ENG

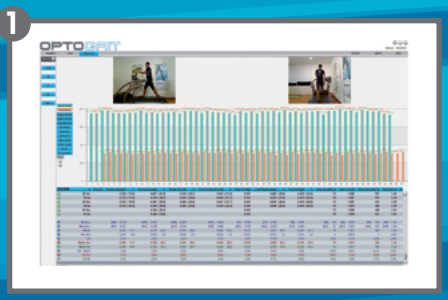
OPTOGAIT

RECOVER YOUR POTENTIAL

MICROGATE

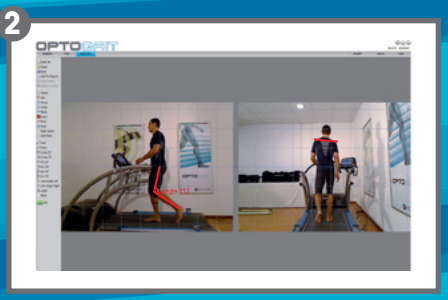
The three steps for biomechanical assessment are the following:

1



Test

2



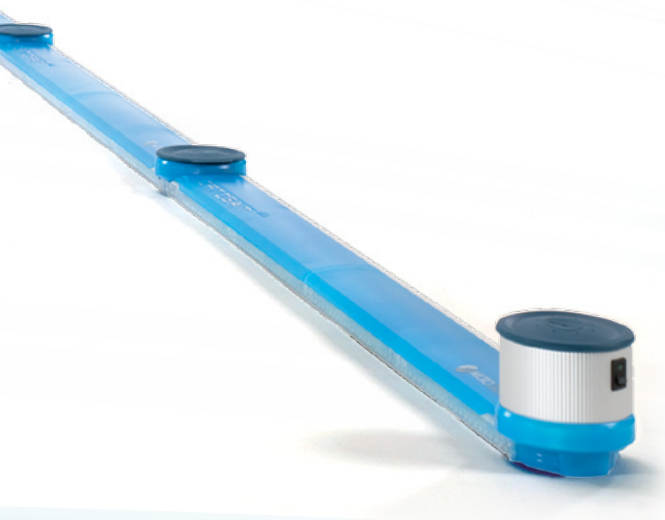
Analisys

3

Report

OPTOGAIT

Optogait is an innovative system for movement analysis and functional assessment of patients with normal or pathological conditions.
The system is equipped with optical sensors working at a frequency of 1000 Hz and having an accuracy of 1 cm, detecting the relevant space and time parameters for gait, running or other test types.
The objective measurement of such data, combined with an integrated video acquisition, allows monitoring of a patient's condition on a constant basis, detecting problem areas, assessing mechanical inefficiencies and rapidly verifying the existence of asymmetries between the two legs.
The software platform allows easy storage of all tests carried out and the ability to recall them instantly if necessary. This allows the development of a customized patient recovery plan. It is also possible to compare very quickly and easily data of tests carried out at different times, in order to assess the validity and the efficiency of the methodology applied.



Optogait allows users to:

- Assess objectively the patient's general physical conditions
- Identify deficiencies, postural problems and asymmetries on the basis of data and videos and determine how the patients' performance is being effected.
- Develop and apply therapeutic-rehabilitation applications, rehab approaches and orthopedic solutions on the basis of precise data
- Prevent - thanks to immediate assessment of numerical values - of relapses, complications and involutions of the pathological or post-accident condition due to wrong evaluations or diagnosis
- Periodically verify the results and the efficacy of treatment
- Motivate patients giving them tangible proof of improvement
- Compare post- and pre-accident values if available
- Verify, in a dynamic situation, the efficacy of arch supports, insoles or functional tapes
- Compare various shoes and their effect on the patient's gait

PRACTICALITY

Quantity and Quality Assessment

Optogait acquires numerical parameters in real-time for gait, running and jump tests that can be viewed immediately. The easy to read report contains all data, and asymmetries between the two legs are highlighted instantly.
Optogait does not only detect the numerical data, but, via small cameras, which can be freely positioned, it allows the user to acquire images of carried out tests, synchronizing them perfectly with detected events. Without the need for any further synchronization between hardware and cameras, the numerous benefits of cross verification of data and images can be fully used. A more detailed video analysis can be had by further utilizing the dedicated utility (angle, distance calculus, graphic tools, etc.) .

