mTEST³

Basic functions

Version 1.0

SUMMARY

Intended Use

mGAIT, mTUG, and mSWAY are medical devices based on inertial systems for the kinematic analysis of movement. They are classified as medical device class I in accordance with the European Directive 93/42/CEE.

mGAIT, mTUG, and mSWAY must be used for the evaluation of spatio-temporal gait parameters, the kinematic of movement during the Timed Up and Go test, and the kinematic of body sway during quiet standing tests.

Devices must be used under supervised conditions and only by medical staff, healthcare professionals and paramedics.

This document is for illustrative purposes only and does not substitute the User Manuals of mGAIT. mTUG, and mSWAY; it only partially describes their functions and characteristics. Please read User Manuals before using the devices.

TECHNICAL SPECIFICATIONS

Motion Sensors

Size: 54 mm x 33 mm x 14 mm

Weight: 22 g

Inertial Sensors included:

- Triaxal Accelerometer (±2 / ±4 / ±8 / ±16 g).
- Triaxal Gyroscope (±250 / ±500 / ±1000 / ±2000 dps)
- Triaxal Magnetometer

Sampling frequency: 100-200Hz

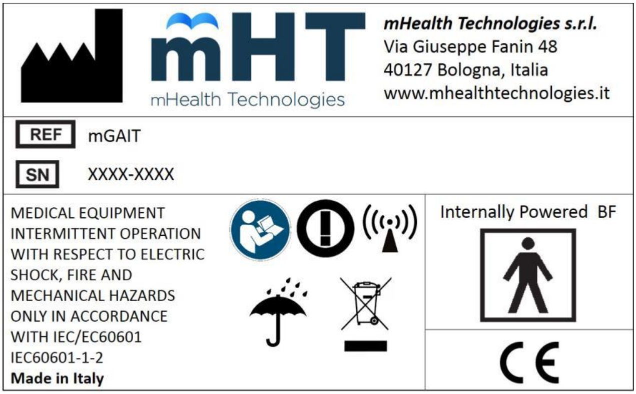
Bluetooth 2.1 class 1

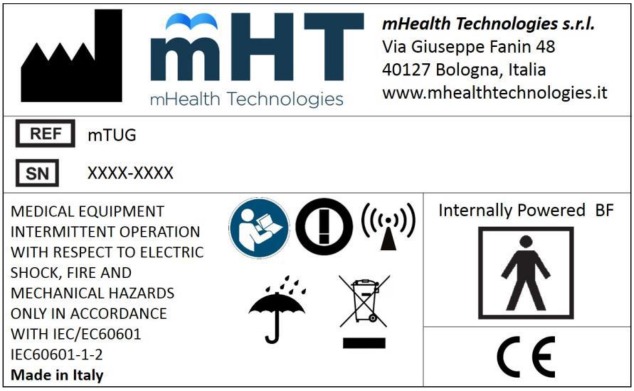
Status LED

Battery rechargeable through dedicated docking station

Charging time: 2h

LABELS


mHT
mHealth Technologies
mHealth Technologies s.r.l.
Via Giuseppe Fanin 48
40127 Bologna, Italia
www.mhealthtechnologies.it
REF
mGAIT
SN
XXXX-XXXX
MEDICAL EQUIPMENT
INTERMITTENT OPERATION
WITH RESPECT TO ELECTRIC
SHOCK, FIRE AND
MECHANICAL HAZARDS
ONLY IN ACCORDANCE
WITH IEC/EC60601
IEC60601-1-2
Made in Italy
Internally Powered BF
CE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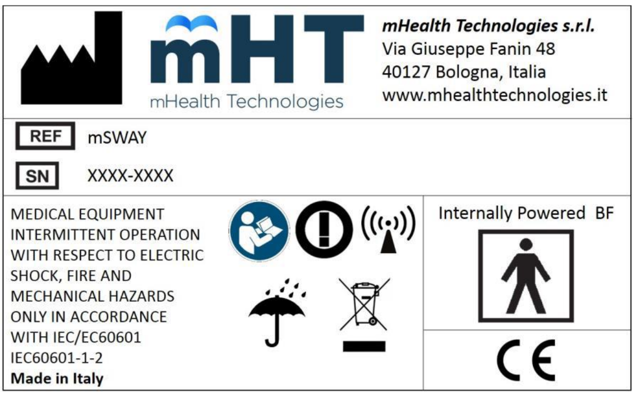
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IEC60601-1-2
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CE

Description of the product

mTEST^3 is a budle of three medical devices: mGAIT, mTUG, and mSWAY.

mGAIT is based on inertial systems for the evaluation of spatio-temporal gait parameters via two inertial sensors fastened on the users' shoes. Sensors are connected via Bluetooth to a Smartphone that is the control and processing unit.

During a session, mGAIT:

1. Registers the patient's gait pattern;
2. Processes the signals and makes a report on the spatio-temporal gait parameters.

mTUG is based on inertial systems for the analysis of kinematics of movement during the Timed Up and Go Test. It works by using an inertial sensor fixed to the patient's back by a belt. The sensor is connected via Bluetooth to a Smartphone that is the control and elaboration unit.

During a session, mTUG:

1. Registers the patient's movement
2. Processes the signals and makes a report on the kinematic analysis of the patient's movements during the test.

mSWAY is based on inertial systems for the analysis of kinematics of body sway during the quiet standing test. It works by using an inertial sensor fixed to the patient's back by a belt. The sensor is connected via Bluetooth to a Smartphone that is the control and elaboration unit.

During a session, mSWAY:

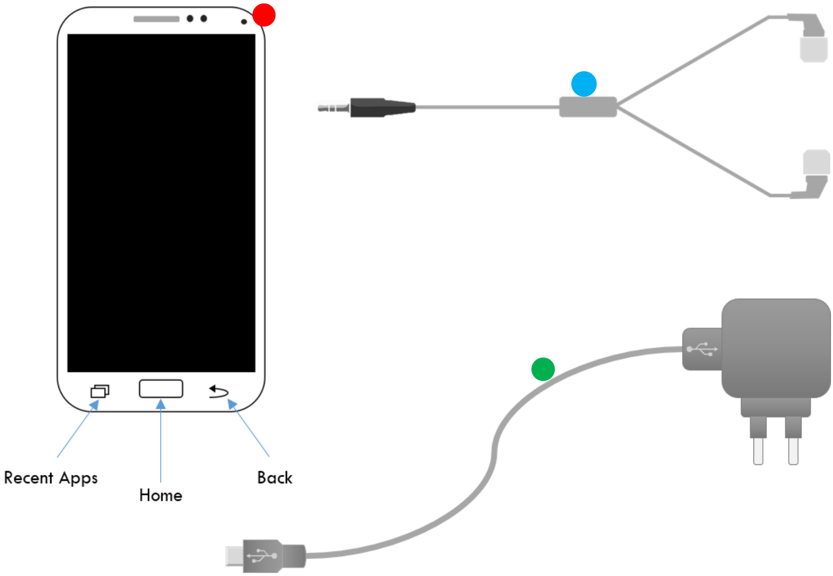
1. Registers the patient's movement
2. Processes the signals and makes a report on the kinematic analysis of the patient's movements during the test.

The apps on the Smartphone allow you to manage the three systems.

Package Contents

Smartphone and Accessories

The Smartphone and all accessories and documents are inside the mGAIT packaging.



Smartphone

Headphones

Smartphone Charger

MOTION SENSORS AND FASTENING ACCESSORIES

- Motion sensor for the left foot with shoe fastening kit;
- Waist belt for the smarphone;
- Motion sensor for the right foot with shoe fastening kit.

Motion Sensor for the trunk and waist fastening kit

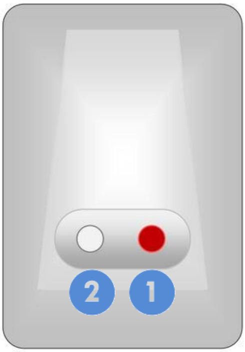
CHARGING ACCESSORIES FOR THE MOTION SENSORS

Docking station for the motion sensors;

Docking station charger.

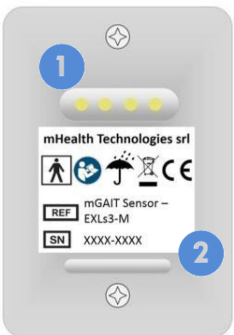
Motion Sensor

Front View of Motion Sensor:



1. Red Button to turn Sensor on and off
2. Led Status of the Sensor

Rear View of the Motion Sensor:



1. Connectors for charging the Sensor
2. Label with the Sensor serial number

WEARING THE SENSORS

The sensors are univocally assigned to a specific part of the body.

Front view of the motion sensors:

1 Left shoe sensor

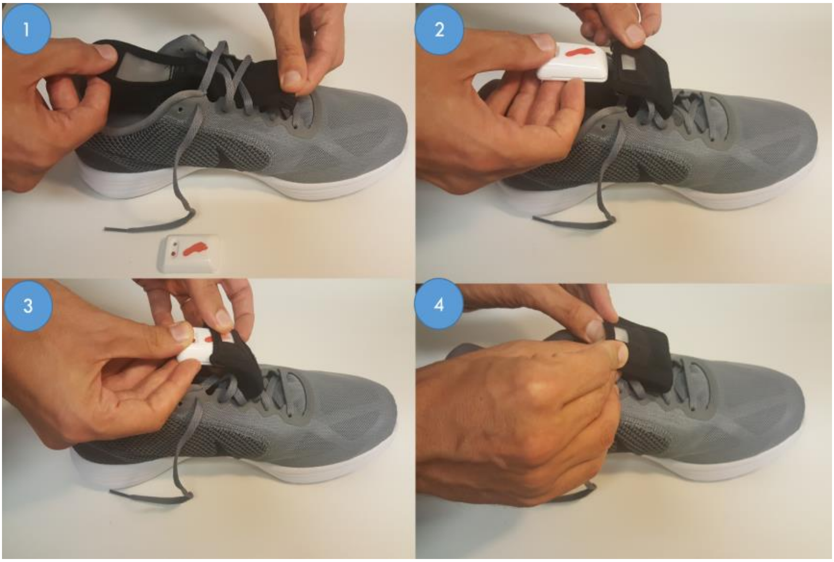
2 Right shoe sensor

3 Trunk sensor

The sensors for the shoes can be worn on any shoelace provided footwear on the market. However, running shoes/sneakers are recommended for an optimal system performance.

Wearing the sensors on shoes

1. Position the fastening case below the shoelaces as shown in figure;
2. Pull the side with the sensor opening towards the tip of the shoe;
3. Insert the sensor in the case;
4. Insert the sensor in its entirety;



5. Take the flap with the straps on it;
6. Strap the flap on the sensor;
7. Turn on the sensor by pushing the red button through the plastic panel;
8. When the status LED emits a still green light, the sensor is ready for use.

WEARING THE SENSOR ON THE TRUNK

1. Take the fastening band. Place it on the lumbar region as shown in the picture.

2. Take the end of the band and let it run through the buckle.

3. Make sure that the fastening band is correctly placed. The band has to be tight and comfortable to wear at the same time. Fasten the band with the Velcro part.

4. Make sure that the case with the sensor is placed in the forward position and at the centre of the back.

5. Put the sensor inside the case so that the buttons are visible through the transparent plastic window (so put sensor with the buttons pointing down).

6. Switch on the sensor by pushing the red button through the transparent plastic window.

7. Once the sensor is switched on, if the status led turns green it means that the sensor is ready.


mHT


mHT

WEARING THE SMARTPHONE ON THE WAIST

The sensors are connected to the smartphone via a Bluetooth connection; the assessor must keep the smartphone in a range of 10 meters in optimal conditions; a maximum distance of 4 meters is suggested. Especially when the walk test is performed over a long distance or for a long time, it is suggested that the smartphone is placed on the patient's waist by means of the waist belt provided in the package.

1. Take the waist belt. Position the belt around the waist as shown in figure;
2. Close the plastic clip;
3. Insert the smartphone in the case with the screen showcased through the plastic;
4. The case can be positioned anywhere around the waist; it is suggested to avoid the contact between the arms and the case.

Smartphone Apps

Apps connect to the motion sensors via Bluetooth, perform the signal processing, provide guidance for the assessment, and generate the reports.

Basic use of mGAIT

There are four basic applications of mGAIT for administering:

I. the 10-Meter Walk Test;
II. standardised time-based walk tests such as the 6 Minute Walk Test;
III. standardised distance-based walk tests such as the 400-Meter Walk Test;
IV. unstructured walk tests

As a representative example, the step-by-step procedure for administering an unstructured walk test is reported below.

