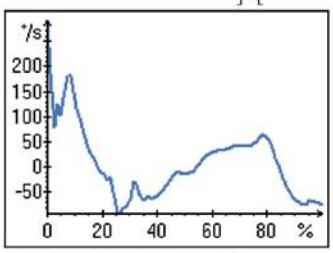
Max: 356.9 °/s; Min: -276.7 °/s

Left upper arm to torso



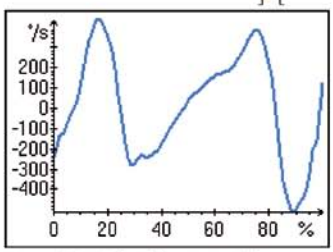
Max: 253.0 °/s; Min: -332.6 °/s

Left knee



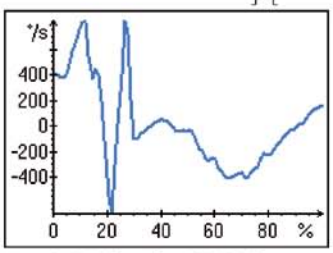
Max: 291.6 °/s; Min: -95.6 °/s

Right knee



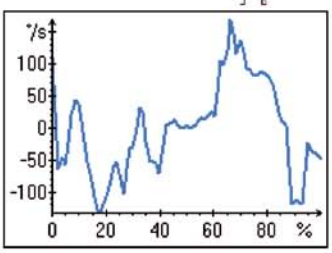
Max: 435.1 °/s; Min: -511.4 °/s

Left elbow



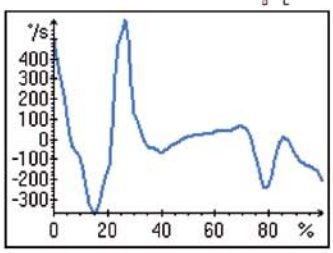
Max: 859.0 °/s; Min: -702.0 °/s

Left ankle joint



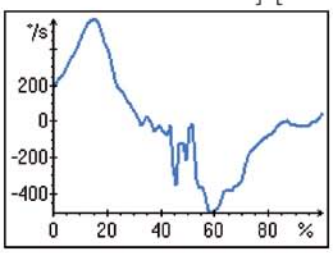
Max: 170.1 °/s; Min: -133.5 °/s

Right ankle joint



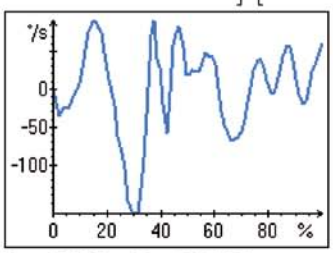
Max: 593.9 °/s; Min: -371.8 °/s

Right upper arm to torso



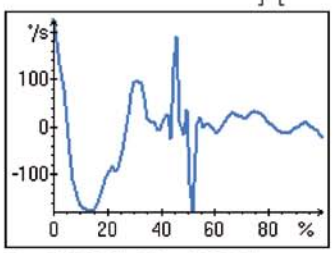
Max: 563.6 °/s; Min: -508.1 °/s

Spine



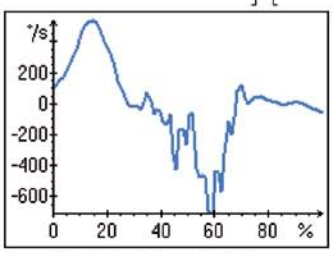
Max: 95.9 °/s; Min: -167.2 °/s

Shoulder axes to hip axes



Max: 226.9 °/s; Min: -193.5 °/s

Right elbow

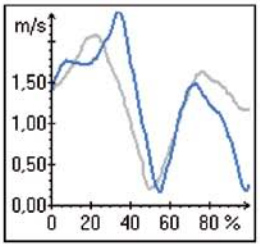


Max: 536.6 °/s; Min: -751.6 °/s

Velocity of segment center of mass

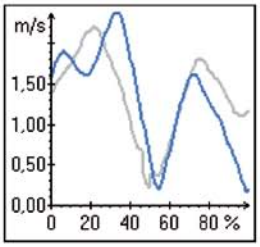
Legend: blue: measured value ; gray: reference value

Center of mass



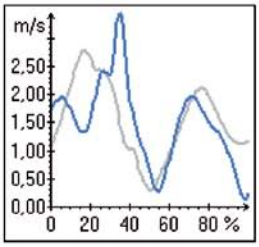
Max: 2.4m/s; Min: 0.2m/s

Torso



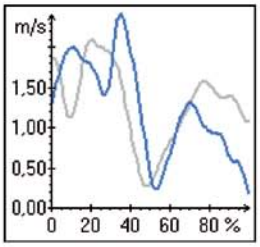
Max: 2.4m/s; Min: 0.2m/s

Head



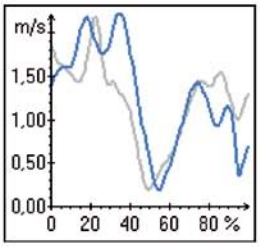
Max: 3.5m/s; Min: 0.1m/s

Left thigh



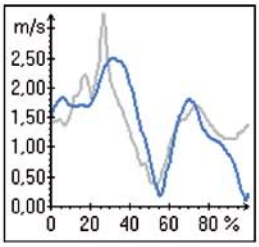
Max: 2.4m/s; Min: 0.2m/s

Right thigh



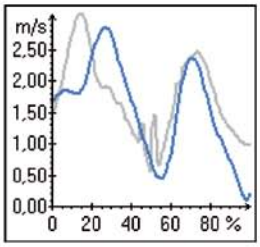
Max: 2.2m/s; Min: 0.2m/s

Left upper arm



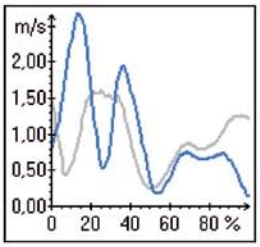
Max: 2.5m/s; Min: 0.1m/s

Right upper arm



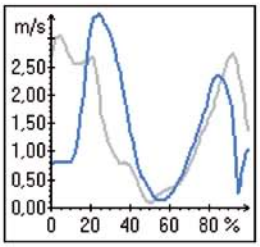
Max: 2.9m/s; Min: 0.1m/s

Left lower leg



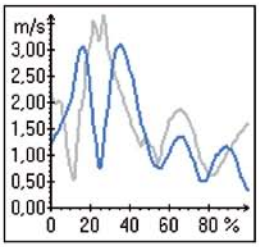
Max: 2.7m/s; Min: 0.1m/s

Right lower leg



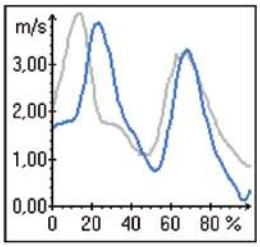
Max: 3.4m/s; Min: 0.1m/s

Left forearm



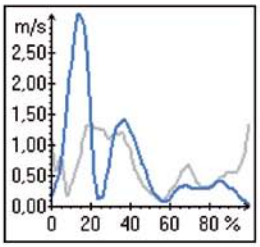
Max: 3.1m/s; Min: 0.3m/s

Right forearm



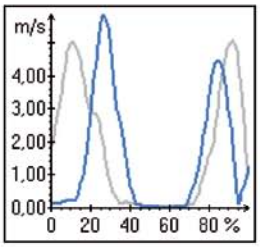
Max: 3.9m/s; Min: 0.1m/s

Left foot



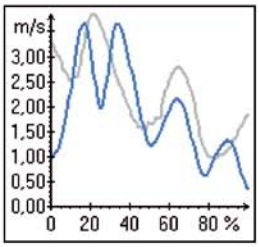
Max: 3.1m/s; Min: 0.0m/s

Right foot



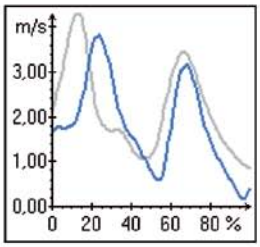
Max: 5.8m/s; Min: 0.0m/s

Left hand



Max: 3.7m/s; Min: 0.3m/s

Right hand

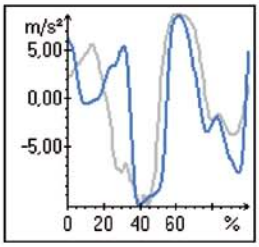


Max: 3.8m/s; Min: 0.2m/s

Acceleration of segment center of mass

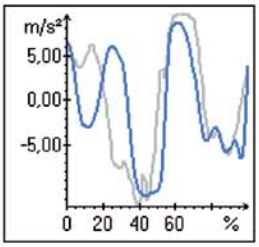
Legend: blue: measured value ; gray: reference value

