



IBALANCE PREMIUM

User Manual

15.7.2015

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1 Introduction

1.1 Overview

Welcome to the HUR Labs iBalance Premium. The iBalance Premium Software automates the performing of different balance tests. With the iBalance Premium results can be stored in the database for later analysis and comparison. The iBalance Premium is designed to work with the trapezoid BTG4 Balance Platform and iB4 Balance Platform.

This User Manual describes iBalance Premium Software's powerful features and helps to use it in an efficient and productive way. Happy testing!

1.2 Features

Basic features:

- Several different test protocols such as: Limits of Stability and Stable/Unstable Platform Romberg 30 s
- Trainer for a fun way to test your balance
- Database for persons and groups
- Test results can be stored for later analysis and comparisons
- Printable test reports
- Comparisons of different tests
- Container to help comparisons
- Normative database includes approximately 2900 test results that can be used when comparing test results.

2 HUR Labs Warranty Terms

These warranty terms apply to the HUR Labs -products manufactured by HUR in Finland.

Warranty of one (1) year applies to:

- Products including electronic components
- Computer software provided with the product

Warranty of five (5) years applies to:

- Materials and workmanship of products frame assembly. Any coating of material is not included in frame warranty.

Warranty is valid only if the installation and routine maintenance is done as follows:

- Installation is done as specified in HUR Labs installation instructions
- Routine maintenance and service is done according to HUR Labs specifications by HUR Labs certified personnel

Warranty will be voided immediately if:

- Electronic devices or parts not supplied or certified by HUR Labs are installed, used to power or used to operate HUR Labs manufactured products
- Parts not supplied or certified by HUR Labs are used for service or repair of HUR Labs manufactured products

Transportation, storage or other handling related damages are not covered in HUR Labs warranty. In case of transportation, storage or other handling related damage, product must be checked by HUR Labs certified person or warranty can be voided. This is to be done before or during the installation of the product.

HUR Labs dealers are responsible of warranty related costs and case handling in their region. Warranty replacement parts are delivered free of charge.

Replaced part should be sent back to HUR Labs only if so noted in the Delivery note of replacement part or otherwise noted. Parts that are not sent back to HUR Labs, should be recycled following local laws and regulations.

Customer of HUR Labs dealer should never be in situation to contact HUR Labs Oy directly.

These terms are valid from 1st of July 2006.

3 Balance Platform

The Balance Platform is a portable platform for easy assessment of balance. The platform connects to your PC via a direct USB connection and the platform takes its power from this connection. This means that no external power is required. As there are no separate power sources, the signal from the platform to the PC is unbiased. All you need for testing balance in the field is a laptop running Windows XP/Vista/7 (32-bit only) with iBalance Premium Software and the Balance Platform. See chapter 4.2 for installation information.

The chassis of the Balance Platform is made of strong aluminum making it robust yet lightweight (BTG4 18.2kg). Each of the sensors can measure up to 200 kg weight. The platform is equipped with 16-bit high precision data acquisition module with an inbuilt a/d conversion. There is a separate a/d conversion made for each channel (each sensor) ensuring that no interference or cross talk can happen making the results highly accurate.

WARNING: Applying more than 200 kg for a sensor can break the sensor!

NOTE: The platform is only for indoor use!

NOTE: Use the platform only for its intended purposes!

3.1 Package

The Balance Platform comes with a soft nylon bag. The bag is designed for easy transportation of the platform. The iBalance Premium Software is included in the bag's pocket. HUR cardboard package is completely recyclable. Local laws and regulations of package material disposal should be followed.

NOTE: Make sure that the handles are properly attached to the bag before lifting the bag!

3.2 Miscellaneous

Calibration

The calibration information is stored in the platform. The need of a new calibration can be checked by measuring a known weight with the General Data Acquisition. For more information about the calibrations, see chapters 7.1.17.1.1 and 7.2.

Cleaning

Keep the platform's surface clean. Use any non-corrosive cleaning detergent and cloth.

NOTE: Make sure that the surface is dry and NOT slippery before stepping on the platform!

WARNING: The use of corrosive detergent might damage the surface!

Transportation

Transportation must be done using an appropriate package. Either using the platform's bag or also with the cardboard package.

NOTE: Do not transport the platform unprotected!

NOTE: Do not drop the device!

Storage

The platform must be stored inside the bag and in normal humidity and temperature conditions. NOTE: Protect the platform from severe shocks!