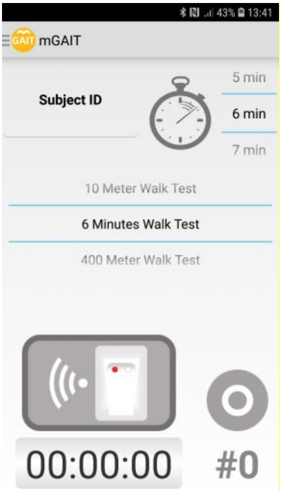
1. Make sure that the batteries of the smartphone and of the sensors are charged Identify a suitable place to administer the test;

2. Define and, where appropriate, mark your custom path;

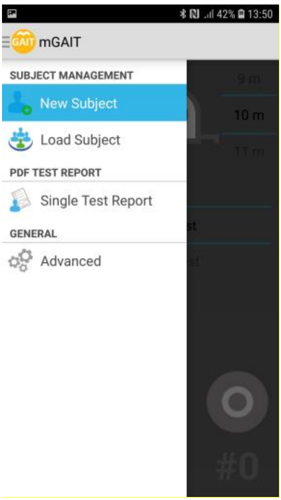
3. Turn on the smartphone. Once on, the mGAIT icon will appear in the foreground on the main screen;

4. Start the application pressing the mGAIT icon;

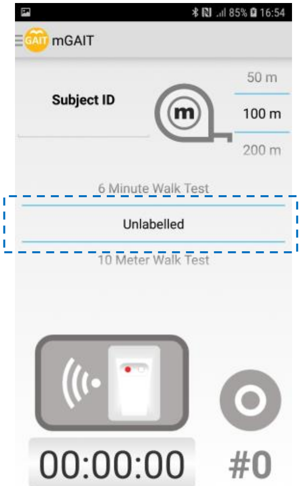
5. The application displays the main interface;



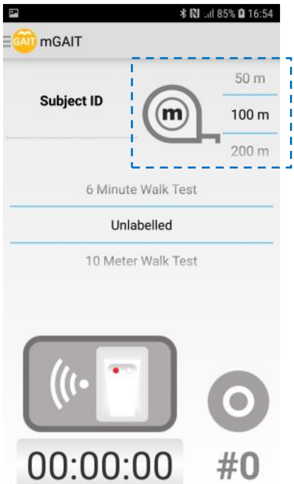
6. Insert the subject ID using the 'New Subject' function and select the desired profile. A profile is associated with a set of normative reference values. For not using any reference value keep the default option 'None';



7. Select the desired label from the list scrolling the label selector or keep the default label 'Unlabelled';

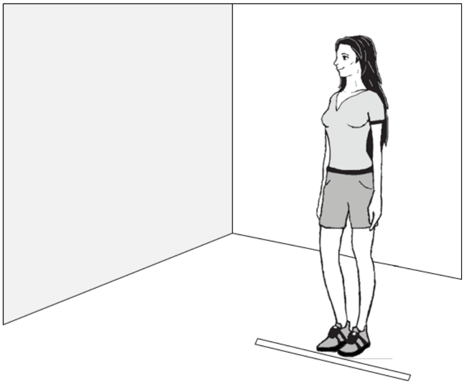


8. Select the desired time or distance of the walk test by scrolling the time selector or the distance selector. Touch the icon for switching between the pocket tape measure icon and the chronometer icon;



9. Have the subject wear the sensors on the shoes. Have the subject wear the waist belt;

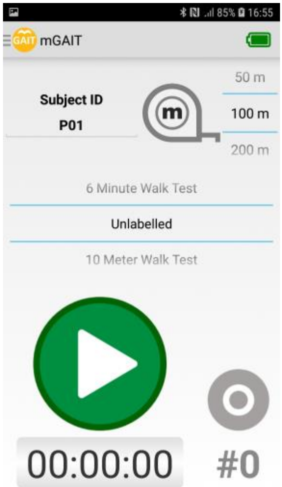
10. The subject must start the test with the feet on the edge of the starting line;



11. Instruct the subject that at the ‘go signal’ (the predefined signal is a ring), he/she must start walking and follow your instructions. If a time-based test is performed the subject will hear a stop signal at the end of the test (default signal is a ring). If a distance-based test is performed, you will need to tell the subject when/where to stop. The test can be performed at preferred walking speed or at the fastest possible speed;

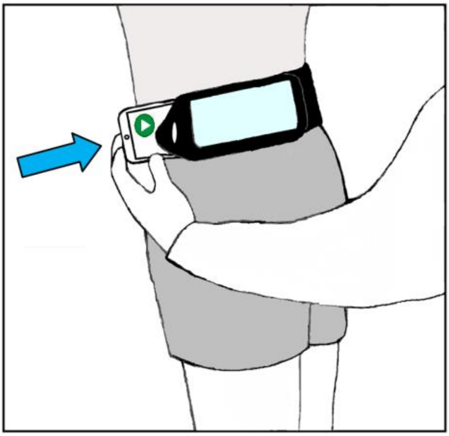
12. Turn the sensors on;

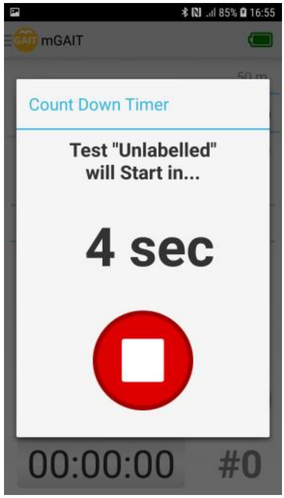
13. Press Connect on the main interface. Wait for the connection to the sensors. Once the sensors are connected, the control button becomes green;



14. The subject waits for the 'go signal' with the feet on the edge of the starting line;

15. Insert the smartphone inside the case. Press the green button to begin the test. This will open a dialogue window with a countdown clock that precedes the start of the test;

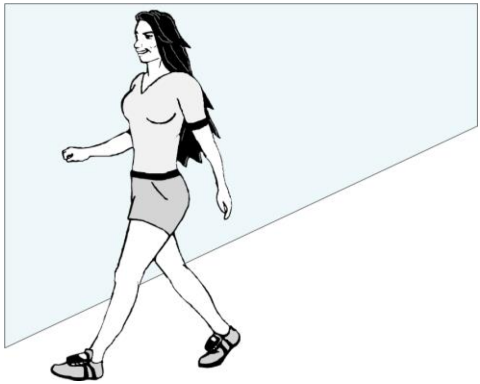




The countdown is preset to 5 seconds; it can be modified in the Advanced Menu on the lateral bar;

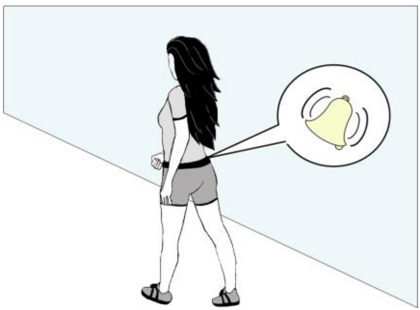
16. At the end of the countdown, the app provides the ‘go signal’ and the subject can perform the test. The ring is the predefined sound, but it may be changed through by selecting another audio file, including vocal recordings. The operator may also decide to not use any sound and simply provide a vocal instruction to start the test.

17. While the subject performs the test the system records the walking pattern;

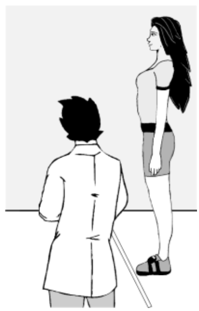


18. If a time-based test is performed, the subject walks till the stop audio signal. The predefined signal is the ring, to change or deactivate the automatic audio signal see the section Single Test Trigger. If a distance-based test is performed, the subject walks till the desired number of laps is completed and/or you will tell him/her when/where to stop. Ask the subject not to move before you press the stop button.

In Case of a time-based test



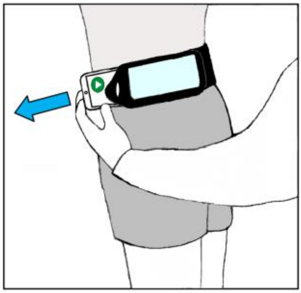
In case of a distance-based test



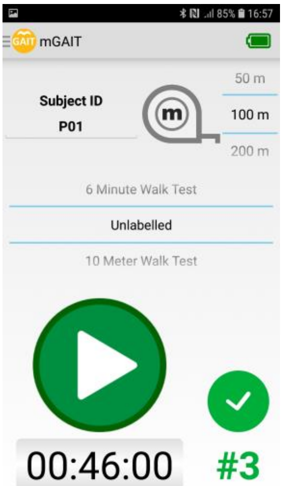
19. Press the stop button if a distance-based test has been performed. Take the smarphone out of the case;

In Case of a distance-based test

In case of both a distance-/time-based



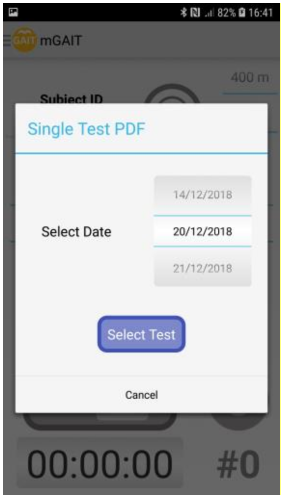
20. If the test was performed correctly, the validity of test indicator will become green;



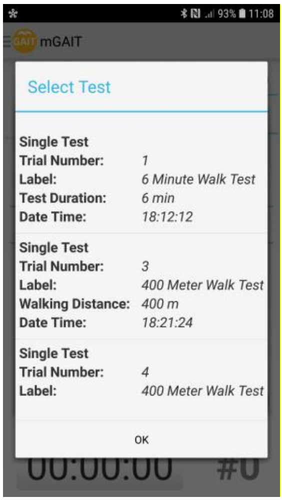
21. When the test is correctly performed, an output report is available in pdf format;

22. Access the lateral bar;

23. Press "Single Test Report";



24. Select the test. If more than one test was correctly performed by the same subject on the same day these will be selectable scrolling the list of available tests;



25. The report of the selected test will be displayed in pdf format and it will include the predefined set of parameters. The report in pdf format is structured as follows.

On the first page of the report the following information is reported:

- Clinical identification

- Subject ID
- Date and time of the test
- A space for notes
- The date of report creation
- A space for the operator's signature
- The label associated to the performed test
- The selected walking distance or test duration

Page 1 of 2

Gait Analysis

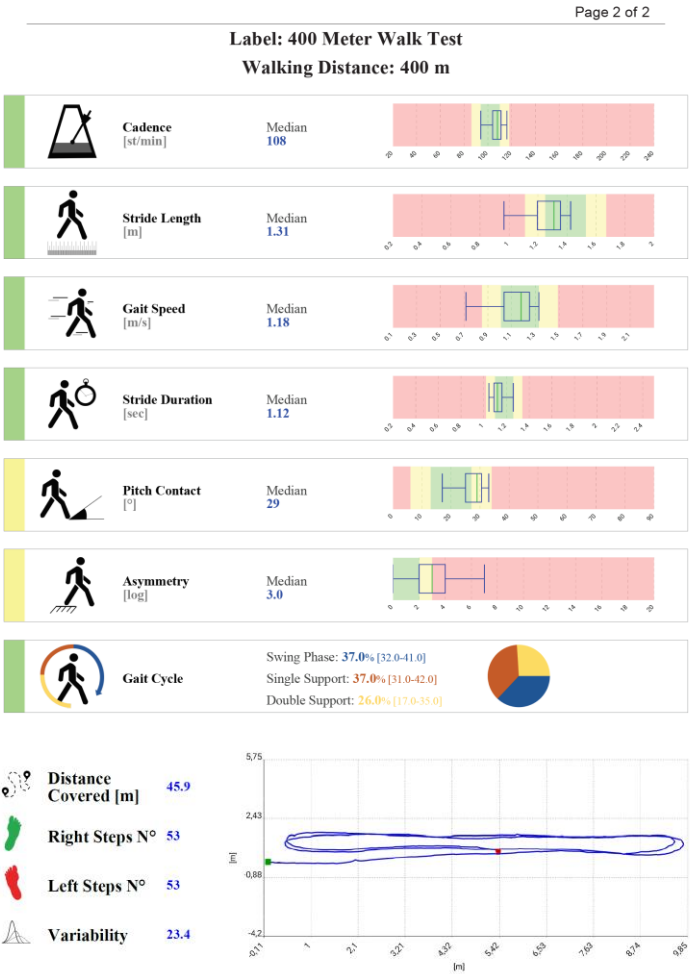
Report generated by Clinician:	**0**
Test performed by subject:	**P01**
Date and Time:	**28/1/2019 - 18:36:53**

Annotation

Date Tue Jan 29 19:03:16 GMT+01:00 2019

Clinician Signature

On the second page, if the Subject ID is associated with a specific set of reference values, the report will show the distributions of the Gait Parameters on a coloured background depending on the Normative Reference Values associated with the profile. If the central value of a parameter is in the green, yellow, or red area, the same color is also displayed on a lateral bar on the left edge of the report. An example is shown below. If the Subject ID is not associated with any Profile the report will show the distributions of the Gait Parameters on a white background.



BASIC USE OF MTUG

mTUG allows you to administer the Timed Up and Go test with a custom walking distance, from the standard 3 meters to 20 meters. The test is administered by means of the following step by step procedure.

1. Make sure that the batteries of the smartphone and of the sensor on the truk are charged

2. Choose the distance that the subject has to walk. The original clinic has a default distance of 3 metres and this is the default distance in the app.

3. Identify a suitable place to administer the test;

4. Mark the end of the distance to be walked (where the turn occurs) by a line on the floor (for instance using adhesive tape).