What is Optogait?

Optogait is a system for optical detection made by a transmitting and a receiving bar. Each one contains 96 LEDs communicating on an infrared (visible) frequency with the same number of LEDs on the opposite bar. Once positioned on the floor or on the treadmill, the system detects the interruptions of the communication between the bars - caused by the patient's movement - and calculates the duration and position. During the execution of a running, gait or series of jumps test, the contact and flight times can be measured with an accuracy of 1 thousandth of a second and the position of the interrupted LEDs with a space resolution of 1 cm. Starting from this basic data, the dedicated software measures in real-time a series of crucial data for the movement analysis*.
The absence of mechanical moving parts ensures a long life, accuracy and repetition possibilities.

(*): please refer to the table to check the parameters available for each test

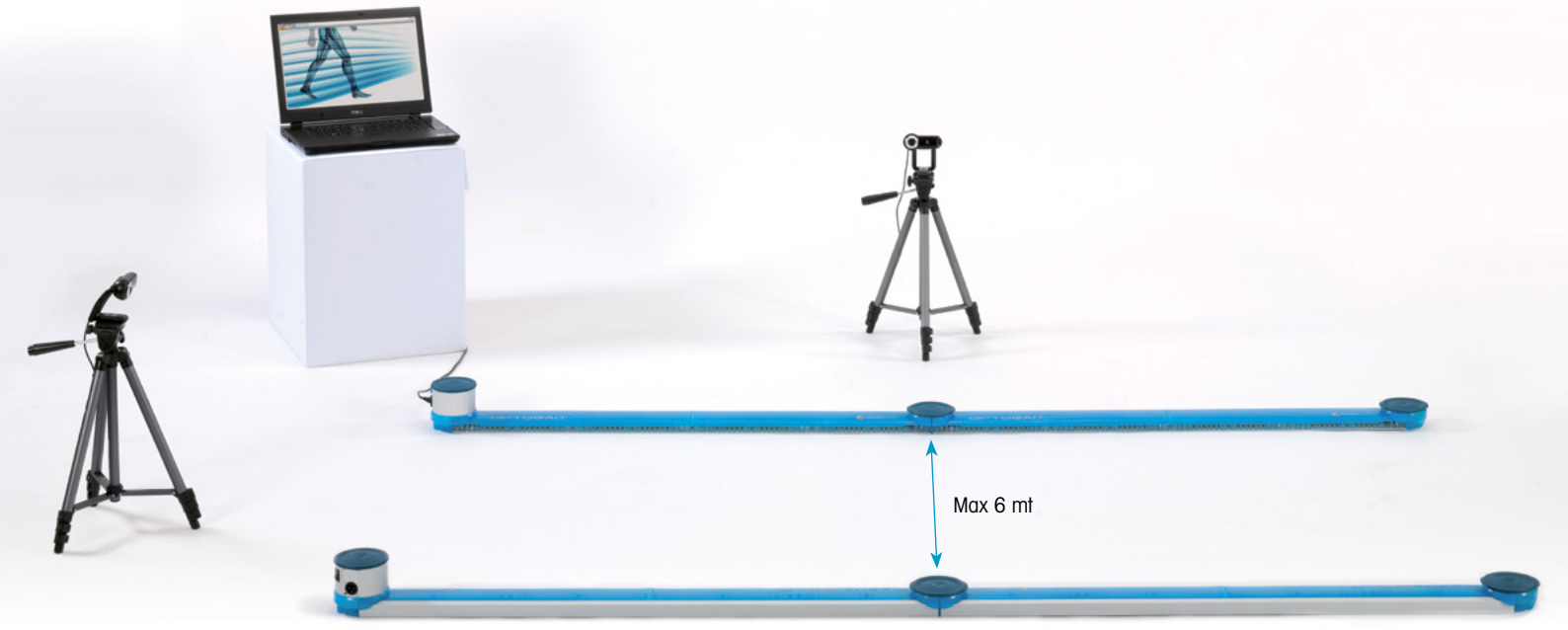
AND PRECISION

Portable, Easy to Use, and Quick to Install

The reduced weight and the practical bags (trolley for modular systems) ensure complete portability of the Optogait system. This allows the user to bring the unit wherever a test needs to be performed.

The system is extremely easy to install: position the bars on the floor and connect the receiving part to the PC using the USB cable - Optogait is ready to be used! The maximum distance between the bars is 6 meters and there is no need for connection cables. This makes the bars easy to move with minimal disturbance to the patient on which the test is carried out.

The correct alignment of the system is shown by a green LED. If the bars are not parallel or in case of any imperfections on the floor influencing the communication between the transmitting and the receiving part, the LED emits a red light to warn the user.



Single Meter

dim. 100 x 8 x 3 cm
weight 2,1 kg

Single Meter

In this configuration Optogait allows already to carry out various test types (*):

> Gait and Run Analysis: Positioned on the side bars of a treadmill, Optogait becomes a portable lab for small spaces and with reduced costs. The system is compatible with the wide majority of treadmills and no synchronization is necessary to start and carry out a test.