Center of mass



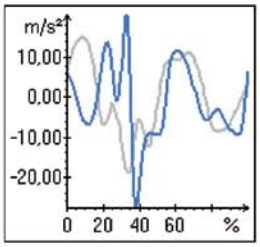
Max: 8.5m/s²; Min: -11.2m/s²

Torso



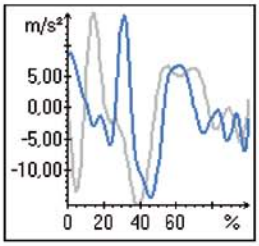
Max: 8.6m/s²; Min: -10.7m/s²

Head



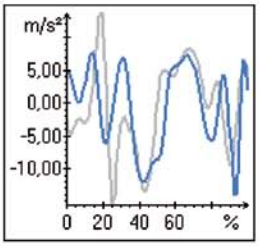
Max: 21.2m/s²; Min: -27.9m/s²

Left thigh



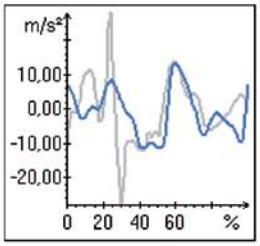
Max: 15.1m/s²; Min: -14.5m/s²

Right thigh



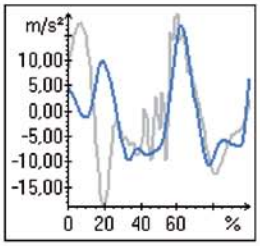
Max: 7.8m/s²; Min: -14.4m/s²

Left upper arm



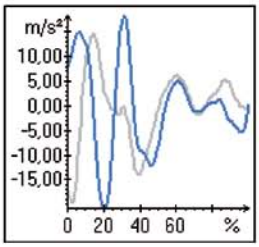
Max: 13.2m/s²; Min: -11.6m/s²

Right upper arm



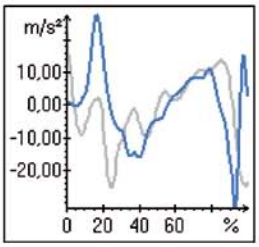
Max: 16.9m/s²; Min: -10.7m/s²

Left lower leg



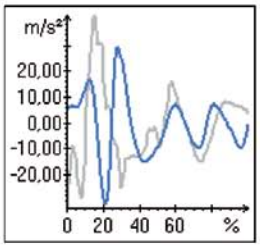
Max: 18.4m/s²; Min: -20.9m/s²

Right lower leg



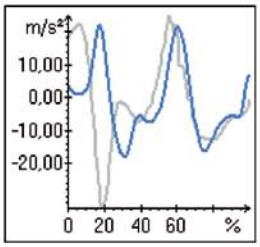
Max: 27.7m/s²; Min: -31.9m/s²

Left forearm



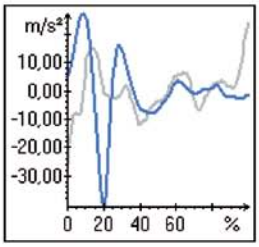
Max: 29.6m/s²; Min: -31.2m/s²

Right forearm



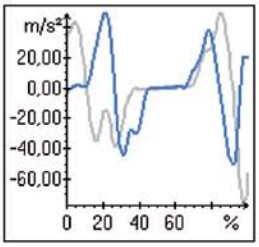
Max: 22.1m/s²; Min: -17.9m/s²

Left foot



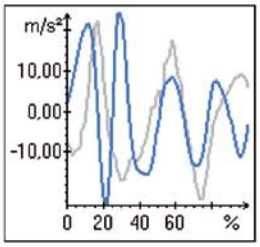
Max: 27.2m/s²; Min: -41.0m/s²

Right foot



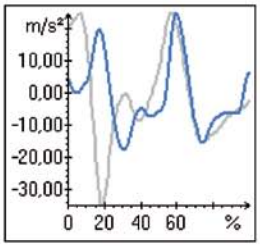
Max: 49.7m/s²; Min: -50.6m/s²

Left hand



Max: 24.5m/s²; Min: -23.4m/s²

Right hand

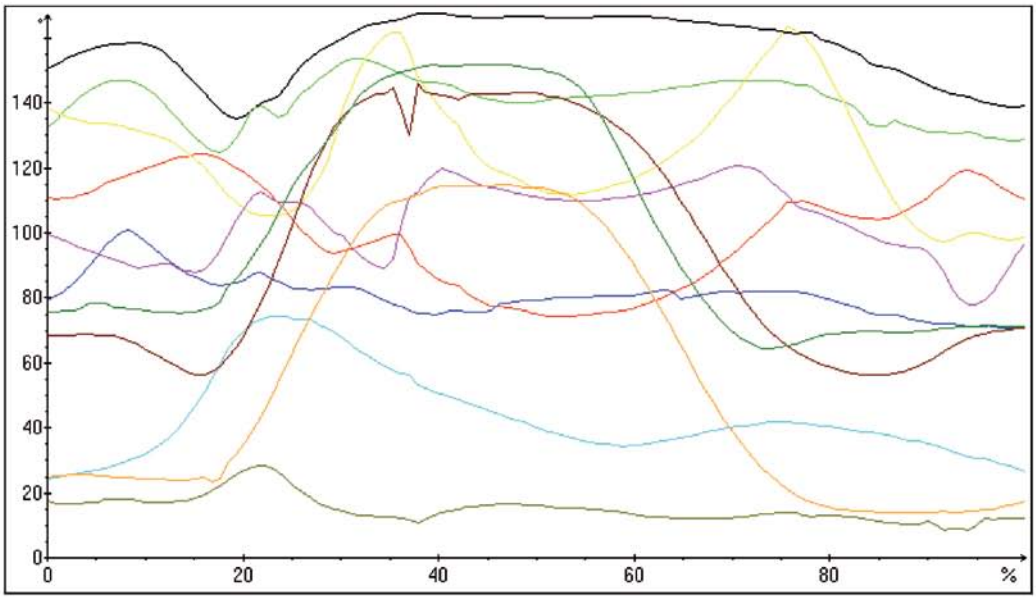


Max: 24.8m/s²; Min: -17.7m/s²

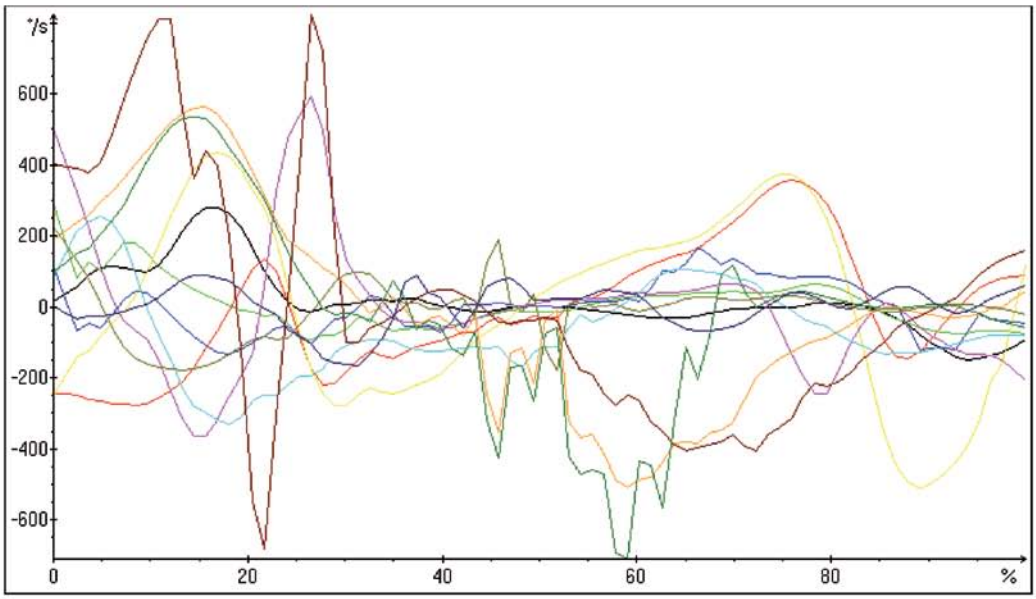
Overview - angles

Legend: black: thigh to torso left; red: thigh to torso right; green: knee left; yellow: knee right; blue: ankle joint left; pink: ankle joint right; light blue: upper arm to torso left; orange: upper arm to torso right; dark red: elbow left; dark green: elbow right; olive: shoulders to hip; dark blue: Spine

Joint angles



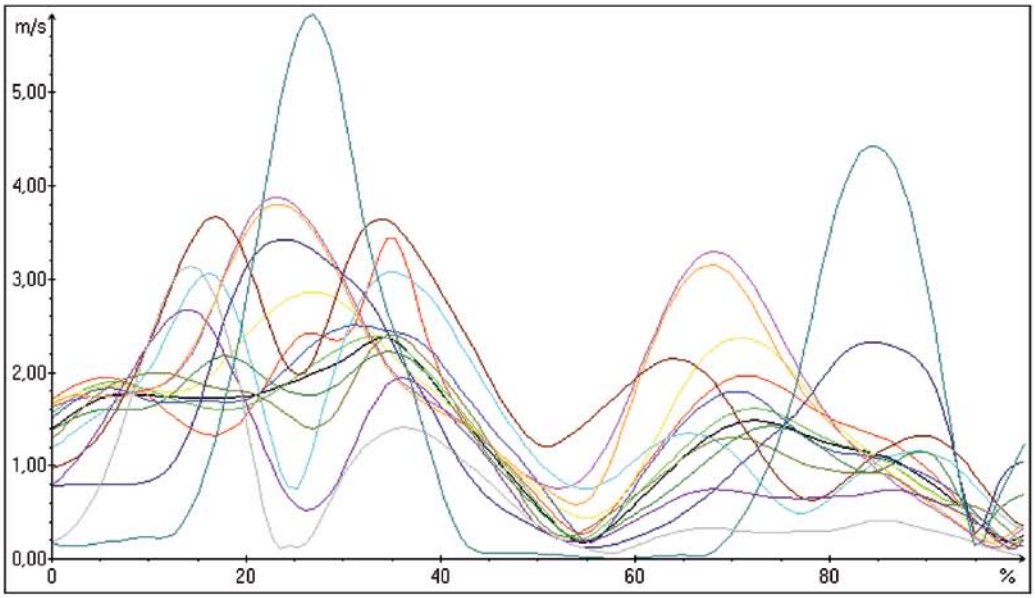
Angle velocity



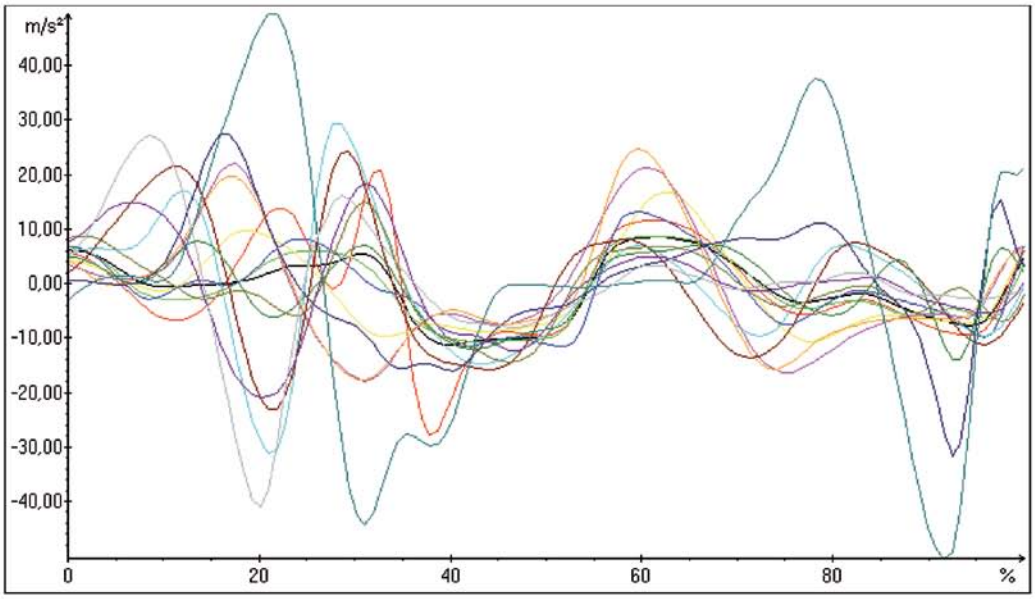
Overview - segments

Legend: black: center of mass; red: head; light green: torso; yellow: upper arm right; blue: upper arm left; pink: forearm right; light blue: forearm left; orange: hand right; dark red: hand left; green: thigh right; olive: thigh left ; dark blue: lower leg right ; purple: lower leg left ; dark green: foot right ; gray: foot left

segment velocity



segment acceleration



Explanation to work with the report

Principles of biomechanics	Explanation and relevant pages
Intial force	Pages 2 and 4 - At reversal angular velocity and segment acceleration exists an initial force.
Optimum path of acceleration	Pages 1 and 4 - The optimal path of acceleration is determined by the acceleration and joint angles.
Coordination of impulse (acceleration/deceleration)	Pages 5 and 6 - The maxima of the angular velocity and acceleration segment in time sequence.
Optimal tendency in the acceleration curve	Page 4 - Falling or rising trend in the acceleration curve.
Reaction	Page 1 - Body parts act against each other or against the ground.
Conservation of momentum	Pages 1 and 3 - The joint position determines the moment of inertia and consequently the velocity.