Disposal

The platform must be disposed according to local disposal laws and regulations.

Repair

Only qualified technicians should repair the device. In case the surface, USB cable or the sensors get broken, contact HUR Labs office.

WARNING: Unauthorized repairs can result in considerable danger to the user!

WARNING: Broken sensors can give incorrect results!

4 Installation

4.1 System Requirements

The iBalance Premium Software needs the following software and hardware:

- Microsoft Vista, 7, 8 or newer
- Screen resolution of 1024 * 768 or higher
- Pentium 3 1 GHz or equivalent
- 256 Mb of RAM
- Graphic card with 32Mb of memory
- USB port

4.2 Installation of the iBalance Premium Software

4.2.1 Installing the iBalance Premium Software

- Insert iBalance Premium Software CD-ROM to appropriate drive
- The program installation starts automatically, if not, go to Run on the Start menu and type "D:\setup" (where D: is the letter for your CD-ROM drive)
- Follow the instructions

NOTE: In Windows Vista the installation needs to be run with administrator rights. If you plan to use the program in regular user account, you might need to set file permissions for database and program directories.

4.2.2 Installing the Balance Platform

Plug the Balance Platform in USB port. Windows recognizes the new hardware and asks its drivers. The drivers can be found in the iBalance Premium Software CD("Drivers" - folder) or in the directory where the software was installed (by default "C:\Program Files\Hur Labs\HUR Labs iBalance Premium Software").

Later on, when plugging the Balance Platform in a different USB port, the Windows might want to install the drivers again. This time, let the Windows search for the drivers by itself. If the Windows doesn't find the drivers, then locate the drivers from the iBalance Premium Software CD("Drivers" - folder) or from the directory where the software was installed (by default "C:\Program Files\Hur Labs\HUR Labs iBalance Premium Software").

4.2.3 iBalance Premium Software in Windows Vista/7

In Windows Vista/7, when UAC (User Account Control) is turned on, every user will have their own program and database folders. Meaning that different users will have different databases. The actual location of the database would be "C:\Users\Hur\AppData\Local\VirtualStore\Program Files\Common Files\HurDB30"-folder, where Hur is the name of the user account. If "Run as administrator"-option is used, the database is common "C:\Program Files\Common Files\HurDB30".

5 Program Settings

The iBalance Premium software has a few settings, which need to be set in order for the program to work properly. Settings can be entered through the '**Settings**'-window, which can be viewed by selecting '**File|Settings**' from the program's main menu. '**Settings**'-window is seen in the Figure 1.

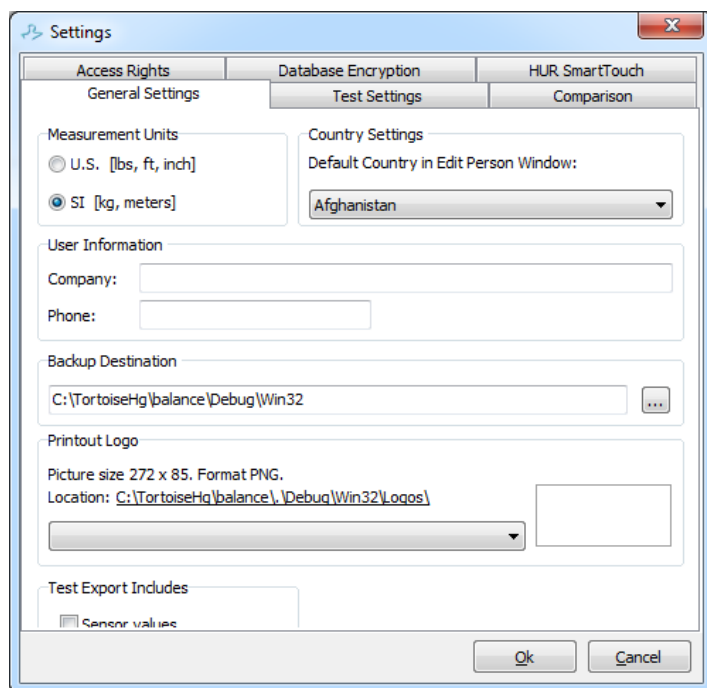


Figure 1: Settings window

The first page of the '**Settings**'-window displays the settings of the units, country and the user information. **The Measurement Units affects the output of the results!** On the first page, there is also the location of the backup directory and sensor values exported setting. The user can also select the printout logo. You can add your own logo if you put your own picture (png-format) into the location shown by the software. Make sure that your image is exactly the size as indicated 161x60 in PNG format for customized reports.