> Different Jump Tests: A series of exercises (squat jump, counter movement jump, drop jump, continuous jumps, jumps on one leg, etc.) and protocols (‘Drift’ for dynamic stability, ‘5 Dot Drill’ for reactivity and endurance, ‘Single Leg Three Hops’ to verify the bending capacity and stability of the knee) are pre-configured. At the same time, the user can easily create customized tests or protocols.

> Tapping/Frequency Test: This type of test is ideal for exercises where separate results are required for the left and right foot (e.g. tapping/frequency test, side movement, walking on the spot, etc.)

> Reaction Test: This test detects the time between one optical/acoustic impulse and the patient’s movement. It can be used to measure simple reactions or more complex movements..

The single meter can be battery-operated (8 hours) or used with a net adapter.

(*): please refer to the table to check the parameters available for each test

The Modular System

In this configuration, Optogait allows to carry out*

- Gait Tests: Gait tests can consist of simple exercises (moving from A to B), but also of more complex ones, such as 'roundtrip' or walking backwards. They can be more complex, if needed, adding obstacles (e.g. plastic cones) or actions to be carried out between the various gait phases (sitting down and getting up before coming back, for example) or simultaneously. Dual task and obstructive task walking, can be easily measured here.
- Running Tests: Running tests, just like gait tests, can be carried out either starting from a stand or running, to analyze the various phases, how the incremental weariness acts on the patient at each round installing the system on a track, measuring the time of a change of direction and the following acceleration, and so on...

Thanks to the practical and innovative assembling system using caps, the modular system is assembled in a few minutes and does not require cables to connect the bars or further net adapters. The length goes from a minimum of 2 meters to a maximum of more than 100 meters.