Aktisys 3D Spine Analysis Protocol

In the analysis process, anatomical markers are detected in real time, illustrating the movement parameters of the spine. As a result, common bodily axes, and different spinal segments can be both examined and analysed. The dynamic 3D angles show the relative movement of all parameters.

It is essential that all parameters are analysed dynamically so that the mobility of individual segments can be analysed in a quasi stationary state, but also during movements such as running.

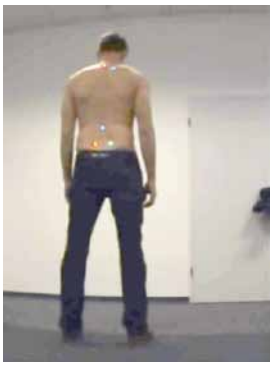
Common protocol with spinal examinations is to place 5 markers; one on each shoulder, one on each superior posterior iliac process and one on C7. This allows for analysis of shoulder rotation and obliquity, scoliotic tendencies, deviation of the spine from the vertical, pelvic rotation and pelvic obliquity.

For segmental analyses, markers are placed on the lumbar, thoracic and cervical vertebrae so that the relative movement of the cervical, thoracic and lumbar spine segments can be investigated whilst in motion.

3D-4D spine analysis

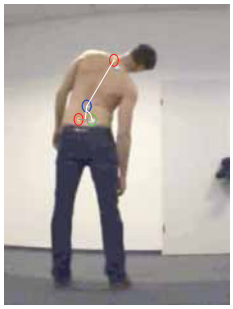
Surname	
Name	
Date	31.01.2014

Static



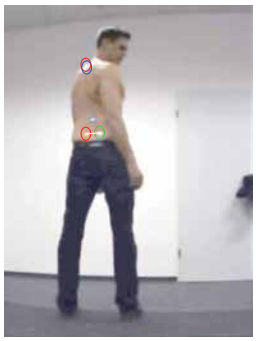
Measurement	Values	Measurement	Values
Absolut Lateral Flexion (°) [R(+)/L(-)]	-0.11	Thoracic Flex/Ext to XZ-plane (°) [Flex(+)/Ext(-)]	0.80
Lateral Flexion relative to Pelvis (°) [R(+)/L(-)]	-1.30	Lumbar Flex/Ext to Pelvis (°) [Flex(+)/Ext(-)]	12.49
Thoracic Lateral Flexion to YZ-plane (°) [R(+)/L(-)]	1.02	Trunk Rotation to Pelvis(°) [CW(+)/CCW(-)]	17.96
Lumbar Lateral Flexion to Pelvis (°) [R(+)/L(-)]	2.48	Pelvic Obliquity to XY-plane (°) [CW(+)/CCW(-)]	1.27
Flexion/Extension Spinal to Pelvis (°) [Flex(+)/Ext(-)]	3.29	Pelvic Rotation zu Pelvis (°) [CW(+)/CCW(-)]	2.57

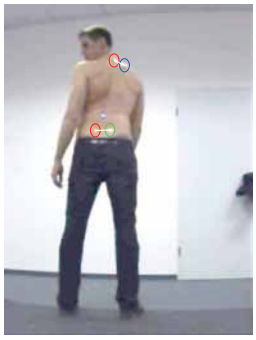
Lateral Flexion



	Deviation from Neutral	
main movement	Left-Right Comparison	Max. Dev.
Absolut Lateral Flexion (°)	R -31.90 / L 25.64	31.90
Lat. Flexion relative to pelvis (°)	R 26.77 / L -20.50	26.85
Thoracic Lateral Flexion to YZ-plane (°)	R -37.88 / L 30.71	37.89
Lumbar Lateral Flexion to Pelvis (°)	R 5.80 / L -2.59	6.03
compensatory movement		
Spinal Flexion/Extension to Pelvis (°) [Flex(+)/Ext(-)]	R 1.94 / L -0.60	19.19
Thoracic Flex/Ext to XZ-plane (°) [Flex(+)/Ext(-)]	R 2.36 / L -0.87	23.33
Lumbar Flexion/Ext to Pelvis (°) [Flex(+)/Ext(-)]	R -0.09 / L -0.23	8.15
Trunk Rotation to XZ-plane (°) [CW(+)CCW(-)]	R 8.84 / L -2.61	22.54
Pelvic Obliquity to XY-plane(°) [CW(+)CCW(-)]	R 5.68 / L -5.15	5.86
Pelvic Rotation zu XZ-plane (°) [CW(+)CCW(-)]	R -7.30 / L 3.92	8.52

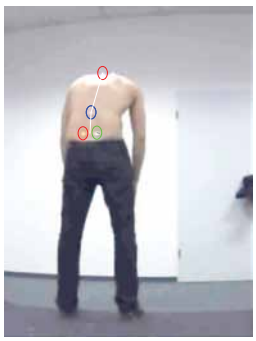
Rotation





main movement	Deviation from Neutral: Left-Right Comparison	Max. Dev.
Trunk Rotation to XZ-plane (°)	R 35.42 / L -45.87	45.87
Pelvic Obliquity to XY-plane(°)	R -1.10 / L 0.33	1.65
Pelvic Rotation to XZ-plane(°)	R -8.63 / L 5.53	14.11
compensatory movement		
Absolut Lateral Flexion (°) [R(+)/L(-)]	R -7.30 / L 6.99	9.67
Lat. Flexion relative to pelvis (°) [R(+)/L(-)]	R 8.90 / L -8.16	11.72
Thoracic Lateral Flexion to YZ-plane (°) [R(+)/L(-)]	R -8.61 / L 8.59	11.34
Lumbar Lateral Flexion to Pelvis (°) [R(+)/L(-)]	R 5.51 / L -3.46	7.61
Spinal Flexion/Extension to Pelvis (°) [Flex(+)/Ext(-)]	R 0.46 / L 4.27	9.74
Thoracic Flex/Ext to XZ-plane (°) [Flex(+)/Ext(-)]	R -0.30 / L 4.32	11.09
Lumbar Flexion/Ext to Pelvis (°) [Flex(+)/Ext(-)]	R 2.75 / L 3.47	6.01

Flexion/Extension



main movement	Deviation from Neutral: Flexion/Extension	Max. Dev.
Spinal Flexion/Extension to Pelvis (°)	F -13.25 / E 26.99	26.99
Thoracic Flex/Ext to XZ-plane (°)	F -16.48 / E 35.93	35.93
Lumbar Flexion/Ext to Pelvis(°)	F -1.62 / E -3.78	8.34
compensatory movement		
Absolut Lateral Flexion (°) [R(+)/L(-)]	F -0.39 / E 0.58	2.06
Lat. Flexion relative to pelvis (°) [R(+)/L(-)]	F -0.55 / E 2.99	3.68
Thoracic Lateral Flexion to YZ-plane (°) [R(+)/L(-)]	F -0.08 / E -0.45	2.17
Lumbar Lateral Flexion to Pelvis (°) [R(+)/L(-)]	F 1.94 / E -1.48	3.36
Trunk Rotation to XZ-plane (°) [CW(+)CCW(-)]	F 8.84 / E -2.61	22.82
Pelvic Obliquity to XY-plane (°) [CW(+)CCW(-)]	F 5.68 / E -5.15	2.09
Pelvic Rotation to XZ-plane (°) [CW(+)CCW(-)]	F -7.30 / E 3.92	8.89

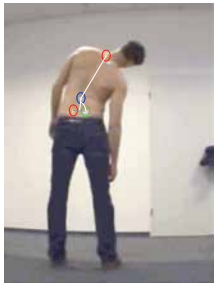
3D-4D spine analysis

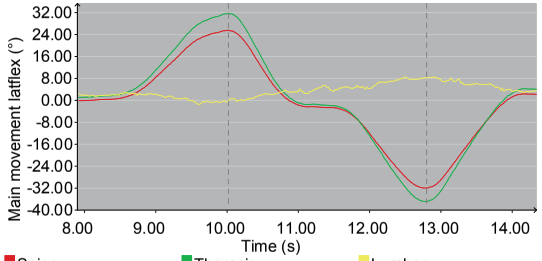
Static	Values
Latflex spine (L4-C7 to YZ)	-0.11
Latflex spine (L4-C7 to pelvis)	-1.30
Latflex thoracic (L1-C7 to YZ)	1.02
Latflex lumbar (L4-L1 to pelvis)	2.48

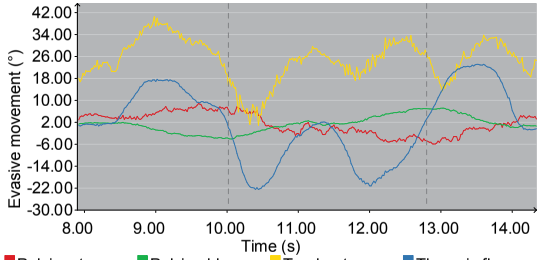
Static	Values
Flex/Ext. Spine (L4-C7 to XZ)	3.29
Flex/Ext thoracic (TH12-C7 to XZ)	0.80
Flex/Ext lumbar (L4-L1 to XZ)	12.49

Static	Values
Trunk Rotation (to XZ)	17.96
Pelvic Obliquity (to XY)	1.27
Pelvic Rotation (to XZ)	2.57