5. Turn on the smartphone. Once on, the mTUG icon will appear in the foreground on the main screen.

6. Start the application pressing the mTUG icon.

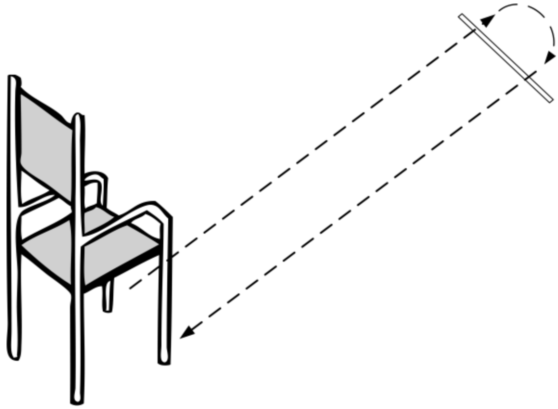
7. The application displays the main interface.

8. Insert the subject ID using the “New Subject” function (pressing the text box under the subject ID tag or accessing the lateral bar) and his weight.

9. Set the distance selected for the test.

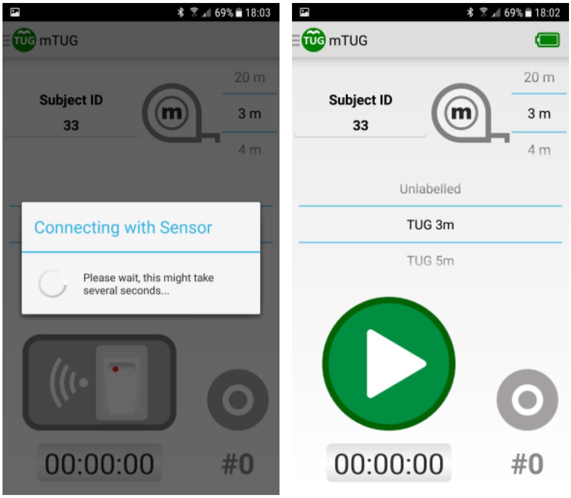
10. Have the subject wear the sensor.

11. Instruct the subject that, when he/she hears the sound signal (the predefined signal is a ring), he/she must rise from the seat, walk to the line on the floor, make a turn, and return to the chair to sit.

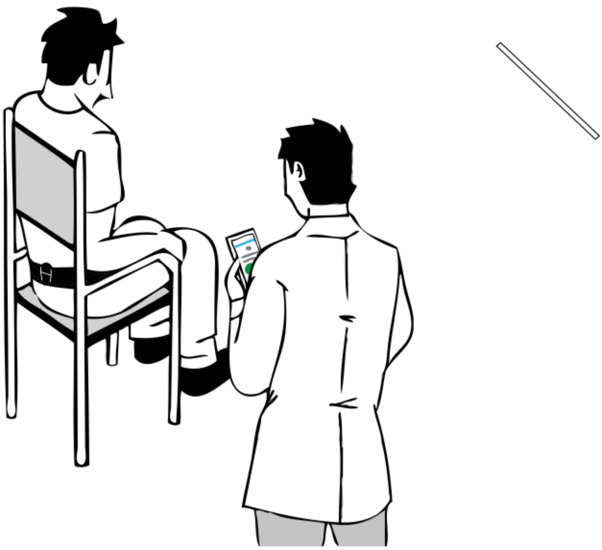


12. Turn the sensor on.

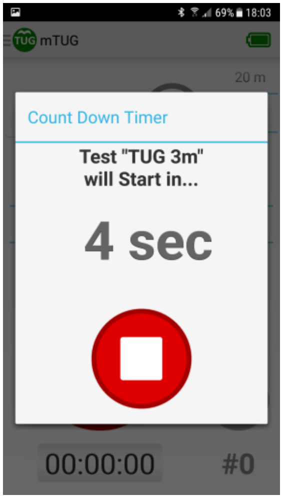
13. Press Connect on the main interface. Wait for the connection to the sensor. Once the sensor is connected, the control button becomes green.



14. The subject begins with his back leaned on the backrest, arms loose on the armrests.

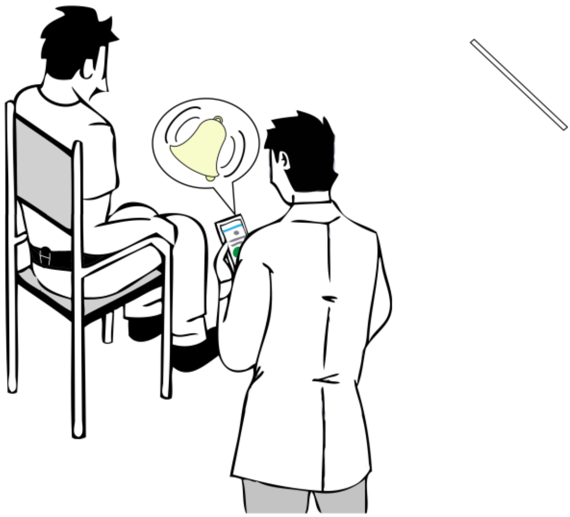


15. Press the green button to begin the test. This will open a dialogue window with a countdown clock that precedes the start of the test.

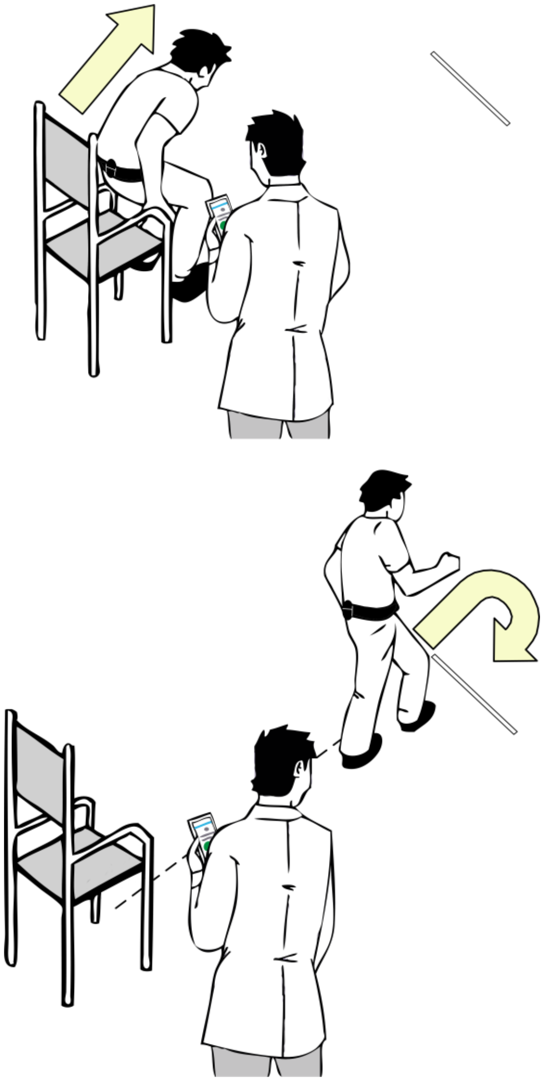


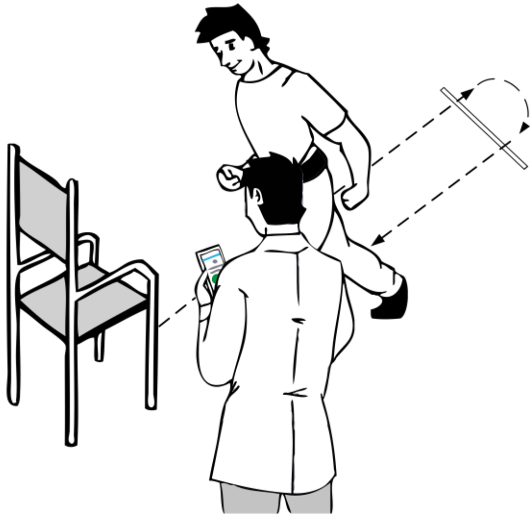
The countdown is preset to 5 seconds, which can be set based on preference in the options on the lateral bar (but not less than 5 seconds, in any case).

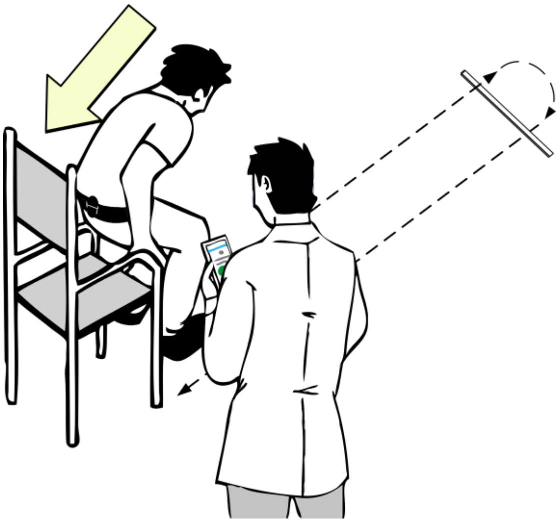
16. The app automatically provides the start sound signal and the subject can perform the test. The ring is the predefined sound, but it may be changed through by selecting another audio file, including vocal recordings. The operator may also decide to not use any sound and simply provide a vocal instruction to start the test.



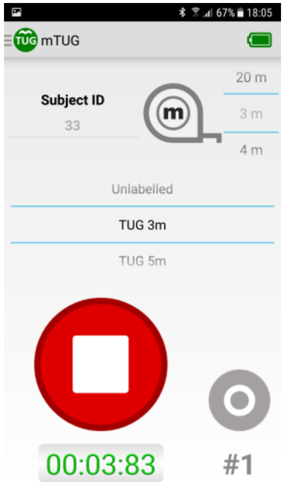
17. The subject performs the test.





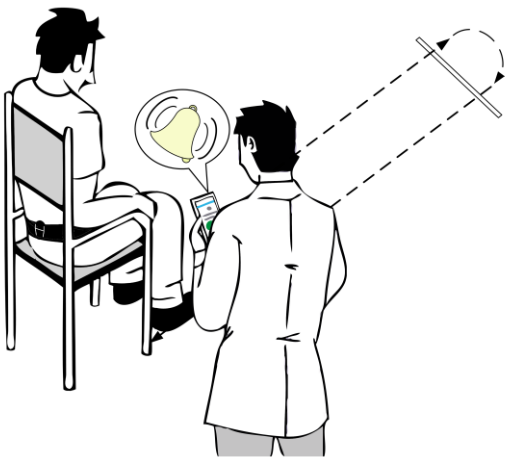


18. While the subject performs the test the system records the movements and shows the transpired time, as in the figure

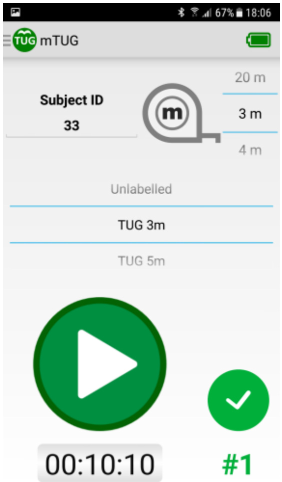


19. At the end of the test the subject must remain seated still for 3 consecutive seconds.

24. After these 3 seconds the app provides again the audio signal indicating that the test is over



25. If the test was performed correctly, the validity of test indicator will become green.



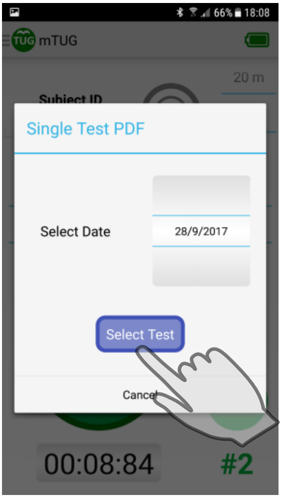
26. Test report will be available in pdf format.

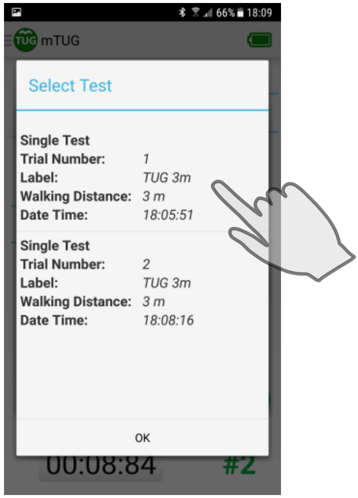
27. Access the lateral bar.

28. Press "Single Test Report".

29. Select the date and press *Select Test*.

30. Select the test. If many tests were performed correctly on the same subject in the same day these will be selectable scrolling the list of available tests.





31. The report of the selected test will be displayed in pdf format. It is structured as follows.

On the first page of the report the following information is reported:

- Clinical identification
- Subject ID
- Date and time of the test
- A space for notes
- The date of report creation
- A space for the operator's signature
- The label associated to the performed test
- The selected walking distance

Page 1 of 3

Timed Up and Go Test

Report generated by Clinician:	**0**
Test performed by subject:	**33**
Date and Time:	**11/5/2017 - 12:40:20**

Annotation

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Date Thu May 11 12:43:28 GMT+02:00 2017 *Clinician Signature*

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On the second page there is the chart with the values of the extracted features. The list of features to be included in the reports is defined by the user in the advanced settings.