(*): please refer to the table to check the parameters available for each test

The two-dimensional system

With the OptoGait software it is possible to use a particular bar configuration for obtaining a two-dimensional measurement area. After positioning the bars on the ground in a linear configuration, it is enough to set up additional TX and RX bars (connected with an appropriate cable to the linear bars) transversally at the beginning and at the end of the measurement area, in order to obtain a rectangle allowing to carry out a two-dimensional gait analysis. Using the regular OptoGait bars it is possible to set up a two-dimensional linear analysis system of up to 5 m. The maximum length of the 2D measurement area can be increased up to 13 m purchasing one or more TX bars called 2D Boosted, equipped with stronger transmission leds compared to the normal ones. Besides the typical Gait analysis parameters, the 2D Gait analysis allows to collect new information, such as:

> Step width: distance between the middle support point of each foot

> Walking Base: distance between the innermost foot support points (for superposed steps this value can be negative)

> Walking Points: middle points between the two support feet; their connection defines the gait progress (Line of Progression)

> Walking Point Gap: progressive variation of the current walking point with respect to the previous one

Thanks to the 2D analysis it is possible to analyze normal walking steps, steps with superposed feet, as well as walking steps with crutches.

Audio and video biofeedback tools

The Videofeedback Module

The main idea of this new feature is to show the patient directly some main parameters of the test he/she is carrying out. This allows to request real-time "corrections" of some trial anomalies. Therefore the test is not only for diagnosis purposes, but it becomes a real exercise session helping the patient in a very simple and instantaneous way to control and improve his/her gait. Particular attention is paid to the concept of asymmetry, i.e. the difference between right and left foot (expressed in %) with respect to a particular parameter.

A classic example is a treadmill gait test, where the patient has a monitor in front of him/her (better if a large-screen TV), where the operator can choose which parameter to display among those available, depending on the pathology or rehabilitation therapy.

During the gait test, the patient receives a numerical/graphical feedback (in the form of green/orange/red colors and up/down arrow symbols) indicating possible asymmetries and how to correct them (e.g. making the left gait longer or increasing the rhythm, etc.).

The Audiofeedback Module

Similarly to the Videofeedback module, the Audiofeedback module stimulates the patient to correct some anomalies and asymmetries in real-time. During a Treadmill Gait Test, for example, the Audiofeedback module generates acoustic signals according to the gait rythm; the better the rhythmicity and the cadence of the acoustic signals, the lower is the asymmetry.

Integration of external devices

Heart-Rate Monitors

OptoGait can handle a series of external devices, among which heart-rate monitors. When a patient wears a heart-rate chest wrap during the test, his/her heart rate is recorded and temporarily associated with the test events (e.g. gait test or treadmill running test, etc.).

It is further possible to customize the so-called "Sport Zone" on graphs of the executed tests using colored bands, according to the maximum or rest frequency.

Inertial sensors

Inertial systems for static and dynamic analysis of the upper body. The parameters are summarized in a simplified and easy readable manner with control, coordination and movement fluidity indexes.

Metronome

The "Metronome" function is an auditory stimulation helping the patient to keep focused on the essential features of the movement to carry out.

The software allows to set various cadences and rhythms; thanks to this auditory, rhythmic help, the patient's gait speed, cadence, stride width, symmetry, etc. improve.

Surface electromyography

OptoGait can be used in a very easy and mildly invasive manner to support Surface EMG. The OptoGait outputs can be used as virtual foot switches avoiding the use of contact sensors on the patient's foot. This is a huge step forward in terms of patient preparation time and data reliability. The correlation of EMG data with Gait Analysis data processed by OptoGait give a complete picture of the patient in a very short period of time and on any natural surface or treadmill.

Special tests and protocols

Gait with Crutches

OptoGait allows to acquire data from a gait test carried out with crutches. The software automatically filters the support points of the crutches and the patient can execute various roundtrips inside the acquisition area, while the typical gait analysis parameters are detected and displayed automatically.

3 Hops Protocol

There are several specific protocols created specifically for the evaluation of various rehabilitation phases, among which the 3 Hops Protocol to evaluate the recovery of the anterior cruciate ligament functionality.

The Software

The interface with which the OptoGait system is managed is divided into three main sections: Patients' Personal Data, Tests and Results.