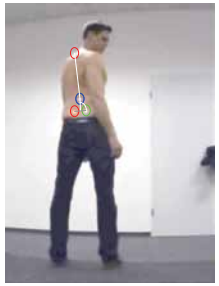
Lateral Flexion

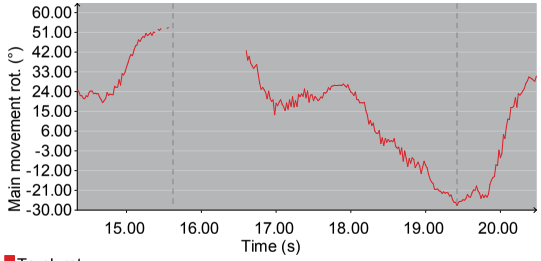


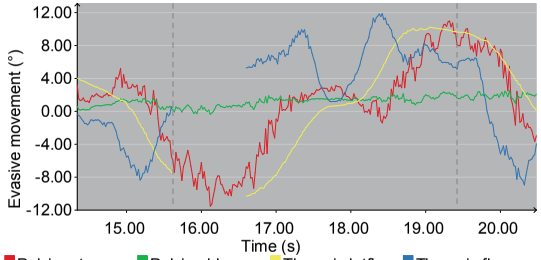




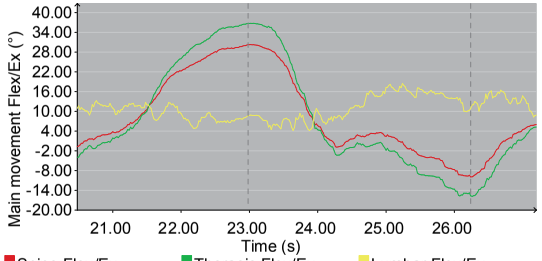
Rotation

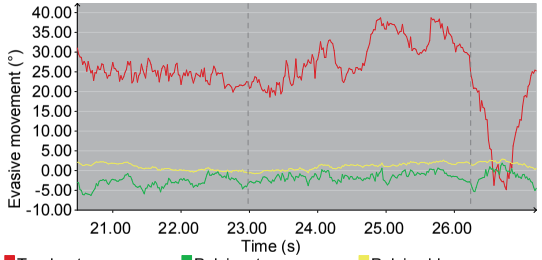






Flexion





Simi Motion Spine Analysis Protocol

In Simi Motion the complete spine can be marked and analysed in 3D. All vertebrae are dynamically tracked and can be observed in motion. This provides an extensive view on parameters of the spine.

Spine analysis report

Examination data

Patient	,
Date of Birth	..
Gender	female
Weight	0.0 kg
Height	0.00 m
Date	..
Author	SIMI-GmbH, Unterschleißheim

Anamnesis

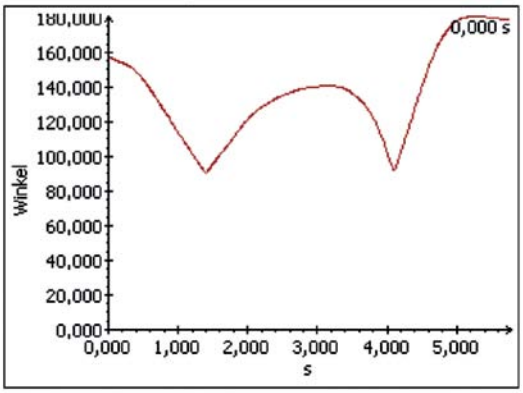
Analysisparameter

Parameter	Values
Torso length [cm]	49.2
Dimple interval [cm]	9.4
Pelvis inconsistency [cm]	0.1
Pelvis rotation	-4.741°
Lateral deflexion [cm]	-0.3
deviation from plumb-line [cm]	1.8
Pelvis torsion	13.633°
Max. left incline thoracic spine	37.029°
Max. right incline thoracic spine	47.548°
Max. left incline lumbar spine	19.651°
Max. right incline lumbar spine	13.838°
Max. Flexion thoracic spine	140.998°
Max. Flexion lumbar spine	100.559°

Diagnosis

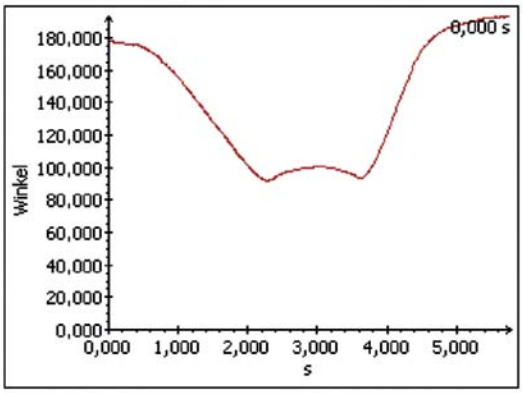
Motion Diagrams

Flexion thoracic spine



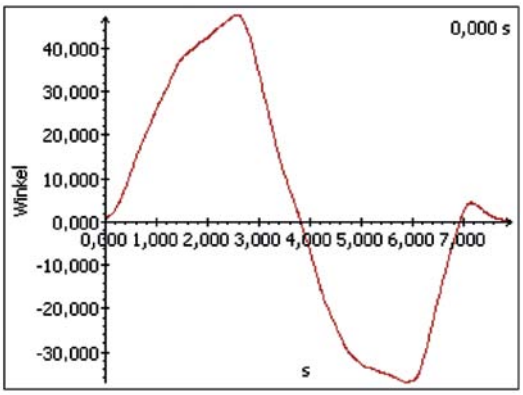
Maximum Flexion: 140.998°

Flexion lumbar spine



Maximum Flexion: 100.559°

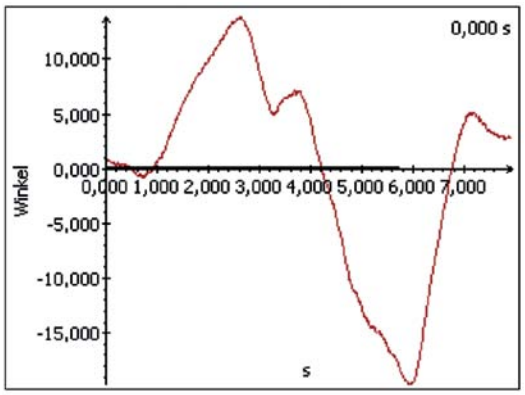
Lateralflexion thoracic spine



Maximum left incline: 37.029°

Maximum right incline: 47.548°

Lateralflexion lumbar spine



Maximum left incline: 19.651°

Maximum right incline: 13.838°

Snapshots out of the videos

Freeze frame

Flexion

Lateralflexion

Aktisys Gait and Running protocols

Sagittal

The sagittal protocols in Aktisys require the use of 5 markers; these are placed on the fore foot, under the ankle joint and on the knee joint, trochanter and shoulder. The recording functions fully automatically and determines values for dorsal and plantar flexion at the ankle, extension and flexion at the knee and hip, and upper body angle to the horizontal. In the review with the patient, therapists can demonstrate the different important phases of movement and discuss the measurement values.

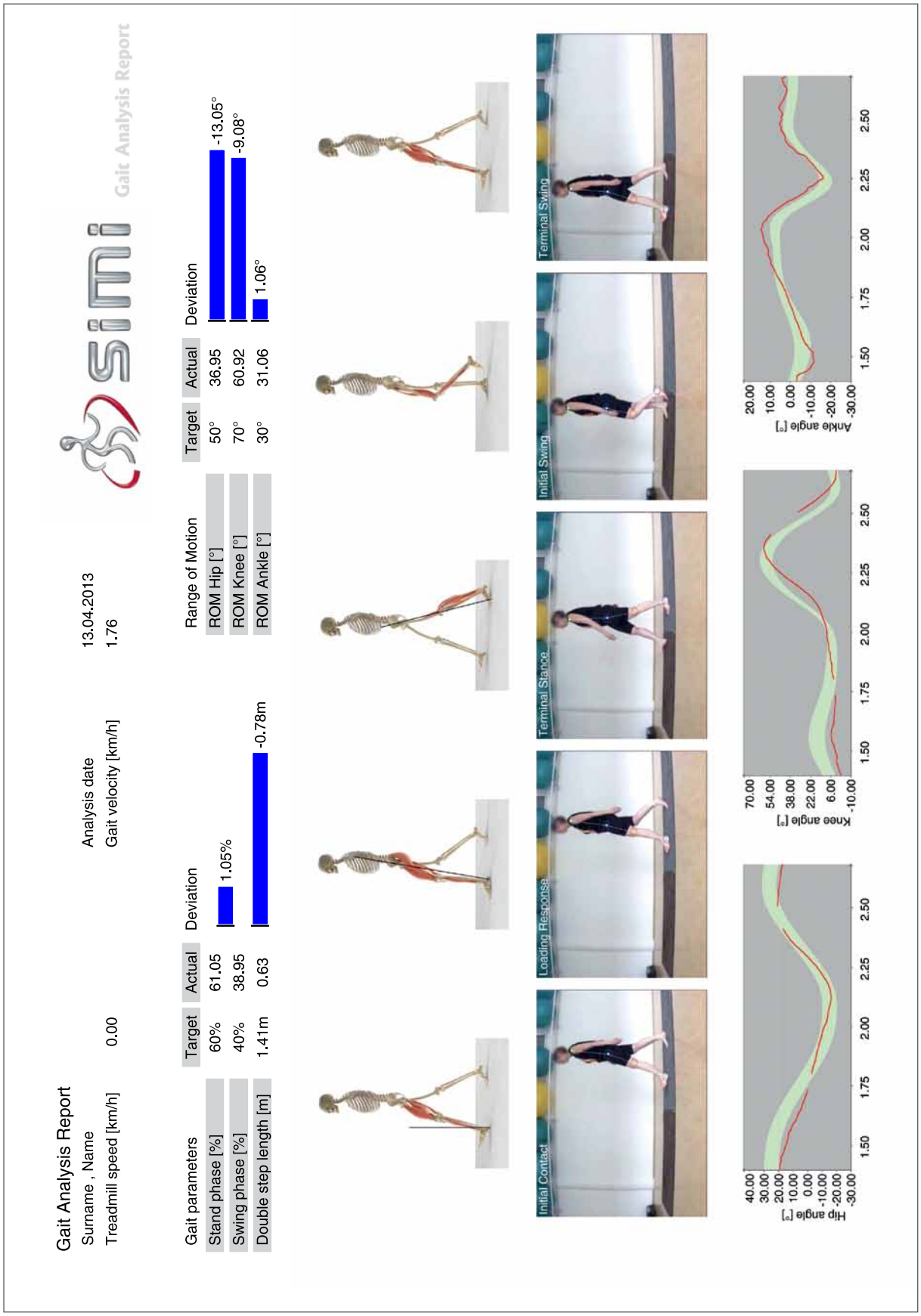
Without the need for further input from the analyst, a report is produced. For gait analysis this is according the model of J. Perry from Rancho Los Amigos and shows the amplitudes of joint angles, step length and the duration of the stand and swing phases, as well as for all other phases. The video image and corresponding joint angles are shown with standard reference values for every phase, as well as angle-time graphs with normalised data for the entire gait cycle. For running analysis all the major parameters being important for running analysis in different theories have been implemented, such as joint angles, cadence, foot over center of mass, tibia to vertical, trunk position, hip acceleration or height of center of mass in flight phase.