Label: TUG 3m

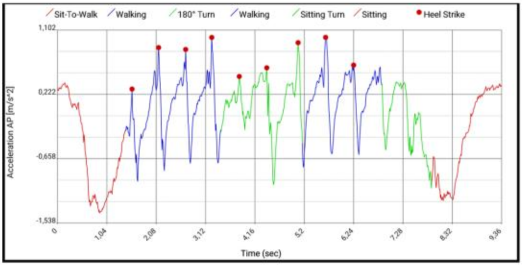
Walking Distance: 3 m

Parameter Name	Value
Total Duration [s]	**9.36**
Sit-to-Walk Duration [s]	**1.44**
180° Turn Duration [s]	**1.72**
Sitting Turn Duration [s]	**1.05**
Turn-to-Sit Duration [s]	**2.52**
Total Number of Steps	**9**
Mean Step Length [m]	**1.0**
Gait Speed [m/s]	**1.63**
Number of Steps in the 180° Turn	**3**
Standard Deviation of Step Duration [s]	**0.072**

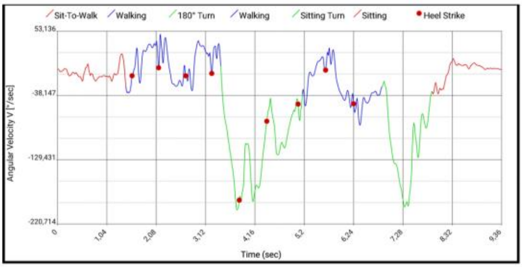
On the third page there are three diagrams that show three of the signals recorded by the inertial sensor with the indication of the phases that constitute the test. More specifically, the following diagrams are present:

- Acceleration of the torso on the Antero-posterior axis
- Angular velocity of the torso on the Vertical axis
- Angular velocity of the torso on the Medio-lateral axis

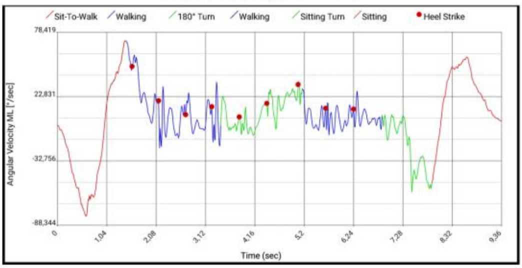
Antero-Posterior Acceleration



Vertical Angular Velocity



Medio-Lateral Angular Velocity

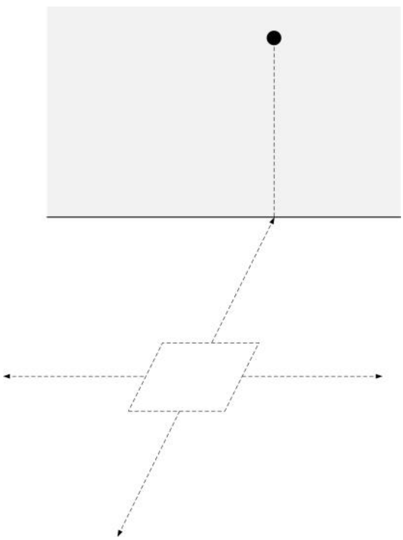


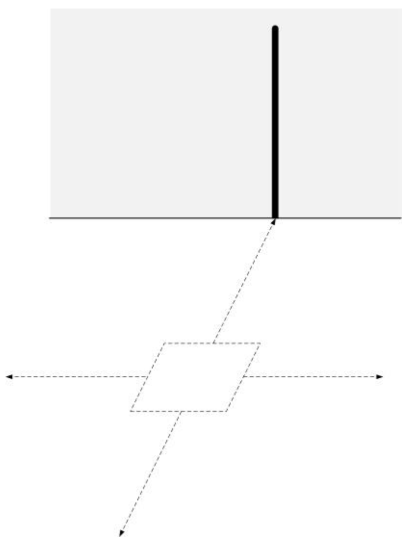
BASIC USE OF MSWAY

mSWAY allows you to perform a postural sway analysis in different conditions. The test is administered by means of the following step by step procedure.

1. Make sure that the batteries of the smartphone and of the sensor are charged Identify a suitable place to administer the test; a minimum distance of 1 m between the patient and the walls is recommended. The patient shall be kept as isolated as possible from external factors that may affect the assessment such as noise sources or the presence of other persons.

2. Once a suitable place has been identified, it is possible to place the visual target, which is used during the test in eyes open conditions, as shown in the figures below. There are two main types of recommended visual targets: the first option is a circular target with a diameter of 5 cm placed in front of the patient at eye level at a distance of 2-3 m; the other option is a vertical line, 2 m high and 5 cm thick, placed in front of the patient at a distance of 2-3 m.





3. Once the assessment environment is set up it is possible to define the test condition(s) for the patient. In general, it should be defined:

   a. Position(s) of the feet
   b. Position(s) of the arms
   c. With/without the use of sight
   d. With/without a foam pad
   e. With/without a secondary task (cognitive dual task)

Regarding the position of the feet, the following are the most common ones:

- feet together
- feet under the SIAS (Anterior Superior Iliac Spine)
- Tandem
- Semi-Tandem
- One leg stance

Regarding the position of the arms, the following are the two most common ones:

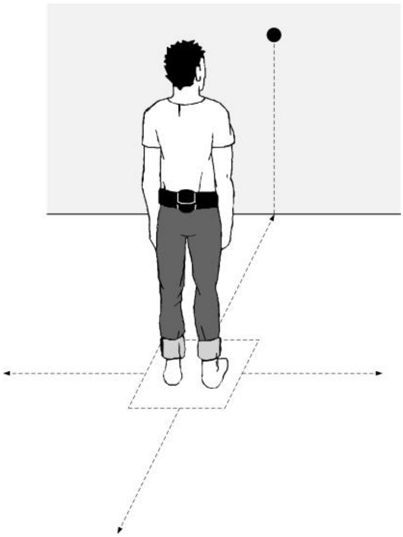
- Arms crossed over chest
- Arms at the side

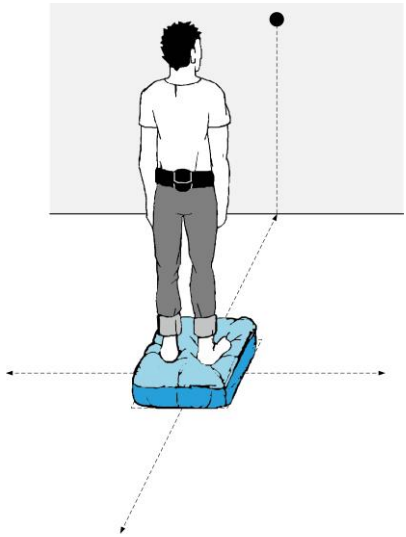
Regarding the sight, the following are the two most common conditions:

- Eyes open, with eyes fixed on the visual target
- Eyes closed, voluntarily or blindfolded

Assessment conditions must be standardised to ensure repeatability and comparability of the outcomes, but they remain at the discretion of the assessor.

A typical example is shown below. The subject stands with the feet under the SIAS, arms at the side, and with eyes open. On the left the subject is on a firm surface while on the right the subject is on a foam pad for increasing the difficulty.





4. The patient must hold the position autonomously, but the assessment has always to be carried out in safe conditions.

5. Turn on the smartphone. Once on, the mSWAY icon will appear in the foreground on the main screen.

6. Start the application pressing the mSWAY icon.

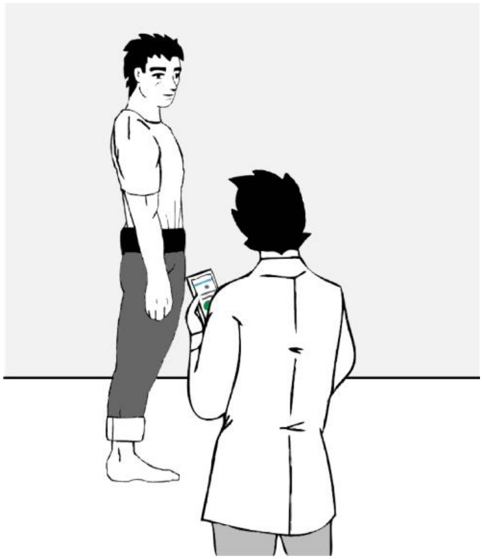
7. The application displays the main interface.

8. Insert the subject ID using the "New Subject" function (pressing the text box under the subject ID tag or accessing the lateral bar) and his weight[1].

9. Set the duration selected for the test.

10. Have the subject wear the sensor.

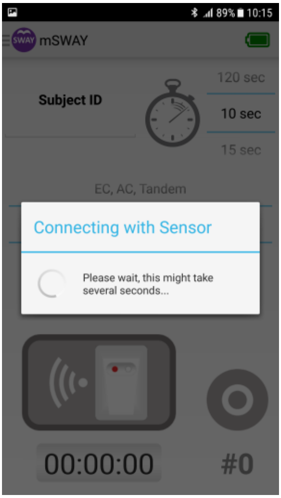
11. Instruct the subject that when he/she hears the audio signal he/she must hold the position for the predetermined time period. In the example below the patient is asked to stand with the feet under the SIAS, arms at the side, and with eyes open looking at the visual target in front of him.

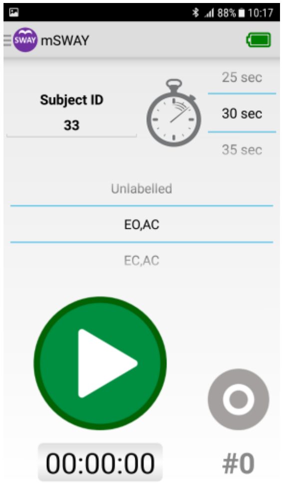


12. Turn the sensor on.

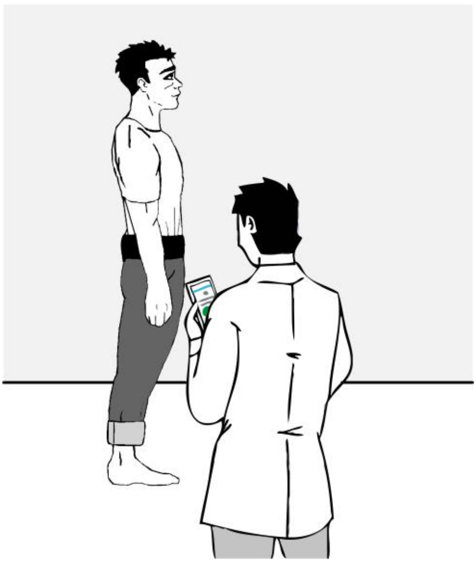
13. Press Connect on the main interface. Wait for the connection to the sensor. Once the sensor is connected, the control button becomes green.

[1] the weight is used to calculate specific parameters

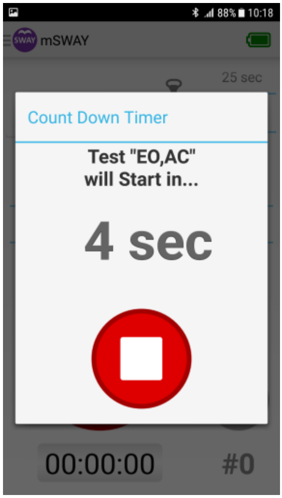




14. The subject takes on the predetermined position and waits for the sound signal.

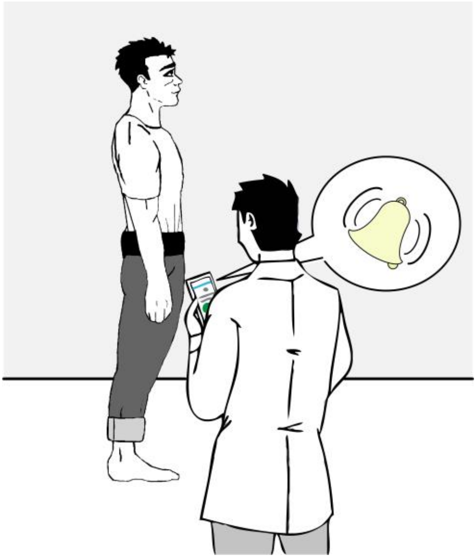


15. Press the green button to begin the test. This will open a dialogue window with a countdown clock that precedes the start of the test.

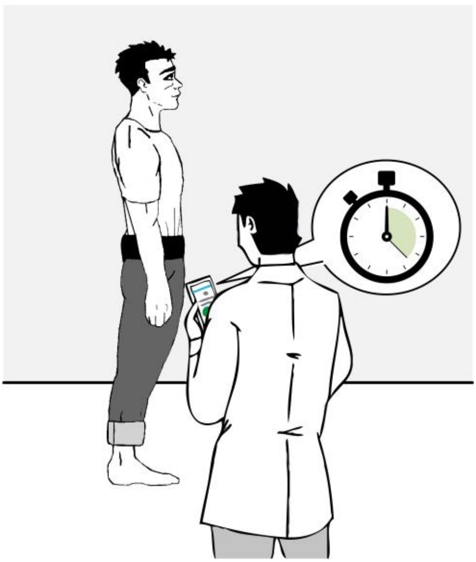


The countdown is preset to 5 seconds, which can be set based on preference in the options on the lateral bar (but not less than 5 seconds, in any case).