Patients' Personal Data

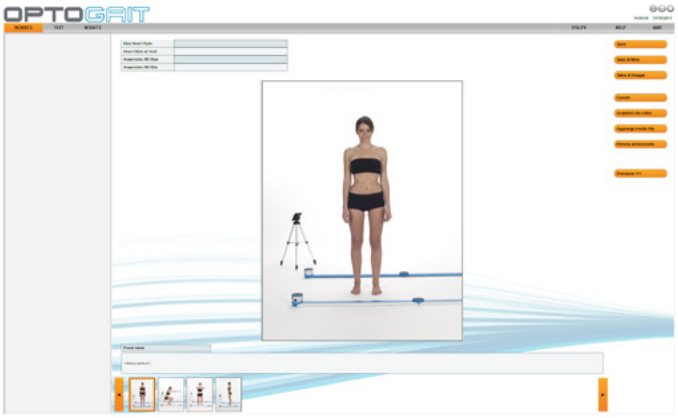
This is the section where the patients' profiles are created and stored. A profile can contain all sorts of information: personal data, notes, patient's photo, etc. Each patient can be added to one or more groups or subgroups. Therefore the Patients' Personal Data can be fully customized and adapted to the user's requirements, and imported and/or exported from/to other programs or formats (xml, Excel, etc.).

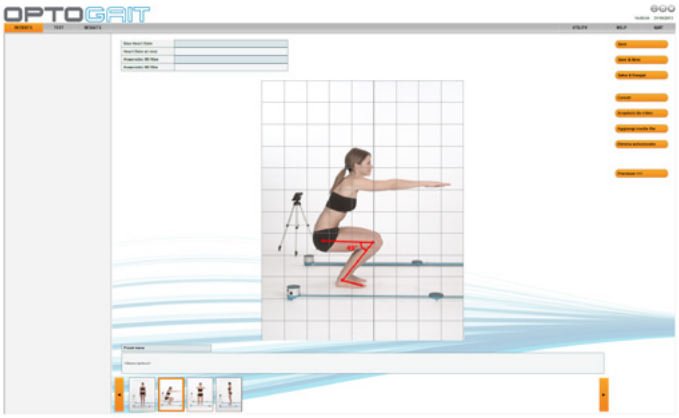
Test

This section is the software's nerve center. It is accessed to devise and configure new tests (jump, reaction, running, etc.) and to perform tests by choosing from the pre-defined tests or those created by the user. It is furthermore possible to group several tests (protocols), if this is useful for measuring particular capacities or conditions (some protocols are already pre-configured, e.g. for measuring reactivity and dynamic stability).
During the test, the user receives three kinds of feedback in real-time: numerical, graphical, and video (from one or two webcams). If the starting foot has been previously selected, the results are calculated assigning the values to the left or right leg. Once confirmed the test, all three types of data are stored and are available for immediate editing or further use in future. The user can also temporarily hide certain unnecessary information (e.g., if the video is of importance for the user, the images can be viewed full-screen).