Frontal

When analysing in the frontal plane, 5 markers are also used. These are placed anteriorly on the ankle joint, the origin of the patella ligament, on both the left and right anterior superior iliac crests and in line with the height of the T6 vertebrae. This allows for the measurement of valgus and varus movement at the knee, lateral hip tilt, and deviations of the upper-body from the midline.

Information regarding initial contact, maximum knee flexion and toe off can also be calculated when reviewing results with the patient. The report automatically shows joint angles as well as the respective video image for key time points. In addition, angle/time graphs can be generated for each joint, which provide an overview of joint movement and the opportunity to determine joint angles at any stage of the cycle.

Tests such as frontal gait analysis, frontal running analysis, step down tests, leg axis stability tests and many more can be conducted automatically for immediate patient feedback.



Gait Analysis Report

Surname , Name

Treadmill speed [km/h] 0.00

Analysis date 13.04.2013

Gait velocity [km/h] 1.76

simi Gait Analysis Report

Gait parameters	Target	Actual	Deviation
Stand phase [%]	60%	61.05	1.05%
Swing phase [%]	40%	38.95	
Double step length [m]	1.41m	0.63	-0.78m

Range of Motion	Target	Actual	Deviation
ROM Hip [°]	50°	36.95	-13.05°
ROM Knee [°]	70°	60.92	-9.08°
ROM Ankle [°]	30°	31.06	1.06°

Gait phases

Initial Contact

	Target	Deviation	Actual
Trunk [Flex(+)/Ext(-)]	0°	5.25°	5.25
Hip [Flex(+)/Ext(-)]	30°	-10.38°	19.62
Knee [Flex(+)/Ext(-)]	0°	-2.25°	-2.25
Ankle [PF(-)/DF(+)]	0°	-3.32°	-3.32

- Heel contact with the ground

Loading Response

	Target	Deviation	Actual
Trunk [Flex(+)/Ext(-)]	0°	7.16°	7.16
Hip [Flex(+)/Ext(-)]	30°	-15.94°	14.06
Knee [Flex(+)/Ext(-)]	15°	-11.35°	3.65
Ankle [PF(-)/DF(+)]	-10°	-0.98°	-10.98

- Shock absorption in knee and ankle
- Weight bearing and hip stability
- Forward progression (heel rocker)

Mid stance

	Target	Deviation	Actual
Trunk [Flex(+)/Ext(-)]	0°	-1.07°	-1.07
Hip [Flex(+)/Ext(-)]	0°	-5.71°	-5.71
Knee [Flex(+)/Ext(-)]	0°	5.37°	5.37
Ankle [PF(-)/DF(+)]	5°	2.97°	7.97

- Hip and knee extension to pull body forward

- Progression of COM over base of support (ankle rocker)

Gait phases

Terminal Stance

	Target	Deviation	Actual
Trunk [Flex(+)/Ext(-)]	0°	-2.82°	-2.82
Hip [Flex(+)/Ext(-)]	-20°	7.92°	-12.08
Knee [Flex(+)/Ext(-)]	0°	9.04°	9.04
Ankle [PF(-)/DF(+)]	10°	3.20°	13.20

- Heel lifts from the ground (forefoot rocker)
- Hip extension

Pre swing

	Target	Deviation	Actual
Trunk [Flex(+)/Ext(-)]	0°	-2.06°	-2.06
Hip [Flex(+)/Ext(-)]	-10°	-3.95°	-13.95
Knee [Flex(+)/Ext(-)]	40°	-11.34°	28.66
Ankle [PF(-)/DF(+)]	-20°	14.57°	-5.43

- Initiate limb advancement (hip and knee flexion)

Initial Swing

	Target	Deviation	Actual
Trunk [Flex(+)/Ext(-)]	0°	-0.43°	-0.43
Hip [Flex(+)/Ext(-)]	20°	-7.42°	12.58
Knee [Flex(+)/Ext(-)]	60°	-2.12°	57.88
Ankle [PF(-)/DF(+)]	-5°	2.72°	-2.28

- Limb advancement (hip flexion)
- Foot clearance (Knee flexion and ankle dorsiflexion)

Gait phases

Mid Swing

	Target	Deviation	Actual
Trunk [Flex(+)/Ext(-)]	0°	2.83°	2.83
Hip [Flex(+)/Ext(-)]	30°	-9.42°	20.58
Knee [Flex(+)/Ext(-)]	30°	-9.88°	20.12
Ankle [PF(-)/DF(+)]	0°	5.80°	5.80

- Continued limb advancement (hip flexion)
- Continued foot clearance via Ankle dorsiflexion

Terminal Swing

	Target	Deviation	Actual
Trunk [Flex(+)/Ext(-)]	0°	4.32°	4.32
Hip [Flex(+)/Ext(-)]	30°	-12.48°	17.52
Knee [Flex(+)/Ext(-)]	0°	1.84°	1.84
Ankle [PF(-)/DF(+)]	0°	2.41°	2.41

- Complete limb advancement (knee extension)
- Prepare limb for stance (ankle neutral)

All Actual values calculated via manual input (Moment of Interest)

All Target values specified by Perry, J. (2003) and Richards, J. (2008) at free gait speed, phase ending

The responsibility for the use and assessment of the data lies in the hand of the user

2D Gait Analysis frontal left

Last name, Name	
Analysis date	05.06.2015
Treadmill speed [km/h]	0.00

			Range of Motion		
Angle parameter	Minimum	Maximum	Target	Actual	Deviation
Trunk angle [°]	-9.99	0.48	0	10.47	10.47
Pelvis angle [°]	-1.16	2.25	10	3.41	-6.59
Valgus/Varus [°]	-3.92	6.45	0	10.37	10.37
Hip add./abd. [°]	2.67	6.11	10	3.44	-6.56

Initial Contact (IC) left

Angle	Target	Actual	Deviation
Trunk angle [°]	0	-9.52	-9.52
Pelvis angle [°]	5	1.35	-3.65
Valgus/Varus [°]	0	6.45	6.45
Hip add./abd. [°]	5	6.11	1.11
Cross over [cm]	No	-14.49	Yes

Dynamic change

Angle	IC	Mst l.	Change
Trunk angle [°]	-9.52	-4.62	4.90
Pelvis angle [°]	1.35	0.41	-0.93
Valgus/Varus [°]	6.45	0.18	-6.28
Hip add./abd. [°]	6.11	4.17	-1.94

Mid Stance (Mst) left

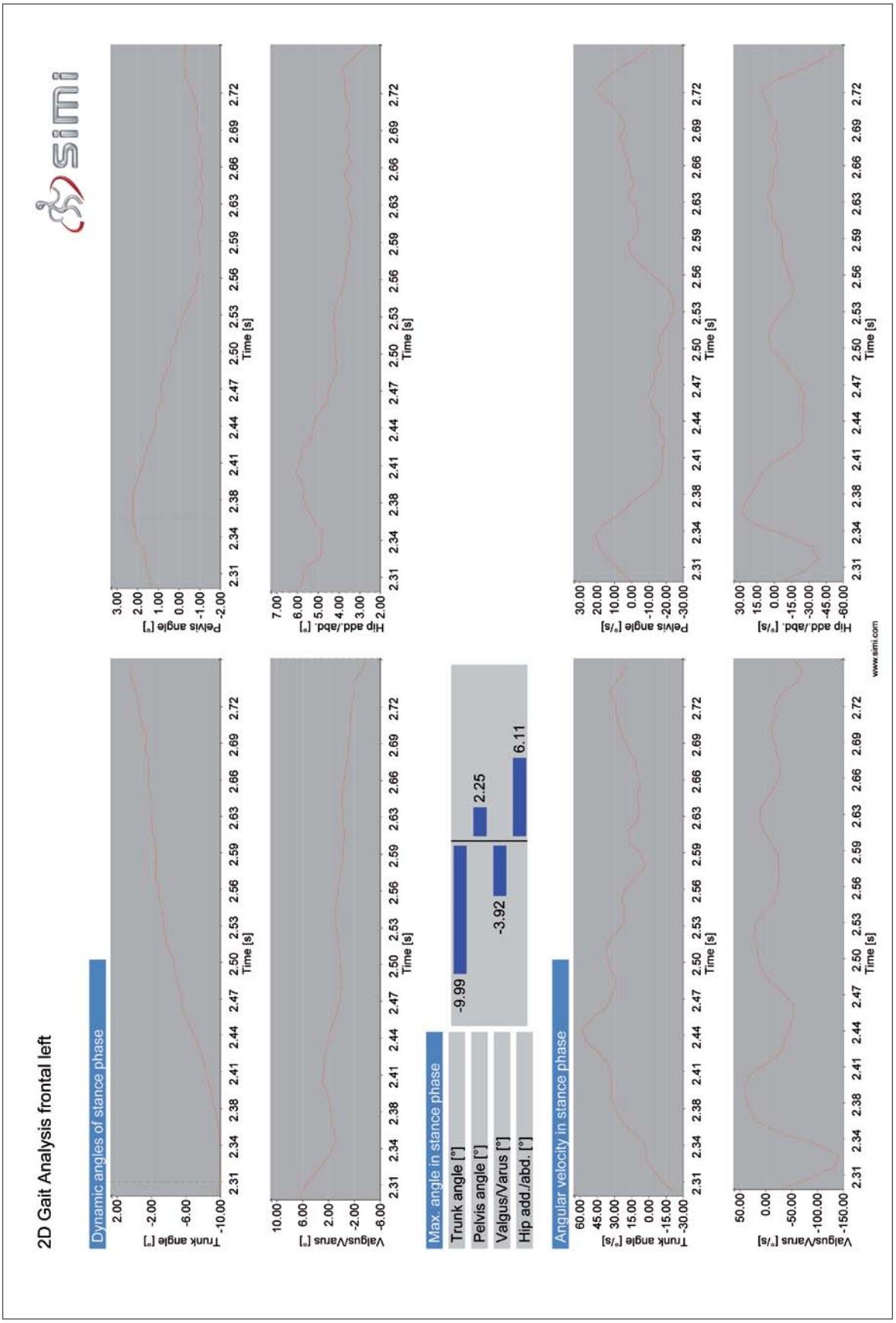
Angle	Target	Actual	Deviation
Trunk angle [°]	0	-4.62	-4.62
Pelvis angle [°]	5	0.41	-4.59
Valgus/Varus [°]	0	0.18	0.18
Hip add./abd. [°]	5	4.17	-0.83