The second page of the '**Settings**'-window gives the opportunity to change the preparation test time and whether the sounds are on or off during the test. Also it's possible to automatically generate default names for the tests, but it's still possible to rename the test during saving.

The third page lets you choose the default filtering options for test result comparisons. It is possible to filter by age and gender. Also one can choose that what comparison data is used. It is not suggested to change the default comparison classification limits!

The fourth page controls the login of the program. You can select automatic login or you can set the login password which will be used next time the program is launched.

The fifth page displays the database encryption setting. With the no encryption setting anyone who can access the database can read it. With standard encryption the database is encrypted with predefined password. Custom encryption lets the user choose his/her own password. Note that if this password is lost, nobody, not even software support can access the database.

The last page displays the HUR SmartTouch related settings. In this view you can set the server address, username and the password for the machine that are needed when integrating with the HUR SmartTouch system.

5.1 Customize Colors

For people who have difficulties to differ or recognize default colors used in the Posturogram analyze chart, the iBalance Premium Software provides possibility to adjust the colors. '**Customize Colors**'-window can be entered by selecting '**Edit|Customize Colors**' from the program's main menu. '**Settings**'-window is seen in the Figure 2.

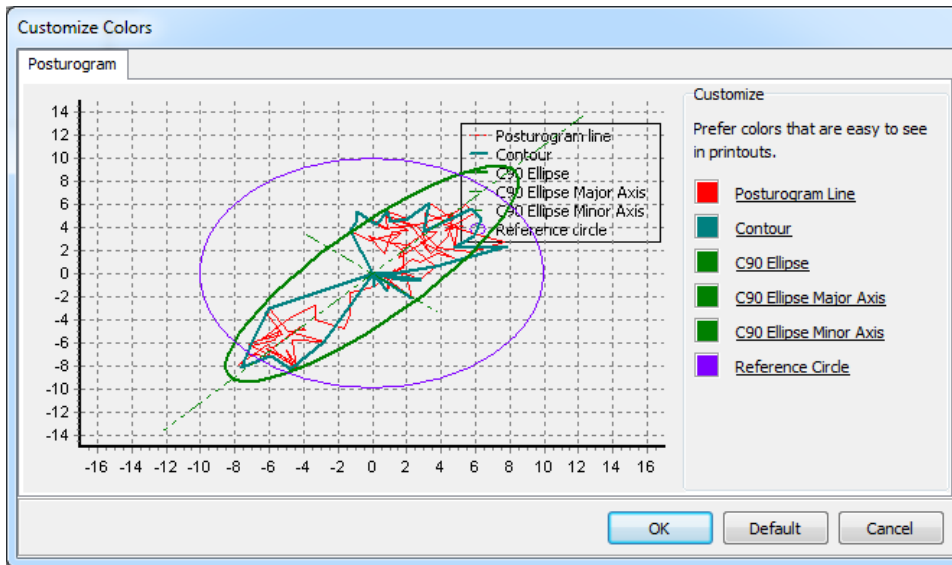


Figure 2: Customizing analysis colors

Click on the names to select the color. The example chart on the left will change according to the selected colors. Default colors will be set when clicking the '**Default**'-button. Pressing '**OK**' will close the window and save the changes.

6 Managing Database

6.1 Structure of the Database

The database behind the iBalance Premium Software consists of groups of persons, persons and tests. This structure helps to organize persons and tests logically, just like the files are organized to sub-directories on the hard drive. Since the iBalance Premium Software version 1.28.5, the database engine has been changed.

6.2 Database Options

From the Database Options, it is possible to change the database, refresh the database tree and import an old Paradox database. The "Change Database"-function makes it possible to create a new empty database. BDE (Borland Database Engine) drivers are required in order to import an old database. BDE drivers can be found from the iBalance Premium Software installation CD.