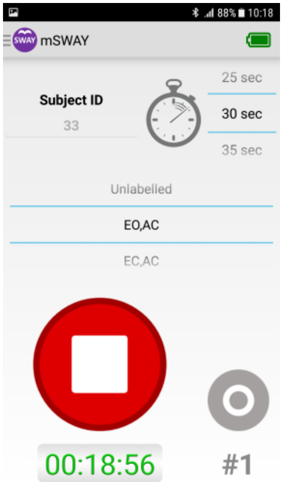
16. The app automatically provides the start sound signal and the subject can perform the test. The ring is the predefined sound, but it may be changed through by selecting another audio file, including vocal recordings. The operator may also decide to not use any sound and simply provide a vocal instruction to start the test.



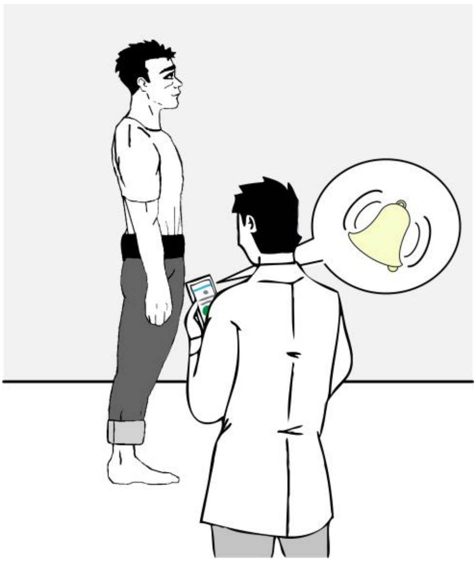
17. The subject holds position during the test.



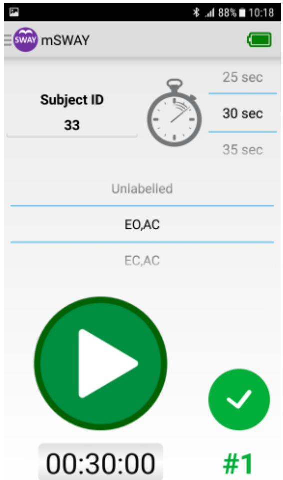
18. While the subject performs the test the system records the movements and shows the elapsed time, as in the figure



19. The app provides the audio signal at the end of test.



20. If the test was performed correctly, the validity of test indicator will become green.



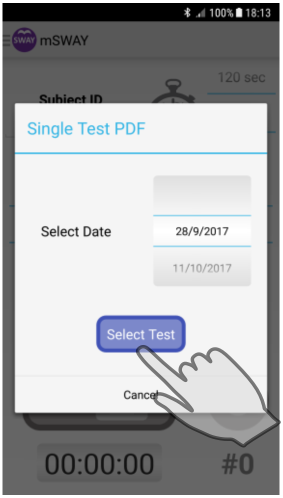
21. When the test is correctly performed, an output report is available in pdf format.

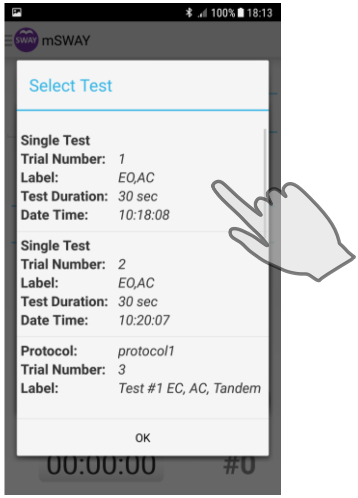
22. Access the lateral bar.

23. Press “Single Test Report”.

24. Select the date and press *Select Test*. If no dates are available, it means that no test was correctly performed.

25. Select the test. If more than one test was correctly performed by the same subject on the same day these will be selectable scrolling the list of available tests.





26. The report of the selected test will be displayed in pdf format. The format of the report is reported below.

On the first page of the report the following information is reported:

- Clinical identification
- Subject ID
- Date and time of the test
- A space for notes
- The date of report creation
- A space for the operator's signature
- The label associated to the performed test
- The selected test duration

Page 1 of 2

Postural Sway Test

Report generated by Clinician:	**0**
Test performed by subject:	**33**
Date and Time:	**23/8/2017 - 19:09:54**

Annotation

Date Wed Aug 23 19:16:37 GMT+02:00 2017 _Clinician Signature_

On the second page there is the chart with the values of the extracted features. The list of features to be included in the reports is defined by the user in the advanced settings.

Page 2 of 2

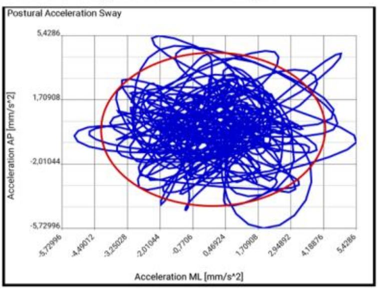
Label: EO, AS

Test Duration: 30 sec

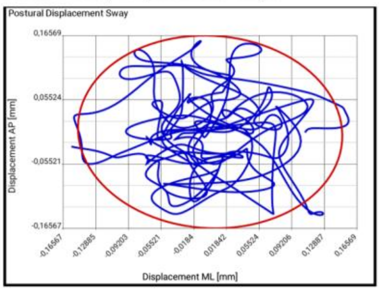
Parameter Name	Value
Root Mean Square of the displacement along the AP axis [mm]	**0.068**
Root Mean Square of the displacement along the ML axis [mm]	**0.061**
Sway Path of the displacement along the AP axis [mm]	**4.506**
Sway Path of the displacement along the ML axis [mm]	**4.458**
Sway Path of the displacement on the horizontal plane [mm]	**7.086**
Sway Area [mm^2/s]	**0.006**
95% confidence interval ellipse area [mm^2]	**0.078**
Mean Sway Velocity along the AP axis [mm/s]	**0.125**
Mean Sway Velocity along the ML axis [mm/s]	**0.132**

Moreover, on the second page two diagrams show the postural sway acceleration graph on the horizontal plane and the postural displacement graph on the horizontal plane. The 95% confidence ellipse for each diagram is also shown.

Postural Sway Acceleration Graph



Postural Sway Displacement Graph

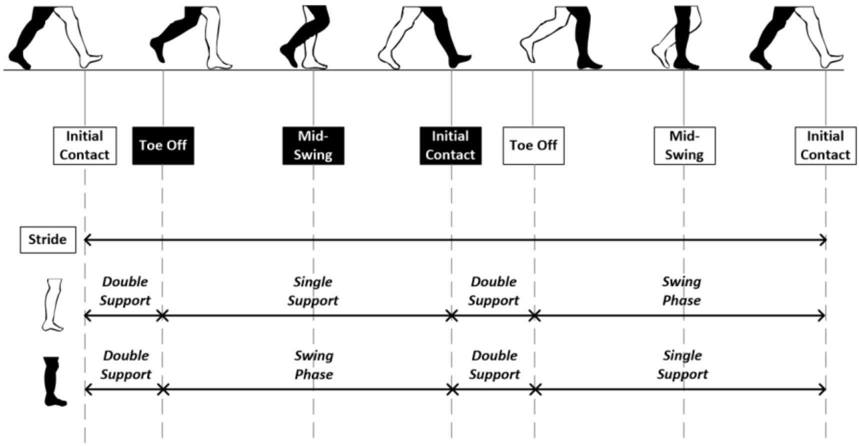


STORED DATA

At the end of each session, mGAIT, mTUG, and mSWAY automatically store files containin detailed information on motor performance in the smartphone's internal memory.

For each single test there is a pdf report and all the extracted features are saved in an open format such as CSV and JSON. Raw inertial signals for each test are also saved in an open TXT format

GAIT PARAMETERS IN MGAIT

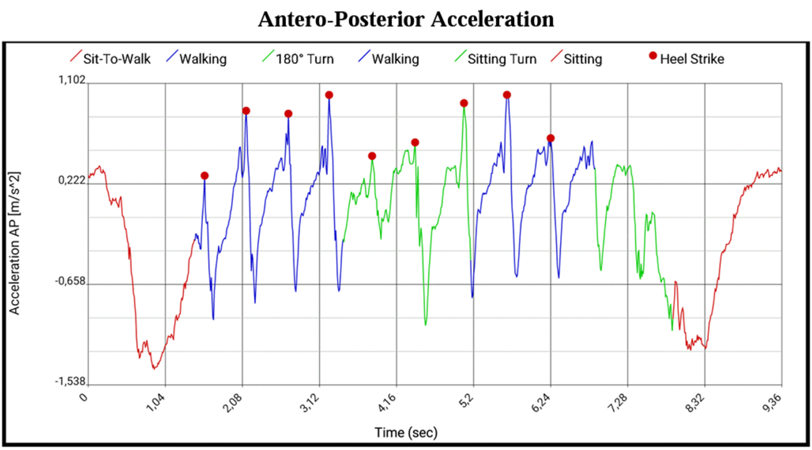


Name [unit of measurement]	Description
Cadence [steps/min]	Number of steps per minute
Stride length [m]	Distance travelled by the foot between two consecutive initial contacts of the same foot
Stride duration [s]	Time elapsed between two consecutive initial contacts of the same foot
Swing duration [s]	Time elapsed between the toe off and the subsequent initial contact of the same foot
Gait Speed [m/s]	Ratio between stride length and stride duration
Asymmetry [%]	Difference in stride velocity between left and right side

Pitch Contact [°]	Foot pitch angle at the initial contact
Swing Phase [%]	The amount of time the foot is in the air expressed as a percentage of the gait cycle
Single Support [%]	The amount of time the foot is on the ground and the contralateral foot is in the air expressed as a percentage of the gait cycle
Double Support [%]	The amount of time the both feet are on the ground expressed as a percentage of the gait cycle
Variability [s]	Standard deviation of the Stride duration

FEATURES EXTRACED FROM THE TIMED UP AND GO TEST IN MTUG

The figure below shows the automatic segmentation of the TUG.



The following phases are considered in the extraction of the parameters:

Sit-to-Walk. Rise from the seat: from the moment the subject begins to rise from the seat to when the subject is upright (see figure, initial part shown in red).

Walk. Union of walking segments, shown in blue in the figure.

180° Turn. Turn at the end of the first walking segment (shown in green, at the center of the diagram).

Sitting-Turn. Turn performed by the subject to sit down (in green, second-to-last segment in the diagram)

Turn-to-Sit. The union of two segments of the diagram: Sitting Turn (in green, second-to-last segment in the diagram) and Sitting (in red, last segment in the diagram). It is therefore the period that begins when the subject begins performing a turn to sit and ends when the subject is in a seated position.

The definitions of Step and Stride are underscored:

- (Step): movement that begins by leaning the foot and ends by resting the foot contralaterally.
- (Stride): movement that begins by leaning the foot and ends by resting the same foot.

PREDEFINED PARAMETERS (DEFAULT)

Name	Description
Total Duration [s]	Total duration of the test. This value is the standard output of the Timed Up and Go test. Using mTUG this value is automatically measured by the signal recorded by the wearable sensor using a validated algorithm [1], [2]. Instead, in the traditional Timed Up and Go this value is measured by the healthcare professional using a stopwatch. [3].
Sit-to-Walk Duration [s]	Duration of the initial phase: from the moment the subject rises from the seat to the moment the subject is upright and begins to walk. [2].
180° Turn Duration [s]	Duration of the 180 degree turn performed by the subject after having traveled the indicated distance [2].
Sitting Turn Duration [s]	Duration of the turn performed by the subject in order to sit.
Turn-to-Sit Duration [s]	Duration of the Turn-to-Sit phase: from when the subject begins to perform a turn to sit to when the subject is seated.
Total Number of Steps	Total number of steps performed during the Timed Up and Go test.