Mid Stance (Mst) right

Angle	Target	Actual	Deviation
Trunk angle [°]	0	-1.87	-1.87
Pelvis angle [°]	-5	-0.62	4.38

All Target values specified by Perry (1992) at free gait speed, phase ending

Trunk angle to vertical axis: positive values = tilt to the contralateral side,
negative values = tilt to the ipsilateral side
Pelvis: positive values = contralateral lowering, negative values = ipsilateral lowering
Leg: positive values = valgus deformity, negative values = varus deformity
Hip: positive values = adduction, negative values = abduction
www.simi.com


2D Gait Analysis frontal left
Dynamic angles of stance phase
Trunk angle [°]
Valgus/Varus [°]
Pelvis angle [°]
Hip add./abd. [°]
Time [s]
Max. angle in stance phase
Trunk angle [°]
Pelvis angle [°]
Valgus/Varus [°]
Hip add./abd. [°]
-9.99
-3.92
2.25
6.11
Angular velocity in stance phase
Trunk angle [°/s]
Pelvis angle [°/s]
Valgus/Varus [°/s]
Hip add./abd. [°/s]
www.simi.com

2D Running protocol left

Name		Running speed [km/h]	0.03
Test date	15.07.2015	Stride length [m]	0.01
Treadmill speed [km/h]	0.00	Cadence [/min]	80.00

Range of motion

Trunk lean [°]	49.23
Hip flex./-ext.[°]	76.31
Knee flex./-ext. [°]	102.14
Ankle [°]	49.66

	Initial contact	Peak knee flex.	Push off	Flight phase
Trunk lean [°]	-14.58	-2.58	23.45	22.90
Hip flex./-ext. [°]	29.09	35.05	-31.41	-34.20
Knee flex./-ext. [°]	16.79	71.62	23.21	31.89
Ankle [°]	-4.30	32.84	21.31	15.04

Angle change during Energy Absorption (Eccentric): Trunk lean 12.00; Hip flex./-ext. 5.96; Knee flex./-ext. 54.83; Ankle 37.14

Angle change during Energy Generation (Concentric): Trunk lean 26.03; Hip flex./-ext. -66.46; Knee flex./-ext. -48.41; Ankle -11.53

Braking impulse parameters

Heel to hip[cm]	24.71
Tibia to vertical[°]	12.30
	8.00

Legend
Trunk lean: +/- anterior/posterior
Hip: +/- flexion/extension
Knee: +/- flexion/extension
Ankle: +/- dorsiflex./plantarflex.

Load distribution parameters

Knee over toe[cm]	9.26
Trunk lean[°]	-2.58

Legend
Trunk lean: +/- anterior/posterior
Hip: +/- flexion/extension
Knee: +/- flexion/extension
Ankle: +/- dorsiflex./plantarflex.

Energy generation parameters

Angular velocity

Hip flex./-ext. [°/s]	483.86
Knee flex./-ext.[°/s]	440.74
Ankle [°/s]	273.73

Time of maximum

Hip flex./-ext. [s]	2.53
Knee flex./-ext. [s]	2.53
Ankle [s]	2.60

Impact force parameter

Vert. displacement hip [cm]	0.63

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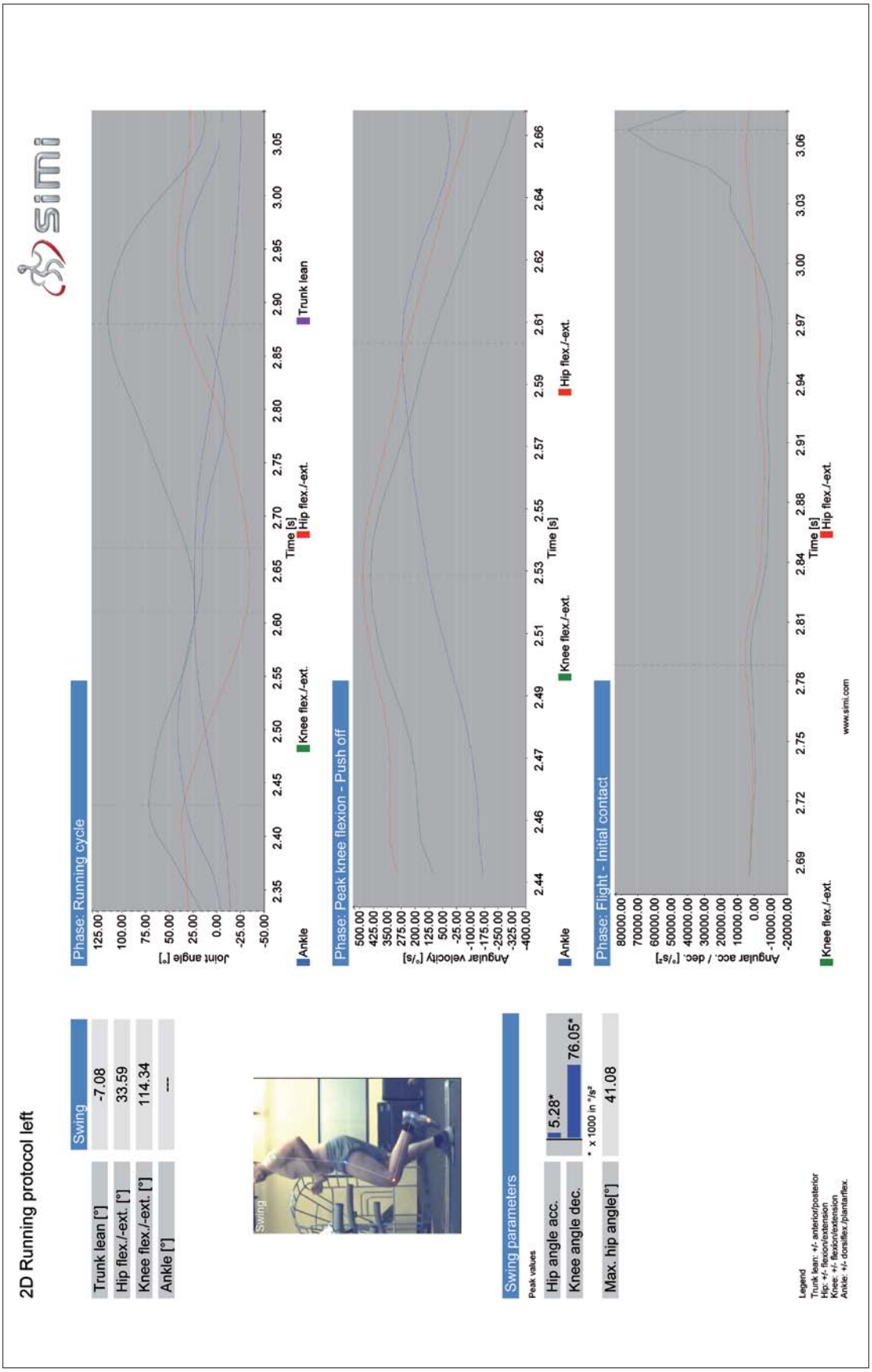
2D Running protocol left
Swing
Trunk lean [°] -7.08
Hip flex./-ext. [°] 33.59
Knee flex./-ext. [°] 114.34
Ankle [°] ---
Swing
Swing parameters
Peak values
Hip angle acc. 5.28*
Knee angle dec. 76.05*
* x 1000 in °/s²
Max. hip angle[°] 41.08
Legend
Trunk lean: +/- anterior/posterior
Hip: +/- flexion/extension
Knee: +/- flexion/extension
Ankle: +/- dorsiflex./plantarflex.
simi
Phase: Running cycle
Joint angle [°]
Time [s]
Ankle
Knee flex./-ext.
Hip flex./-ext.
Trunk lean
Phase: Peak knee flexion - Push off
Angular velocity [°/s]
Time [s]
Ankle
Knee flex./-ext.
Hip flex./-ext.
Phase: Flight - Initial contact
Angular acc. / dec. [°/s²]
Time [s]
Knee flex./-ext.
Hip flex./-ext.
www.simi.com


Running protocol left
Knee angle
Knee angle [°]
120.00
80.00
40.00
0.00
0.00 0.31 0.63 0.94 1.25 1.56 1.88 2.19 2.50 2.81 3.13 3.44 3.75 4.06 4.38 4.69 5.00 5.31 5.63 5.94 6.25 6.56 6.88 7.19 7.50 7.81 8.13 8.44 8.75 9.06 9.38
Time [s]
Ankle angle
Ankle angle [°]
30.00
20.00
10.00
0.00
-10.00
-20.00
0.00 0.31 0.63 0.94 1.25 1.56 1.88 2.19 2.50 2.81 3.13 3.44 3.75 4.06 4.38 4.69 5.00 5.31 5.63 5.94 6.25 6.56 6.88 7.19 7.50 7.81 8.13 8.44 8.75 9.06 9.38
Time [s]

Simi Aktisys Running Analysis Report

2D Running Analysis frontal left

Last Name, Name	
Analysis date	20.02.2015
Treadmill speed [km/h]	0.00

Angle parameter	Minimum	Maximum	Range of Motion
Trunk angle [°]	-11.48	7.48	18.96
Pelvis angle [°]	-5.59	5.74	11.33
Valgus/Varus [°]	-3.93	2.49	6.42
Hip add./abd. [°]	-1.34	10.13	11.47

Initial contact (IC) left

Angle		
Trunk angle [°]	-8.26	
Pelvis angle [°]		1.78
Valgus/Varus [°]		2.49
Hip add./abd. [°]		4.66
Cross over [cm]	No -6.29	Yes

Dynamic change

Angle	IC	Mst l.	Change
Trunk angle [°]	-8.26	-8.84	-0.58
Pelvis angle [°]	1.78	3.81	2.03
Valgus/Varus [°]	2.49	-2.87	-5.37
Hip add./abd. [°]	4.66	6.84	2.18