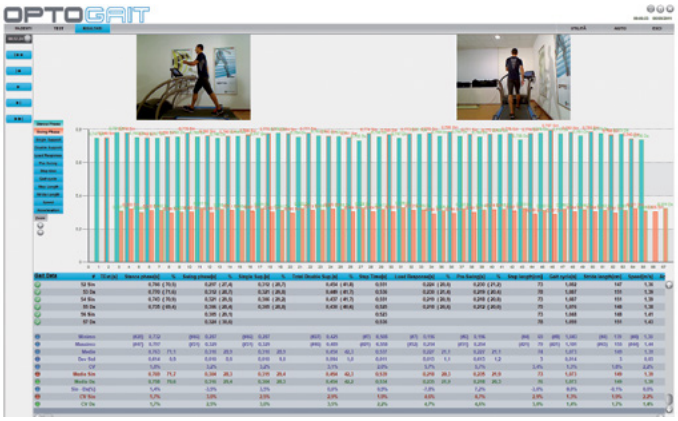
Results and Video Analysis

The tests carried out previously can be recalled at any moment accessing the Results area. Selecting a test and clicking on 'View', (numerical or graphical) data can be compared with the images. The video is of great help to the user to detect immediately postural or motor problems, and, more in general, to carry out a qualitative analysis. In fact, thanks to the 'video memory', possible anomalies of the numerical data can be easily identified and motivated.
The video images are synchronized with the data. This allows to verify with accuracy what has happened at the time of acquisition of a certain value (e.g. if a contact time is extremely long, it is possible to look for the cause viewing the images of the instant, when the value has been recorded). Synchronization is carried out automatically by the software; no user action is necessary. The video reproduction speed can be reduced down to a still image, to view the video frame-by-frame. A video analysis utility is also provided, with traditional tools such as lines, arches, circles, text, ruler, goniometer to measure angles and other.
In the Results section two or more tests can be compared ('Compare' option) using the video as well as the data, having all necessary information at dispostion. This allows to quickly and intuitively carry out an analysis of quantitative and qualitative differences between tests carried out at a different time (pre-/post- rehab, for example) or between different patients (healthy and rehab).
If more than two tests are to be compared, the 'History' function must be used, which allows to select an infinite number of tests to verify the parameters (indicated when a patient's progress must be measured constantly carrying out numerous tests).
All data, numerical and graphical, can be printed or exported to the most common formats.



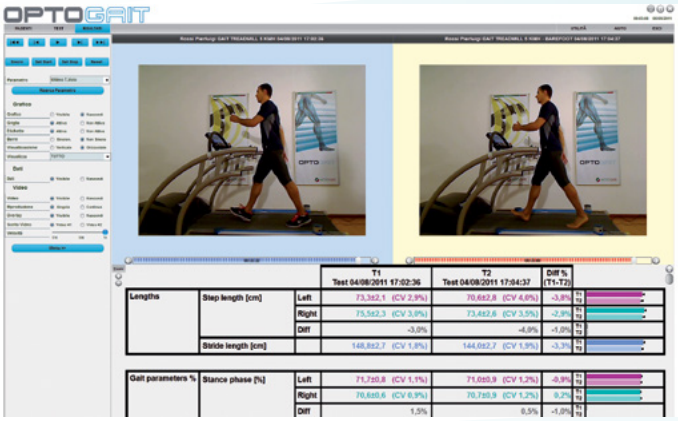


Evaluation of static postural analysis using pictures and videos in the MediaGallery can be managed via the Patients section.



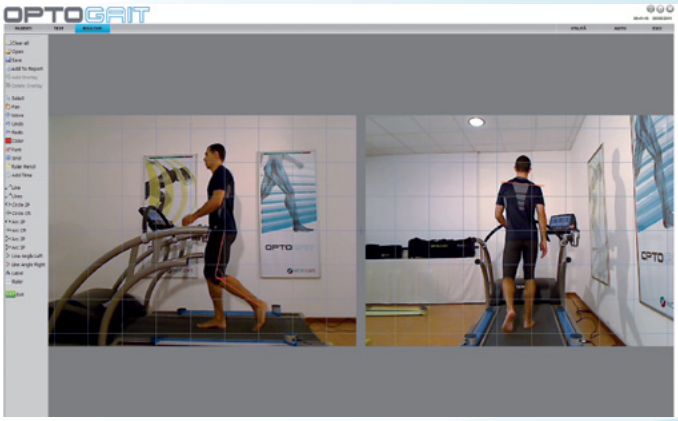
Viewing videos, graphs, and data during a Treadmill Gait Test

*Viewing increased-size videos, dynamical gait report and **Optogait** bar status in real-time*



Comparing two tests with compared Gait Report and videos (T1 = test with shoes, T2 = barefoot test)