Mean Step Length [m]	Mean length of steps (ratio of traveled distance to number of steps)
Gait Speed [m/s]	Gait speed (ratio of distance traveled to time elapsed during walking phase)
Number of Steps in the 180° Turn	Number of steps during the 180 degree turn
Standard Deviation of Step Duration [s]	Standard deviation of duration of the step [1], [2]

ADVANCED PARAMETERS

Name	Description
Range of the Antero-Posterior Acceleration during Sit-to-Walk [m/s²]	Range (difference between maximum and minimum values) of the acceleration signal during the Sit-to-Walk phase in the antero-posterior direction.
Range of the Medio-Lateral Acceleration during Sit-to-Walk [m/s²]	Range (difference between maximum and minimum values) of the acceleration signal during the Sit-to-Walk phase in the medio-lateral direction.
Range of the Vertical Acceleration during Sit-to-Walk [m/s²]	Range (difference between maximum and minimum values) of the acceleration signal during the Sit-to-Walk phase in the vertical direction.
Root Mean Square of the Antero-Posterior Acceleration during Sit-to-Walk [m/s²]	Root Mean Square (RMS) of the acceleration signal during the Sit-to-Walk phase in the antero-posterior direction: $$RMS = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(s(i))^2}$$ where s is the signal of acceleration in the relevant direction.
Root Mean Square of the Medio-Lateral Acceleration	Root Mean Square (RMS) of the acceleration signal during

during Sit-to-Walk [m/s²]	the Sit-to-Walk phase in the medio-lateral direction: $$RMS = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(s(i))^2}$$ where *s* is the signal of acceleration in the relevant direction.
Root Mean Square of the Vertical Acceleration during Sit-to-Walk [m/s²]	Root Mean Square (RMS) of the acceleration signal during the Sit-to-Walk phase in the vertical direction: $$RMS = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(s(i))^2}$$ where *s* is the signal of acceleration in the relevant direction.
Time-Normalized Jerk Score of the Antero-Posterior Acceleration during Sit-to-Walk [m]	Index of Jerk normalized by the movement during the Sit-to-Walk phase in the antero-posteriore direction: $$tNJS = \sqrt{\frac{T^5}{2}\int_{Tstart}^{Tend}(\dot{a})^2\,dt}$$ where T is the duration of the movement (T_{end}-T_{start}) and $\dot{a}$ is the derivative of acceleration in the relevant direction. [2], [4]
Time-Normalized Jerk Score of the Medio-Lateral Acceleration during Sit-to-Walk [m]	Index of Jerk normalized by the movement during the Sit-to-Walk phase in the medio-lateral direction: $$tNJS = \sqrt{\frac{T^5}{2}\int_{Tstart}^{Tend}(\dot{a})^2\,dt}$$ where T is the duration of the movement (T_{end}-T_{start}) and $\dot{a}$ is the derivative of acceleration in the relevant direction. [2], [4]
Time-Normalized Jerk Score of the Vertical	Index of Jerk normalized by the movement during the Sit-

Acceleration during Sit-to-Walk [m]	to-Walk phase in the vertical direction: $$tNJS = \sqrt{\frac{T^5}{2}\int_{Tstart}^{Tend}(\dot{a})^2\,dt}$$ where T is the duration of the movement (T_{end}-T_{start}) and $\dot{a}$ is the derivative of acceleration in the relevant direction. [2], [4]
Range of the Antero-Posterior Angular Velocity during Sit-to-Walk [°/s]	Range (difference between maximum and minimum values) of the angular velocity signal around the antero-posterior axis during the Sit-to-Walk phase.
Range of the Medio-Lateral Angular Velocity during Sit-to-Walk [°/s]	Range (difference between maximum and minimum values) of the angular velocity signal around the medio-lateral axis during the Sit-to-Walk phase.
Range of the Vertical Angular Velocity during Sit-to-Walk [°/s]	Range (difference between maximum and minimum values) of the angular velocity signal around the vertical axis during the Sit-to-Walk phase.
Root Mean Square of the Antero-Posterior Angular Velocity during Sit-to-Walk [°/s]	Root Mean Square (RMS) of the angular velocity signal around the antero-posterior axis during the Sit-to-Walk phase: $$RMS = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(s(i))^2}$$ where *s* is the signal of angular velocity in the relevant direction.
Root Mean Square of the Medio-Lateral Angular Velocity during Sit-to-Walk [°/s]	Root Mean Square (RMS) of the angular velocity signal around the medio-lateral axis during the Sit-to-Walk phase: $$RMS = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(s(i))^2}$$ where *s* is the signal of angular velocity in the relevant

	direction.
Root Mean Square of the Vertical Angular Velocity during Sit-to-Walk [°/s]	Root Mean Square (RMS) of the angular velocity signal around the vertical axis during the Sit-to-Walk phase: $$RMS = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(s(i))^2}$$ where *s* is the signal of angular velocity in the relevant direction.
Normalized Jerk Score of the Antero-Posterior Angular Velocity during Sit-to-Walk	Index of Jerk normalized by the antero-posterior axis during the Sit-to-Walk phase: $$NJS = \sqrt{\frac{T^5}{2TA^2}\int_{Tstart}^{Tend}(\ddot{\omega})^2 dt} \quad TA = \int_{Tstart}^{Tend}\omega dt$$ where T is the duration of the movement (T_{end}-T_{start}), ω is the angular velocity around the relevant axis and TA is the angle traveled [4].
Normalized Jerk Score of the Medio-Lateral Angular Velocity during Sit-to-Walk	Index of Jerk normalized by the medio-lateral axis during the Sit-to-Walk phase: $$NJS = \sqrt{\frac{T^5}{2TA^2}\int_{Tstart}^{Tend}(\ddot{\omega})^2 dt} \;; \quad TA = \int_{Tstart}^{Tend}\omega dt$$ where T is the duration of the movement (T_{end}-T_{start}), ω is the angular velocity around the relevant axis and TA is the angle traveled [4].
Normalized Jerk Score of the Vertical Angular Velocity during Sit-to-Walk	Index of Jerk normalized by the vertical axis during the Sit-to-Walk phase: $$NJS = \sqrt{\frac{T^5}{2TA^2}\int_{Tstart}^{Tend}(\ddot{\omega})^2 dt} \;; \quad TA = \int_{Tstart}^{Tend}\omega dt$$ where T is the duration of the movement (T_{end}-T_{start}), ω is the angular velocity around the relevant axis and TA is

	the angle traveled [4].
Power of the Vertical Push Off during Sit-to-Walk [Nm]	Power applied to lifting the center of gravity of the body during the movement of rising from seat; the power is estimated starting with the vertical acceleration of the center of gravity [5].
Range of the Antero-Posterior Acceleration during Turn-to-Sit [m/s^2]	Range (difference between maximum and minimum values) of the acceleration signal during the Turn-to-Sit phase in the antero-posterior direction.
Range of the Medio-Lateral Acceleration during Turn-to-Sit [m/s^2]	Range (difference between maximum and minimum values) of the acceleration signal during the Turn-to-Sit phase in the medio-lateral direction.
Range of the Vertical Acceleration during Turn-to-Sit [m/s^2]	Range (difference between maximum and minimum values) of the acceleration signal during the Turn-to-Sit phase in the vertical direction.
Root Mean Square of the Antero-Posterior Acceleration during Turn-to-Sit [m/s^2]	Root Mean Square (RMS) of the acceleration signal during the Turn-to-Sit phase in the antero-posterior direction: $$RMS = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(s(i))^2}$$ where *s* is the signal of acceleration in the relevant direction.
Root Mean Square of the Medio-Lateral Acceleration during Turn-to-Sit [m/s^2]	Root Mean Square (RMS) of the acceleration signal during the Turn-to-Sit phase in the medio-lateral direction: $$RMS = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(s(i))^2}$$ where *s* is the signal of acceleration in the relevant direction.
Root Mean Square of the Vertical Acceleration during Turn-to-Sit [m/s^2]	Root Mean Square (RMS) of the acceleration signal during the Turn-to-Sit phase in the vertical direction:

	$$RMS = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(s(i))^2}$$ where s is the signal of acceleration in the relevant direction.
Time-Normalized Jerk Score of the Antero-Posterior Acceleration during Turn-to-Sit [m]	Index of Jerk normalized to the duration of movement during the Turn-to-Sit phase in the antero-posterior direction: $$tNJS = \sqrt{\frac{T^5}{2}\int_{Tstart}^{Tend}(\dot{a})^2 dt}$$ where T is the duration of the movement (T_{end}-T_{start}) and $\dot{a}$ is the derivative of acceleration in the relevant direction. [2], [4]
Time-Normalized Jerk Score of the Medio-Lateral Acceleration during Turn-to-Sit [m]	Index of Jerk normalized to the duration of movement during the Turn-to-Sit phase in the medio-lateral direction: $$tNJS = \sqrt{\frac{T^5}{2}\int_{Tstart}^{Tend}(\dot{a})^2 dt}$$ where T is the duration of the movement (T_{end}-T_{start}) and $\dot{a}$ is the derivative of acceleration in the relevant direction. [2], [4]
Time-Normalized Jerk Score of the Vertical Acceleration during Turn-to-Sit [m]	Index of Jerk normalized to the duration of movement during the Turn-to-Sit phase in the vertical direction: $$tNJS = \sqrt{\frac{T^5}{2}\int_{Tstart}^{Tend}(\dot{a})^2 dt}$$ where T is the duration of the movement (T_{end}-T_{start}) and $\dot{a}$ is the derivative of acceleration in the relevant direction. [2], [4]
Range of the Antero-	Range (difference between maximum and minimum

Posterior Angular Velocity during Turn-to-Sit [°/s]	values) of the angular velocity signal around the antero-posterior axis during the Turn-to-Sit phase.
Range of the Medio-Lateral Angular Velocity during Turn-to-Sit [°/s]	Range (difference between maximum and minimum values) of the angular velocity signal around the medio-lateral axis during the Turn-to-Sit phase.
Range of the Vertical Angular Velocity during Turn-to-Sit [°/s]	Range (difference between maximum and minimum values) of the angular velocity signal around the vertical axis during the Turn-to-Sit phase.
Root Mean Square of the Antero-Posterior Angular Velocity during Turn-to-Sit [°/s]	Root Mean Square (RMS) of the angular velocity signal around the antero-posterior axis during the Turn-to-Sit phase: $RMS = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(s(i))^2}$ where s is the angular velocity signal in the relevant direction.
Root Mean Square of the Medio-Lateral Angular Velocity during Turn-to-Sit [°/s]	Root Mean Square (RMS) of the angular velocity signal around the medio-lateral axis during the Turn-to-Sit phase: $RMS = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(s(i))^2}$ where s is the angular velocity signal in the relevant direction.
Root Mean Square of the Vertical Angular Velocity during Turn-to-Sit [°/s]	Root Mean Square (RMS) of the angular velocity signal around the vertical axis during the Turn-to-Sit phase: $RMS = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(s(i))^2}$ where s is the angular velocity signal in the relevant direction.

Normalized Jerk Score of the Antero-Posterior Angular Velocity during Turn-to-Sit	Normalized index of angular Jerk of the antero-posterior axis during the Turn-to-Sit phase: $$NJS = \sqrt{\frac{T^5}{2TA^2}\int_{Tstart}^{Tend}(\ddot{\omega})^2\,dt} \quad TA = \int_{Tstart}^{Tend}\omega dt$$ where T is the duration of the movement (T_{end}-T_{start}), ω is the angular velocity around the relevant axis and TA is the angle traveled [4].
Normalized Jerk Score of the Medio-Lateral Angular Velocity during Turn-to-Sit	Normalized index of angular Jerk of the medio-lateral axis during the Turn-to-Sit phase: $$NJS = \sqrt{\frac{T^5}{2TA^2}\int_{Tstart}^{Tend}(\ddot{\omega})^2\,dt} \;; \quad TA = \int_{Tstart}^{Tend}\omega dt$$ where T is the duration of the movement (T_{end}-T_{start}), ω is the angular velocity around the relevant axis and TA is the angle traveled [4].
Normalized Jerk Score of the Vertical Angular Velocity during Turn-to-Sit	Normalized index of angular Jerk of the vertical axis during the Turn-to-Sit phase: $$NJS = \sqrt{\frac{T^5}{2TA^2}\int_{Tstart}^{Tend}(\ddot{\omega})^2\,dt} \;; \quad TA = \int_{Tstart}^{Tend}\omega dt$$ where T is the duration of the movement (T_{end}-T_{start}), ω is the angular velocity around the relevant axis and TA is the angle traveled [4].
Turning Angle of the 180° Turn [°]	Turning angle in the 180° turn obtained by adding the angular velocity around the vertical axis: $$TA = \int_{Tstart}^{Tend}\omega dt$$ where ω is the angular velocity and T_{end}/T_{start} are the

	instant of end and start of the turn, respectively.
Turning Angle of the Sitting Turn [°]	Turning angle of the turn that precedes the seated position obtained by adding the angular velocity around the vertical axis: $$TA = \int_{Tstart}^{Tend} \omega dt$$ where ω is the angular velocity and T_{end}/T_{start} are the instant of end and start of the turn, respectively.
Mean Angular Velocity of the 180° Turn [°/s]	The mean value of the angular velocity (around the vertical axis) in a 180° turn.
Mean Angular Velocity of the Sitting Turn [°/s]	The mean value of the angular velocity (around the vertical axis) in the turn that precedes the seated position..
Peak Angular Velocity of the 180° Turn [°/s]	The maximum value of angular velocity (around the vertical axis) in the 180° turn.
Peak Angular Velocity of the Sitting Turn [°/s]	The maximum value of angular velocity (around the vertical axis) in the turn that precedes the seated position.
Normalized Jerk Score of the Angular Velocity of the 180° Turn	Normalized index of angular Jerk of the 180° turn: $$NJS = \sqrt{\frac{T^5}{2TA^2} \int_{Tstart}^{Tend} (\ddot{\omega})^2 dt} \;;\quad TA = \int_{Tstart}^{Tend} \omega dt$$ where T is the duration of the movement (T_{end}-T_{start}), ω is the angular velocity around the vertical axis and TA is the angle traveled [4].
Normalized Jerk Score of the Angular Velocity of the Sitting Turn	Normalized index of angular Jerk of the turn that precedes the seated position:

	$$NJS=\sqrt{\frac{T^5}{2TA^2}\int_{Tstart}^{Tend}(\ddot{\omega})^2\,dt}\;;\quad TA=\int_{Tstart}^{Tend}\omega dt$$ where T is the duration of the movement (T_{end}-T_{start}), ϖ is the angular velocity around the vertical axis and TA is the angle traveled [4].
Walk Duration [s]	Duration of waking phase only (turns are not considered) [2].
Number of Steps during Walk	Number of steps in the walking phase only (steps performed in turns are not counted).
Cadence [steps/min]	Value of cadence in the walking phase.
Mean Step Duration [s]	Mean step duration [2].
Coefficient of Variation of Step Duration [%]	Coefficient of variation of step duration [2].
Mean of Phase Differences [°]	The phase defines the duration of each step (in °) compated to the duration of a single step (a 360° cycle): $$\varphi_i=360^\circ\frac{hs_{Si}-hs_{Li}}{hs_{L(i+1)}-hs_{Li}}$$ where hs_{Li} and hs_{Si} are the instant of foot rest with the cycle of the longer step and the instant of the foot rest with the cycle of the shorter step, respectively. The mean value of the phase differences and the mean value of the values of single phases ϕi compared to the ideal value (180°).
Standard Deviation of Phase Differences [°]	The phase defines the duration of each step (in °) compared to the duration of a single step (in a 360° cycle): $$\varphi_i=360^\circ\frac{hs_{Si}-hs_{Li}}{hs_{L(i+1)}-hs_{Li}}$$ where hs_{Li} and hs_{Si} are the instant of foot rest with the

	cycle of the longer step and the instant of the foot rest with the cycle of the shorter step, respectively. The standard deviation of the phase differences and the standard value of the values of single phases ϕi compared to the ideal value (180°).
Mean Phase [°]	The phase defines the duration of each step (in °) compared to the duration of a single step (in a 360° cycle): $$\varphi_i = 360^\circ \frac{hs_{Si} - hs_{Li}}{hs_{L(i+1)} - hs_{Li}}$$ the mean value of the phase and the mean value of the single phases where hs_{Li} and hs_{Si} are the instant of foot rest with the cycle of the longer step and the instant of the foot rest with the cycle of the shorter step, respectively. [2], [6].
Standard Deviation of Phase[°]	The phase defines the duration of each step (in °) compared to the duration of a single step (in a 360° cycle): $$\varphi_i = 360^\circ \frac{hs_{Si} - hs_{Li}}{hs_{L(i+1)} - hs_{Li}}$$ the standard deviation of the phase and the standard deviation of the single phases ϕi where hs_{Li} and hs_{Si} are the instant of foot rest with the cycle of the longer step and the instant of the foot rest with the cycle of the shorter step, respectively. [2], [6].
Coefficient of Variation of Phase [%]	The phase defines the duration of each step (in °) compared to the duration of a single step (in a 360° cycle): $$\varphi_i = 360^\circ \frac{hs_{Si} - hs_{Li}}{hs_{L(i+1)} - hs_{Li}}$$ the coefficient of variation of the phase and the

	coefficient of variation of the single phases ϕi where hs_{Li} and hs_{Si} are the instant of foot rest with the cycle of the longer step and the instant of the foot rest with the cycle of the shorter step, respectively. [2], [6].
Phase Coordination Index [%]	Phase Coordination Index (PCI). Measure of the coordination of walking defined as accuracy and coherence: $$PCI = \varphi CV + 100 \cdot \frac{\frac{1}{N}\sum_{i=1}^{N} \lvert \varphi_i - 180^\circ \rvert}{180^\circ}$$ where φCV is the coefficient of variation of the phase and ϕi the value of the single phases [2], [6].
Harmonic Ratio in the Antero-Posterior direction	The frequency of the step is used as an essential frequency of the periodic variation in acceleration of the torso in the antero-posterior direction during the step cycle in regular walking conditions; the essential period of the signal is therefore a factor of step duration. The coefficients of the first 10 odd harmonics and the first 10 even harmonics are calculated using a finite Fourier series and the Harmonic Ratio (HR) is calculated as follows: $$HR = \frac{\sum_{i=1}^{10} eh_i}{\sum_{i=1}^{10} oh_i}$$ where eh_i and oh_i sare the coefficients of odd harmonics and even harmonics in the Fourier series, respectively [2], [7].
Harmonic Ratio in the Medio-Lateral direction	The frequency of the step is used as an essential frequency of the periodic variation in acceleration of the torso in the medio-lateral direction during the step cycle in regular walking conditions; the essential period of the signal is therefore a factor of step duration. The coefficients of the first 10 odd harmonics and the first 10 even harmonics are calculated using a finite Fourier series and the Harmonic Ratio (HR) is calculated as follows:

	$$HR = \frac{\sum_{i=1}^{10} oh_i}{\sum_{i=1}^{10} eh_i}$$ where eh_i and oh_i sare the coefficients of odd harmonics and even harmonics in the Fourier series, respectively [2], [7].
Harmonic Ratio in the Vertical direction	L The frequency of the step is used as an essential frequency of the periodic variation in acceleration of the torso in the vertical direction during the step cycle in regular walking conditions; the essential period of the signal is therefore a factor of step duration. The coefficients of the first 10 odd harmonics and the first 10 even harmonics are calculated using a finite Fourier series and the Harmonic Ratio (HR) is calculated as follows: $$HR = \frac{\sum_{i=1}^{10} eh_i}{\sum_{i=1}^{10} oh_i}$$ where eh_i and oh_i sare the coefficients of odd harmonics and even harmonics in the Fourier series, respectively [2], [7].
Step Regularity in the Antero-Posterior Direction [%]	Index of step regularity measured with an estimate of unbiased distortion of the function of autocorrelation of the signal in the antero-posterior direction: $$A_{unbiased} = \frac{1}{N-\lvert m \rvert} \sum_{i=1}^{N-\lvert m \rvert} x_i x_{i+m}$$ Where *X* is the acceleration signal in the relevant direction. The first dominant period (Ad1) of the coefficient of correlation is a measure of step regularity. [8].
Step Regularity in the Medio-Lateral Direction	Index of step regularity measured with an estimate of unbiased distortion of the function of autocorrelation of

[%]	the signal in the medio-lateral direction: $$A_{unbiased} = \frac{1}{N-\|m\|}\sum_{i=1}^{N-\|m\|} x_i x_{i+m}$$ Where X is the acceleration signal in the relevant direction. The first dominant period (Ad1) of the coefficient of correlation is a measure of step regularity. [8]. Unlike the item in [8], the function of autocorrelation for the medio-lateral signal calculated herein is considered in terms of absolute value, thereby making the value of Ad1 positive (instead of negative).
Step Regularity in the Vertical Direction [%]	Index of step regularity measured with an estimate of unbiased distortion of the function of autocorrelation of the signal in the vertical direction: $$A_{unbiased} = \frac{1}{N-\|m\|}\sum_{i=1}^{N-\|m\|} x_i x_{i+m}$$ Where X is the acceleration signal in the relevant direction. The first dominant period (Ad1) of the coefficient of correlation is a measure of step regularity. [8].
Stride Regularity in the Antero-Posterior Direction [%]	Index of stride regularity measured with an estimate of unbiased distortion of the function of autocorrelation of the acceleration signal in the antero-posterior direction: $$A_{unbiased} = \frac{1}{N-\|m\|}\sum_{i=1}^{N-\|m\|} x_i x_{i+m}$$ Where X is the acceleration signal in the relevant direction. The second dominant period (Ad2) of the coefficient of correlation is a measure of stride regularity. [8].
Stride Regularity in the Medio-Lateral Direction	Index of stride regularity measured with an estimate of unbiased distortion of the function of autocorrelation of

[%]	the acceleration signal in the medio-lateral direction: $$A_{unbiased} = \frac{1}{N-\lvert m\rvert}\sum_{i=1}^{N-\lvert m\rvert} x_i x_{i+m}$$ Where X is the acceleration signal in the relevant direction. The second dominant period (Ad2) of the coefficient of correlation is a measure of stride regularity. [8].
Stride Regularity in the Vertical Direction [%]	Index of stride regularity measured with an estimate of unbiased distortion of the function of autocorrelation of the acceleration signal in the vertical direction: $$A_{unbiased} = \frac{1}{N-\lvert m\rvert}\sum_{i=1}^{N-\lvert m\rvert} x_i x_{i+m}$$ Where X is the acceleration signal in the relevant direction. The second dominant period (Ad2) of the coefficient of correlation is a measure of step regularity. [8].
Gait Symmetry in the Antero-Posterior Direction	The index of gait symmetry in the antero-posterior direction is expressed as a ratio of the index of step regularity in the antero-posterior direction (Ad1) to the index of stride regularity in the antero-posterior direction (Ad2) [8].
Gait Symmetry in the Medio-Lateral Direction	The index of gait symmetry in the medio-lateral direction is expressed as a ratio of the index of step regularity in the medio-lateral direction (Ad1) to the index of step stride regularity in the medio-lateral direction (Ad2) [8]. Unlike in the item in [8], as regards the medio-lateral signal, the values of Ad1 and Ad2 have the same sign (positive). Therefore the best value (index of high symmetry) of Gait Symmetry for the medio-lateral direction will be close to 1, being thus homogeneous as per the best values of Gait Symmetry for the antero-posterior and vertical directions (in article [8] however, the best value of medio-lateral Gait Symmetry was -1,

	contrary to those in the antero-posterior and vertical directions).
Gait Symmetry in the Vertical Direction	The index of gait symmetry in the vertical direction is expressed as a ratio of the index of step regularity in the antero-posterior direction (Ad1) to the index of stride regularity in the vertical direction (Ad2) [8].
Range of the Antero-Posterior Acceleration during Walk [m/s^2]	Range (difference between maximum and minimum values) of the acceleration signal during the walking phase in the antero-posterior direction. .
Range of the Medio-Lateral Acceleration during Walk [m/s^2]	Range (difference between maximum and minimum values) of the acceleration signal during the walking phase in the medio-lateral direction. .
Range of the Vertical Acceleration during Walk [m/s^2]	Range (difference between maximum and minimum values) of the acceleration signal during the walking phase in the vertical direction. .
Root Mean Square of the Antero-Posterior Acceleration during Walk [m/s^2]	Root Mean Square (RMS) of the acceleration signal around the antero-posterior axis during the walking phase: $$RMS = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(s(i))^2}$$ where s is the acceleration signal in the relevant direction.
Root Mean Square of the Medio-Lateral Acceleration during Walk [m/s^2]	Root Mean Square (RMS) of the acceleration signal around the medio-lateral axis during the walking phase: $$RMS = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(s(i))^2}$$ where s is the acceleration signal in the relevant direction.
Root Mean Square of the Vertical Acceleration during Walk [m/s^2]	Root Mean Square (RMS) of the acceleration signal around the vertical axis during the walking phase:

	$$RMS = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(s(i))^2}$$ where s is the acceleration signal in the relevant direction.
Range of the Antero-Posterior Angular Velocity during Walk [°/s]	Range (difference between maximum and minimum values) of the angular velocity signal around the antero-posterior axis during the walking phase.
Range of the Medio-Lateral Angular Velocity during Walk [°/s]	Range (difference between maximum and minimum values) of the angular velocity signal around the medio-lateral axis during the walking phase.
Range of the Vertical Angular Velocity during Walk [°/s]	Range (difference between maximum and minimum values) of the angular velocity signal around the vertical axis during the walking phase.
Root Mean Square of the Antero-Posterior Angular Velocity during Walk [°/s]	Root Mean Square (RMS) of the angular velocity signal around the antero-posterior axis during the walking phase: $$RMS = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(s(i))^2}$$ where s is the signal of angular velocity in the relevant direction.
Root Mean Square of the Medio-Lateral Angular Velocity during Walk [°/s]	Root Mean Square (RMS) of the angular velocity signal around the medio-lateral axis during the walking phase: $$RMS = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(s(i))^2}$$ where s is the signal of angular velocity in the relevant direction.
Root Mean Square of the Vertical Angular Velocity during Walk [°/s]	Root Mean Square (RMS) of the angular velocity signal around the vertical axis during the walking phase:

	$$RMS = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(s(i))^2}$$ where *s* is the signal of angular velocity in the relevant direction.
Time-Normalized Jerk Score of the Antero-Posterior Acceleration during Walk [m]	Median index of Jerk normalized to step duration during the walking phase in the antero-posterior direction: $$Gait\ NJS = \frac{1}{N}\sum_{i=1}^{N}\left(\sqrt{\frac{(hs_{i+1}-hs_i)^5}{2}\int_{hs_i}^{hs_{i+1}}(\dot{a})^2\,dt}\right)$$ where hs_i is the moment of contact by foot, N is the number of steps and *a* is the acceleration signal in the relevant direction [2], [4].
Time-Normalized Jerk Score of the Medio-Lateral Acceleration during Walk [m]	Median index of Jerk normalized to step duration during the walking phase in the medio-lateral direction: $$Gait\ NJS = \frac{1}{N}\sum_{i=1}^{N}\left(\sqrt{\frac{(hs_{i+1}-hs_i)^5}{2}\int_{hs_i}^{hs_{i+1}}(\dot{a})^2\,dt}\right)$$ where hs_i is the moment of contact by foot, N is the number of steps and *a* is the acceleration signal in the relevant direction [2], [4].
Time-Normalized Jerk Score of the Vertical Acceleration during Walk [m]	Median index of Jerk normalized to step duration during the walking phase in the vertical direction: $$Gait\ NJS = \frac{1}{N}\sum_{i=1}^{N}\left(\sqrt{\frac{(hs_{i+1}-hs_i)^5}{2}\int_{hs_i}^{hs_{i+1}}(\dot{a})^2\,dt}\right)$$ where hs_i is the moment of contact by foot, N is the number of steps and *a* is the acceleration signal in the relevant direction [2], [4].
Speed-Normalized Jerk	Index of Jerk normalized to the walking velocity in the

Score of the Antero-Posterior Acceleration during Walk	antero-pposterior direction: $$NJS = \frac{1}{N}\sum_{i=1}^{N}\left(\sqrt{\frac{(hs_{i+1}-hs_i)^3}{2GS^2}\int_{hs_i}^{hs_{i+1}}(\dot{a})^2\,dt}\right)$$ where hs_i is the moment of contact by foot, N is the number of steps, *GS* is the walking velocity and *a* is the acceleration signal in the antero-posterior direction [4].
Walk Duration including the 180° Turn [s]	Duration of walking phase including the 180° turn.
Walk/Turn Ratio Outward	Ratio of 180° turn duration and duration of walking phase from seat to turning point [9].
Walk/Turn Ratio Return	Ratio of 180° turn duration and duration of walking phase from the turning point to the seat [9].
Walk/Turn Ratio Overall	Ratio of 180° turn duration and comprehensive duration of walking phase [9].