Mid stance (Mst) left

Angle		
Trunk angle [°]	-8.84	
Pelvis angle [°]		3.81
Valgus/Varus [°]	-2.87	
Hip add./abd. [°]		6.84

Mid stance (Mst) right

Angle		
Trunk angle [°]		4.94
Pelvis angle [°]	-1.70	

Trunk angle: positive values = tilt to the contralateral side, negative values = tilt to the ipsilateral side
Trunk lean is realtiv to pelvis
Pelvis: positive values = contralateral lowering, negative values = ipsilateral lowering
Leg: positive values = valgus deformity, negative values = varus deformity
Hip: positive values = adduction, negative values = abduction

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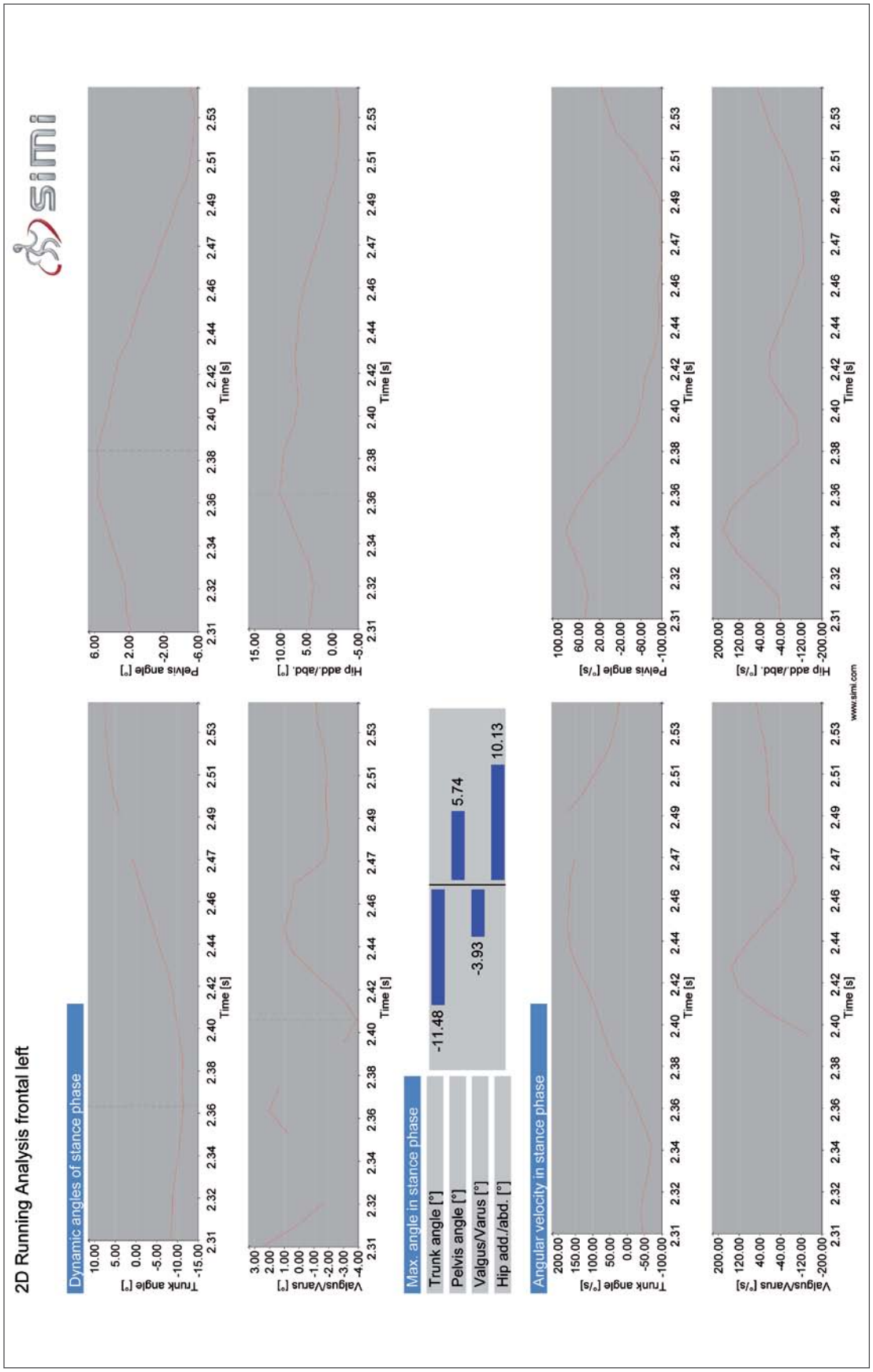
2D Running Analysis frontal left
Dynamic angles of stance phase
Trunk angle [°]
Valgus/Varus [°]
Pelvis angle [°]
Hip add./abd. [°]
Time [s]
Max. angle in stance phase
Trunk angle [°]
Pelvis angle [°]
Valgus/Varus [°]
Hip add./abd. [°]
-11.48
-3.93
5.74
10.13
Angular velocity in stance phase
Trunk angle [°/s]
Pelvis angle [°/s]
Valgus/Varus [°/s]
Hip add./abd. [°/s]
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Simi Brochures

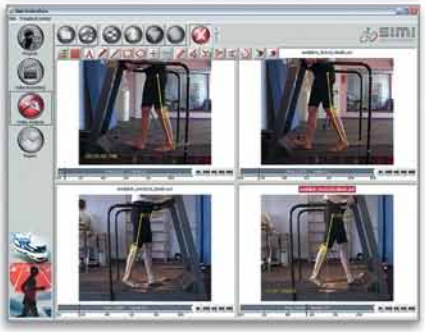
Simi MotionTwin

simi
reality motion systems

Simi MotionTwin is a video based system for 2D motion analysis using up to 4 cameras. The software is the perfect solution for everyday motion analysis in orthopaedic, rehabilitation, physiotherapy and sports clinics. Simi MotionTwin is easy to use and includes measurement and video functions for accurate 2D motion analysis.

With Simi MotionTwin you can easily measure angles, axis displacements and distances. Furthermore Simi MotionTwin offers several video functions like video overlay, video split or stroboscope for demonstrative comparisons.

The analysis system allows the easy and objective monitoring and evaluation of treatment, rehabilitation and training methods as well as the clear documentation of therapy or training progress for physicians, therapists, orthopaedists, patients, trainers or athletes.



Typical Medical Applications:

Gait analysis
Spine analysis
Stance and posture analysis
Physical therapy
Rehabilitation and prevention
Orthopaedics
And many more...

Examples of typical examinations:

Running barefoot and with shoes
Walking with and without insoles
Compare pre and post surgery
Prosthesis adjustment and control

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Simi MotionTwin

2D motion analysis

reality motion systems

Medicine and Biomechanics

Key Features

Flexible

- Up to 4 camera perspectives
- Use indoors or outdoors
- Mobile system – notebook or PC
- Carry out various analyses with one system setup

Transparent

- All data in one database
- Before-after-comparison at a glace
- Extensive anamnesis with documentation of statistical and dynamic findings of abnormalities
- Export of all results (HTML report, email or print)

Easy-to-use

- Video mix (video overlay)
- Stroboscope
- Zoom, scroll and rotate videos
- Cut and compress video files
- Synchronize videos
- Measure distances, stride length, angles, axis displacement, etc.
- Complete analysis with commonly used therapy recommendations
- Individual report layouts (MS Word template)

Work Flow

- Enter or choose patient data (integrated data base)
- Perform anamnesis
- Record video sequences directly to hard disk
- Perform analysis and display measurements for immediate biofeedback
- Create and document therapy recommendations
- Automatically generate and produce reports

System Requirements

- Microsoft Windows XP (Windows 7 currently under development)
- Up-to-date PC or laptop
- Up to four cameras (firewire recomended)

Available for immediate purchase at
www.simistore.com
For your individual consultation and more informations please send an email to
sales@simi.com

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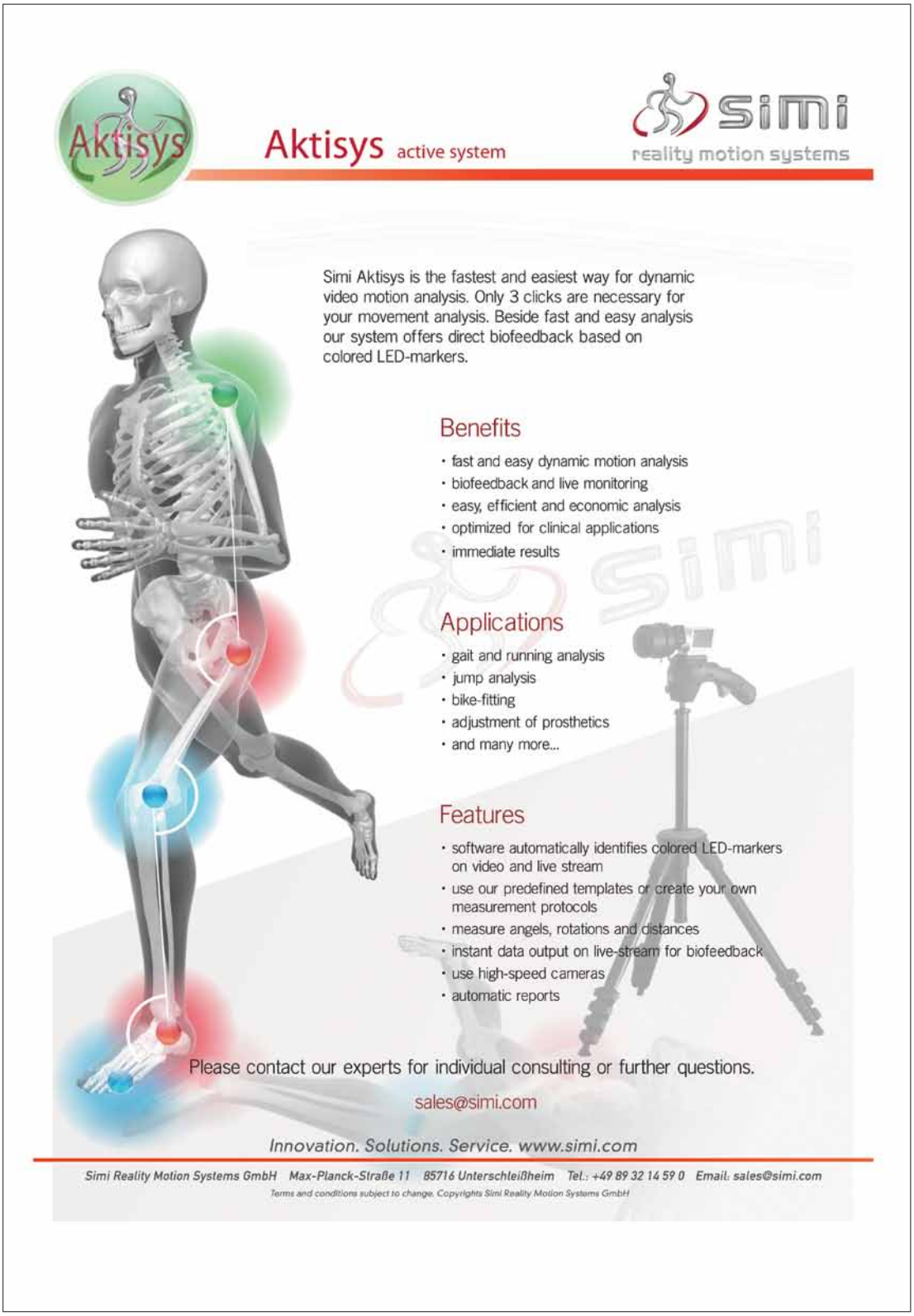
Simi Aktisys



Simi Aktisys

Aktisys active system

simi reality motion systems

Easy, fast and efficient Biofeedback

Mobile Motion

Simi Aktisys is a compact and portable system, created for different settings and flexible applications of practioners.