History mode for analyzing the results of a series of tests

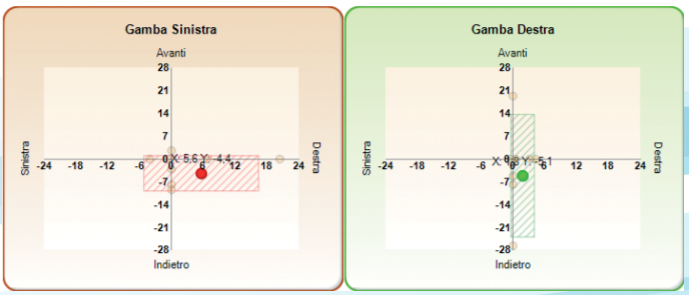


Video analysis of two synchronized still images with the possibility of adding graphical notes, as well as angle and length measurements

Report Drift Protocol >

Drift Protocol

	Sin	Dx	Delta%
Altezza media[cm]	29,8	29,7	0,4%
Potenza media[W/Kg]	29,12	29,60	-1,6%
Tempo di contatto medio[s]	0,341	0,334	2,1%
Tempo di volo medio[s]	0,493	0,492	0,2%
Media SINISTRA/DESTRA[cm]	5,6	1,8	67,6%
Media AVANTI/INDIETRO[cm]	-4,4	-5,1	-14,7%
Deviazione standard SINISTRA/DESTRA[cm]	10,8	2,2	79,8%
Deviazione standard AVANTI/INDIETRO[cm]	5,4	18,8	-249,4%
Area[cm^2]	234,0	165,3	29,4%



Report

After having carried out and saved a test, two reports are immediately available:

> Gait/Run report: specific report for gait or running tests, with average values, standard deviation and variability coefficient of all typical parameters (*) for the left and right leg. Furthermore, any possible asymmetries and imbalances between the legs can be spotted instantly.
The same report type is available when selecting two tests, allowing for a quick comparison thanks to a graphically intuitive and clear interface.
Gait/Run reports show also if the patient's parameters are within the normal range of values.

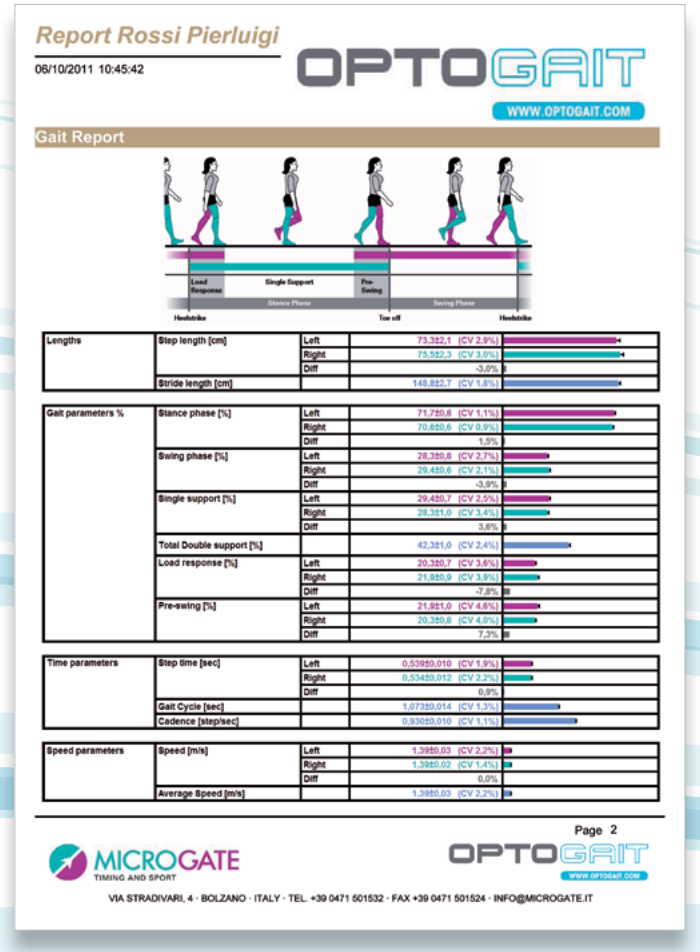
> Extended Report: contains all numerical and graphical data, stored step by step during the test.