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Features extraced from the Postural Sway Analysis in mSWAY

LEGEND

AP: Antero-Posterior axis

ML: Medio-Lateral axis

V: Vertical axis

Horizontal plane: horizontal plane defined by AP and ML. axis

Displacement: the displacement information is obtained by processing the acceleration signal as explained in [1].

Tremor band: frequency band defined from 4 to 7 Hz.

Low Frequency Band: from 0.15 to 3.5 Hz.

High Frequency Band: from3.5 to 15 Hz.

Root Mean Square (RMS):

$$RMS = \sqrt{\frac{1}{N}\sum_{i=1}^{N} s(i)^2}$$

Where *s* is the signal and *N* is the number of samples.

Normalized Jerk Score of the Acceleration:

$$NJS_{acc} = \sqrt{\frac{T^5}{2\ SP}\int_{T_{start}}^{T_{end}} (\dot{a})^2 dt}$$

Where *T* is the duration of the movement (Tend-Tstart) and *SP* is the Sway Path travelled.

Normalized Jerk Score of the Angular Velocity:

$$NJS_{ang} = \sqrt{\frac{T^5}{2\,TA}\int_{T_{start}}^{T_{end}} (\ddot{\omega})^2 dt} \qquad TA = \int_{T_{start}}^{T_{end}} \omega dt$$

Where *T* is the duration of the movement (Tend-Tstart) and TA is the angle travelled.

PREDEFINED PARAMETERS (DEFAULT)

Name [unit of measurement]	Description
Root Mean Square of the displacement along the AP axis [mm]	Root Mean Square Value of the displacement (with respect of the center) along the anterior-posterior axis [1].
Root Mean Square of the displacement along the ML axis [mm]	Root Mean Square Value of the displacement (with respect of the center) along the medio-lateral axis [1].
Sway Path of the displacement along the AP axis [mm]	Length of the Sway Path travelled from the Center of Mass (CoM) during the oscillation in the anterio-posterior axis [1].
Sway Path of the displacement along the ML axis [mm]	Length of the Sway Path travelled from the Center of Mass (CoM) during the oscillation in the medio-lateral axis [1].
Sway Path of the displacement on the horizontal plane [mm]	Length of the Sway Path travelled from the Center of Mass (CoM) during the oscillation in the horizontal plane. The horizontal plane is defined as the combination of AP and ML axis [1].
Sway Area [mm^2/s]	Area travelled by the Center of Mass (CoM) per seconds [1].
95% confidence interval ellipse area [mm^2]	Confidence ellipse area containing 95% of trajector points on the horizontal plane (AP, ML) [1].
Mean Sway Velocity along the AP axis [mm/s]	Center of Mass (CoM) mean sway velocity along the antero-posterior axis [1].
Mean Sway Velocity along the ML axis [mm/s]	Center of Mass (CoM) mean sway velocity along the medio-lateral axis [1].

ADVANCED PARAMETERS

Name [unit of measurement]
Root Mean Square of the displacement along the V axis [mm]
Sway Path of the displacement along the V axis [mm]
Mean Sway Velocity along the V axis [mm/s]
Mean Value of the Acceleration along the AP axis [mm/s2]
Mean Value of the Acceleration along the ML axis [mm/s2]
Mean Value of the Acceleration along the V axis [mm/s2]
Root Mean Square of the Acceleration along the AP axis [mm/s2]
Root Mean Square of the Acceleration along the ML axis [mm/s2]
Root mean Square of the Acceleration along the V axis [mm/s2]
Range of the Acceleration along the AP axis [mm/s2]
Range of the Acceleration along the ML axis [mm/s2]
Range of the Acceleration along the V axis [mm/s2]
Mean Value of the Angular Velocity around the AP axis [°/s]
Mean Value of the Angular Velocity around the ML axis [°/s]
Mean Value of the Angular Velocity around the V axis [°/s]
Root Mean Square of the Angular Velocity around the AP axis [°/s]
Root Mean Square of the Angular Velocity around the ML axis [°/s]
Root Mean Square of the Angular Velocity around the V axis [°/s]
Range of the Angular Velocity around the AP axis [°/s]
Range of the Angular Velocity around the ML axis [°/s]
Range of the Angular Velocity around the V axis [°/s]
Mean Value of the displacement along the AP axis [mm]
Mean Value of the displacement along the ML axis [mm]
Mean Value of the displacement along the V axis [mm]
Range of the displacement along the AP axis [mm]
Range of the displacement along the ML axis [mm]
Range of the displacement along the V axis [mm]
Length of the ellipse major semi-axis [mm]
Length of the ellipse minor semi-axis [mm]
Direction of maximum variance of the displacement [°]

50% Power Frequency of the acceleration along the AP axis [Hz]
50% Power Frequency of the acceleration along the ML axis [Hz]
50% Power Frequency of the acceleration along the V axis [Hz]
95% Power Frequency of the acceleration along the AP axis [Hz]
95% Power Frequency of the acceleration along the ML axis [Hz]
95% Power Frequency of the acceleration along the V axis [Hz]
Centroidal Frequency of the acceleration along the AP axis [Hz]
Centroidal Frequency of the acceleration along the ML axis [Hz]
Centroidal Frequency of the acceleration along the V axis [Hz]
Frequency Dispersion of the acceleration along the AP axis [Hz]
Frequency Dispersion of the acceleration along the ML axis [Hz]
Frequency Dispersion of the acceleration along the V axis [Hz]
Percentage of power in the tremor band of the acceleration along the AP axis [%]
Percentage of power in the tremor band of the acceleration along the ML axis [%]
Percentage of power in the tremor band of the acceleration along the V axis [%]
Frequency peak of the acceleration along the AP axis in the tremor band [Hz]
Frequency peak of the acceleration along the ML axis in the tremor band [Hz]
Frequency peak of the acceleration along the V axis in the tremor band [Hz]
Power ratio between the high and low frequency bands of the acceleration along the AP axis
Power ratio between the high and low frequency bands of the acceleration along the ML axis
Power ratio between the high and low frequency bands of the acceleration along the V axis
Spectral Entropy of the acceleration along the AP axis
Spectral Entropy of the acceleration along the ML axis
Spectral Entropy of the acceleration along the V axis
50% Power Frequency of the angular velocity along the AP axis [Hz]
50% Power Frequency of the angular velocity along the ML axis [Hz]
50% Power Frequency of the angular velocity along the V axis [Hz]
95% Power Frequency of the angular velocity along the AP axis [Hz]
95% Power Frequency of the angular velocity along the ML axis [Hz]
95% Power Frequency of the angular velocity along the V axis [Hz]

Centroidal Frequency of the angular velocity around the AP axis [Hz]
Centroidal Frequency of the angular velocity around the ML axis [Hz]
Centroidal Frequency of the angular velocity around the V axis [Hz]
Frequency dispersion of the angular velocity around the AP axis [Hz]
Frequency dispersion of the angular velocity around the ML axis [Hz]
Frequency dispersion of the angular velocity around the V axis [Hz]
Percentage of power in the tremor band of the angular velocity around the AP axis [%]
Percentage of power in the tremor band of the angular velocity around the ML axis [%]
Percentage of power in the tremor band of the angular velocity around the V axis [%]
Frequency peak of the angular velocity around the AP axis in the tremor band [Hz]
Frequency peak of the angular velocity around the ML axis in the tremor band [Hz]
Frequency peak of the angular velocity around the V axis in the tremor band [Hz]
Power ratio between the high and low frequency bands of the angular velocity along the AP axis
Power ratio between the high and low frequency bands of the angular velocity along the ML axis
Power ratio between the high and low frequency bands of the angular velocity along the V axis
Spectral Entropy of the angular velocity around the AP axis
Spectral Entropy of the angular velocity around the ML axis
Spectral Entropy of the angular velocity around the V axis
Normalized jerk score of the acceleration along the AP axis
Normalized jerk score of the acceleration along the ML axis
Normalized jerk score of the acceleration along the V axis
Normalized jerk score of the angular velocity around the AP axis
Normalized jerk score of the angular velocity around the ML axis
Normalized jerk score of the angular velocity around the V axis

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DECLARATIONS OF CONFORMITY

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Cod. fisc. e P.IVA (VAT) 03389641204
CCIAA BO N. 515417

DECLARATION OF CONFORMITY

Manufacturer Name: mHealth Technologies s.r.l.

Manufacturer Address: Via Giuseppe Fanin 48, 40127 Bologna, Italy

We hereby declare under our sole responsibility that:

Product Name	**mGAIT**
Classification	**Class I, no measurement purposes (Annex IX, 12)**
Classification based on the 60601-1 standard	Insulation class: **internal energy supply** Applied part: **BF type**
Harmonised standards applied	**EN 60601-1:2006/A11:2011/A1:2013** **EN 60601-1-2:2007** **EN 14971:2012** **EN 62304:2006** **EN 60601-1-6:2010** **EN 62366:2008**
S/N	**XXXX-XXXX**

Corresponds to the essential requirements of the 93/42/CEE and further modifications, 2007/47/CE regulations concerning medical devices, along with the host country's national legislation.

The conformity assessment procedure referred to in Article 11 of the 93/42/CEE directive (Annex VII) has been followed.

Dr. Carlo Tacconi, CEO

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DECLARATION OF CONFORMITY

Manufacturer Name: mHealth Technologies s.r.l.

Manufacturer Address: Via Giuseppe Fanin 48, 40127 Bologna, Italy

We hereby declare under our sole responsibility that:

Product Name	**mTUG**
Classification	**Class I, no measurement purposes (Annex IX, 12)**
Classification based on the 60601-1 standard	Insulation class: **internal energy supply** Applied part: **BF type**
Harmonised standards applied	**EN 60601-1:2006/A11:2011/A1:2013** **EN 60601-1-2:2007** **EN 14971:2012** **EN 62304:2006** **EN 60601-1-6:2010** **EN 62366:2008**
S/N	**XXXX-XXXX**

Corresponds to the essential requirements of the 93/42/CEE and s.m.i. 2007/47/CE regulations concerning medical devices, along with the host country's national legislation.

The conformity assessment procedure referred to in Article 11 of the 93/42/CEE directive (Annex VII) has been followed.

CE Certification N°: 1497/MDD

Dr. Carlo Tacconi, CEO

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DECLARATION OF CONFORMITY

Manufacturer Name: mHealth Technologies s.r.l.

Manufacturer Address: Via Giuseppe Fanin 48, 40127 Bologna, Italy

We hereby declare under our sole responsibility that:

Product Name	**mSWAY**
Classification	**Class I, no measurement purposes (Annex IX, 12)**
Classification based on the 60601-1 standard	Insulation class: **internal energy supply** Applied part: **BF type**
Harmonised standards applied	**EN 60601-1:2006/A11:2011/A1:2013** **EN 60601-1-2:2007** **EN 14971:2012** **EN 62304:2006** **EN 60601-1-6:2010** **EN 62366:2008**
S/N	**XXXX-XXXX**

Corresponds to the essential requirements of the 93/42/CEE and s.m.i. 2007/47/CE regulations concerning medical devices, along with the host country's national legislation.

The conformity assessment procedure referred to in Article 11 of the 93/42/CEE directive (Annex VII) has been followed.

CE Certification N°: 1497/MDD

Dr. Carlo Tacconi, CEO

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