Fields of application

- physical therapy
- orthopedics
- personal training
- sport performance analysis
- strength and conditioning
- protocol for gait and running analysis

Biofeedback

For trainers or therapists

- illustration of a functional motion analysis
- motion monitoring with software

For athletes or patients

- optimized functional training system
- real-time motion feedback
- enhanced learning

Enhance self-awareness

Simi Aktisys offers trainers, physical therapists or orthopedic doctors quick and precise analysis. Athletes or patients take benefits from the integrated real-time biofeedback which increases self-awareness and success.

Specific therapy

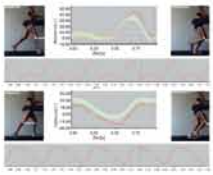
Specific treatment requires biomechanical information and feedback. This allows a successful therapy. Let the patients see their progress. Create your unique methodology and optimize your treatment with technology.

Simi Aktisys is developed for the needs of health and sports professionals. It offers full automatic movement analysis for practical requirements of therapists, personal trainers, strength and conditioning specialists, or orthopedics. The user-friendly and automatic design saves time and is highly efficient.

1. start acquisition

2. stop acquisition

3. create report



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2D/3D Medicine and Biomechanics

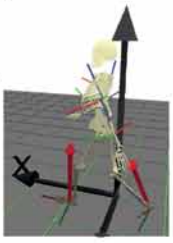
Simi Motion 2D/3D is a dynamic video based system for the noninvasive analysis, monitoring, and diagnosing of musculoskeletal disorders. Through advanced measurement technology the software can calculate user defined equations or standard calculations, such as, joint angles, accelerations, axial symmetries, joint forces, moments, etc. The video based system enables accurate and step-by-step diagnosis, monitoring and documentation of patient care without side effects.

Calculations

- Inverse dynamics/kinematics -- calculate momentums, joint centers, segment rotations, joint forces, etc.
- Various filters for data processing -- root mean square, median and mean frequency, automatic and interactive onset and offset determination
- Calculate angles, distances, velocities, accelerations...
- Freely define movements in cyclical phases
- Combine and compare date from multiple projects or with standardized medical values
- Center of gravity

And many more...

Typical Medical Applications



- Gait/Spine/Joint anaylsis
- Hand/Tremor analysis
- Foot/Ankle kinematics
- Facial expression tracking
- Balance and motor control

Visualization

- Combine actual video images from video cameras with synchronous data display
- Colorful 3D trajectories of points and segments
- Create 3D models from captured video data (stick figures, skeletal diagrams, 3D views)
- Graphical displays of user defined motion analysis (coordinates, accelerations, velocities, angles, etc.)
- Simultaneously compare and analyse video data in same Simi interface with external devices, such as, EMG, force plates, and foot pressure.

Key Features

Flexibility

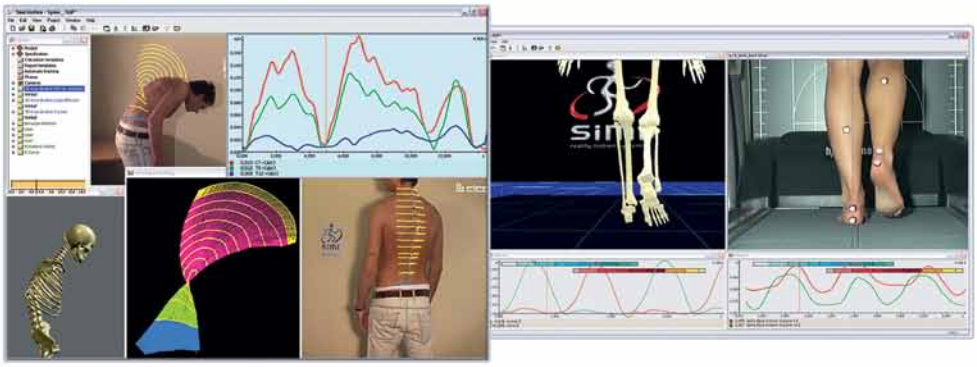
- Perform a **variety of analyses** with **one system**
- Modular set up for easy acquisition, upgrading, and individual customization
- Mobility – laptop or PC/indoor and outdoor
- Track complicated and detailed movements -- fingers, spinal vertabrae, facial expressions, etc.

Transparency

- Video imaged based - not infrared! Always see corresponding movements on real video!
- Track movements directly on video recordings
- Export all data to 3rd party programs i.e. Anybody, Excel, MATLAB, etc.
- Access to raw data

Accuracy

- Real time tracking automatically and accurately tracks reflective markers on recorded videos.
- Calculate static and dynamic data with sub pixel accuracy



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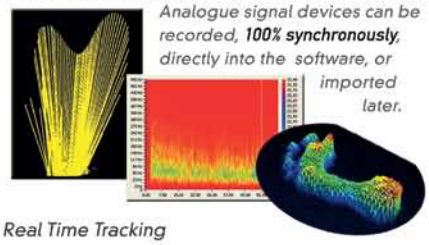
External Devices (Hardware Neutral)

Synchronously record and display video capture with output from external measuring instruments such as force plates, foot pressure plates, and EMG devices.



*Analogue signal devices can be recorded, **100% synchronously**, directly into the software, or imported later.*

Real Time Tracking

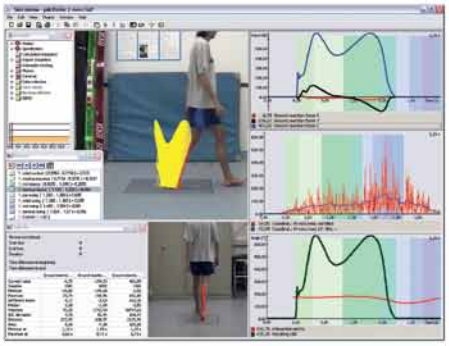
*The new **automatic** real time tracking module quickly tracks any number of reflective markers directly on all video recordings simultaneously. Track videos recorded in various environments - outdoors, lighted laboratories - without a problem. No need to confine yourself to a blacked out room!*

Flexible Mobile Technology

*Video based Simi systems are extremely flexible and mobile, unlike infrared systems. Video recording can take place indoors or outdoors. Motion tracking can be performed with **markers, or markerless**, using pattern matching. With Simi Motion systems you do not have to feel restricted!*

Example Configuration - Gait Analysis

A popular application for the Simi Motion system is the clinical gait analysis. A patient's gait can be quickly and accurately, captured, tracked, analyzed, and documented, so that changes and irregularities can be measured and evaluated early in the treatment process. Any number of configurations can be arranged, from mobile three camera systems to large eight camera laboratory set-ups, depending on laboratory size and analysis needs.



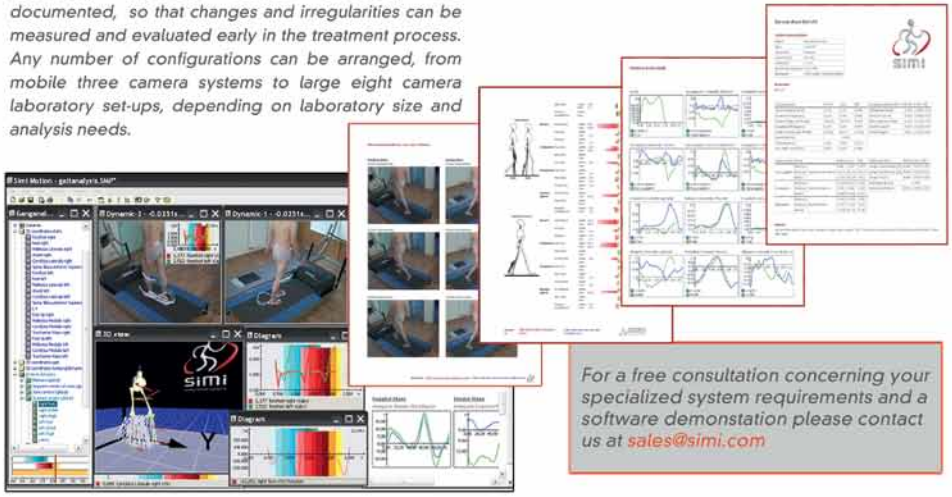
Results

Record Improvements

Evaluate and compare pre and post operative patients, as well as, prosthetic and orthotic fittings through overlaid graphs and videos. Recorded data help in the selection and tailoring of a suitable treatment approach according to patient needs.

Documentation and Presentation

Compile and analyze patient data quickly and objectively with easy-to-use tools. Graphically display kinetic and kinematic calculations such as joint angles, forces, moments and accelerations. An integrated report builder creates, user defined, interactive text documents for print and email, which we can customize upon request.



For a free consultation concerning your specialized system requirements and a software demonstation please contact us at sales@simi.com

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Customers

The quality of Simi software systems is constantly being tested and verified by our customers. For a list of actual customer references please see our website.

Publications

The quality of Simi software systems in terms of their accuracy and precision has been tested and verified time and time again in scientific establishments and universities worldwide. For this reason it has proved popular for scientific investigations and hundreds of studies using the software have been published in well renowned scientific journals. A comprehensive list can be found on our website.

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