In both report types it is possible to add screenshots taken with the video utility available in the 'View' option, as well as in the 'Compare' option.

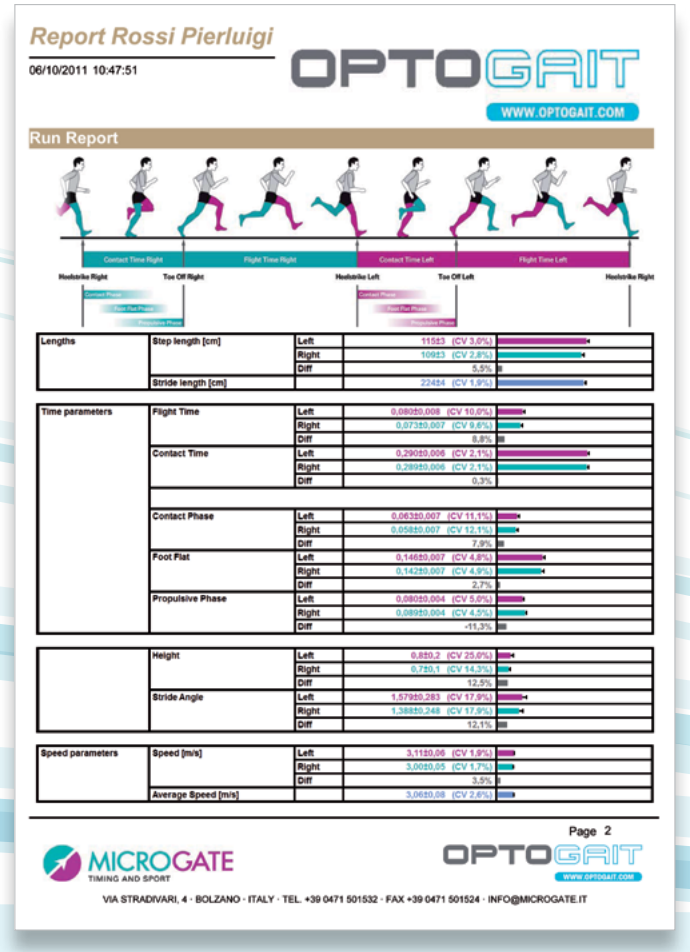
At present the software is available in 7 languages (Italian, English, German, French, Spanish, Japanese, Chinese) and more languages are to come.

(*): please refer to the table to check the parameters available for each test

Gait Report



Run Report



Data Table

Besides the below listed data, in each test average value, standard deviation, and variability coefficient are stated for each leg, where available. In this case, a difference between the two legs is shown in percentage.

	Gait/Run Test	Gait Test on Treadmill	Run Test on Treadmill	Jump Test	Tapping Test	Reaction Test
Stance Time	X	X				
Swing Time	X	X				
Step Time	X	X	X			
Gait Cycle	X	X				
Single Support	X	X				
Double Support	X	X	X			
Loading Response	X	X				
Pre-Swing	X	X				
Step Length	X	X	X			
Stride Length	X	X	X			
3 Foot Phases (Contact, Flat, Propulsive)	X	X	X			
Cadence/Rhythm/Pace	X	X	X	X	X	
Speed	X					
Acceleration	X					
Flight Time	X		X	X	X	X
Contact Time	X		X	X	X	
Height	X		X	X		X
Stride Angle	X		X			
Imbalance	X		X			
Specific Power				X		
Jumping Point				X		
Jumping Point Gap				X		
Used Area				X	X	
Cycle Time (Flight + Contact)					X	
Reaction Time						X

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