6.3 Synchronize Databases

In some cases users might want to merge their database with another user's database. This can be done with database synchronization. Select '**File|Advanced DB Options|Synchronize Database**' from the program's main menu. First select the target database and then the operation. There are three options to choose:

- Synchronize – Both databases will be merged
- Export – Data will be taken to the target database
- Import – Data will be taken from target database

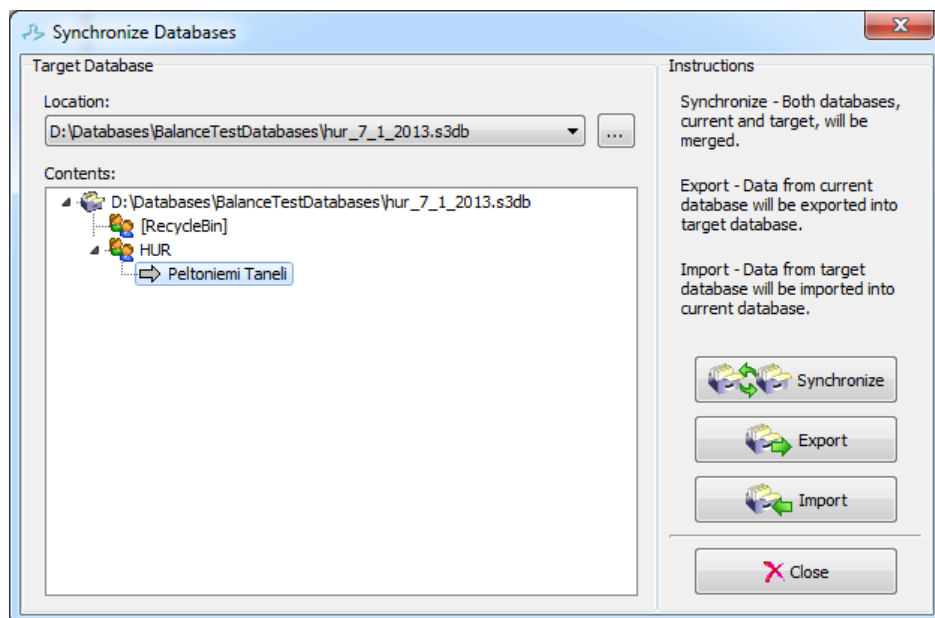


Figure 3: Synchronize databases

6.4 Browsing Group / Person Database

The **contents of group / person database** can be viewed by clicking the '**Database**'-button (Figure 4) from the program's toolbar.

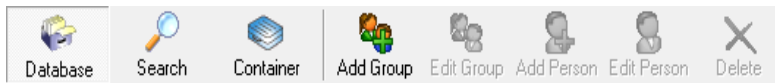


Figure 4: Main toolbar

Through the toolbar you can perform various activities such as search for persons, put tests into the container. You can also add, edit and delete groups and persons.

The database tree is shown in Figure 5. The database tree is used to navigate the groups and persons you have in the database. When you click item on the tree, you will see its contents on the right side. If you have person selected, it will show all of the tests that the user has done.

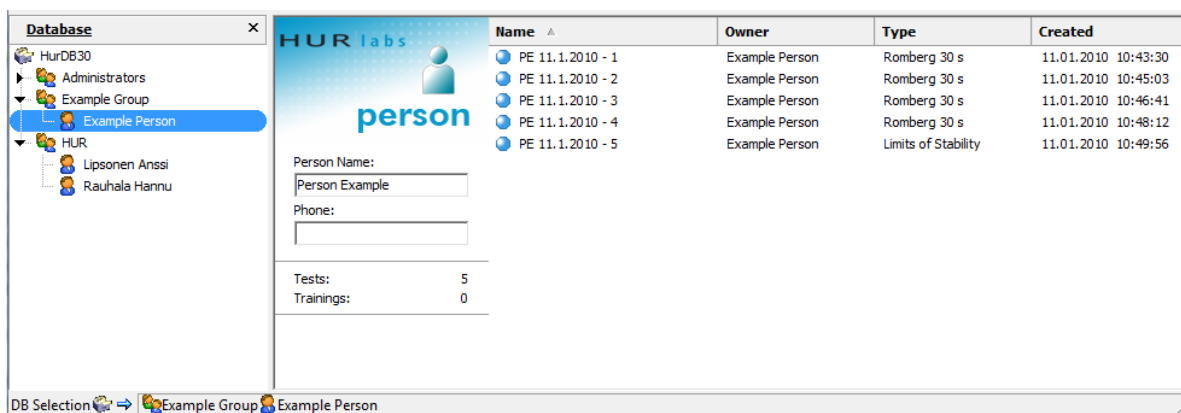


Figure 5: Browsing the database

6.4.1 Adding, Removing and Editing Groups

A new group can be added to the database by clicking the '**Add New Group**'-button. A dialog, where information about the new group can be entered, will appear (Figure 6).

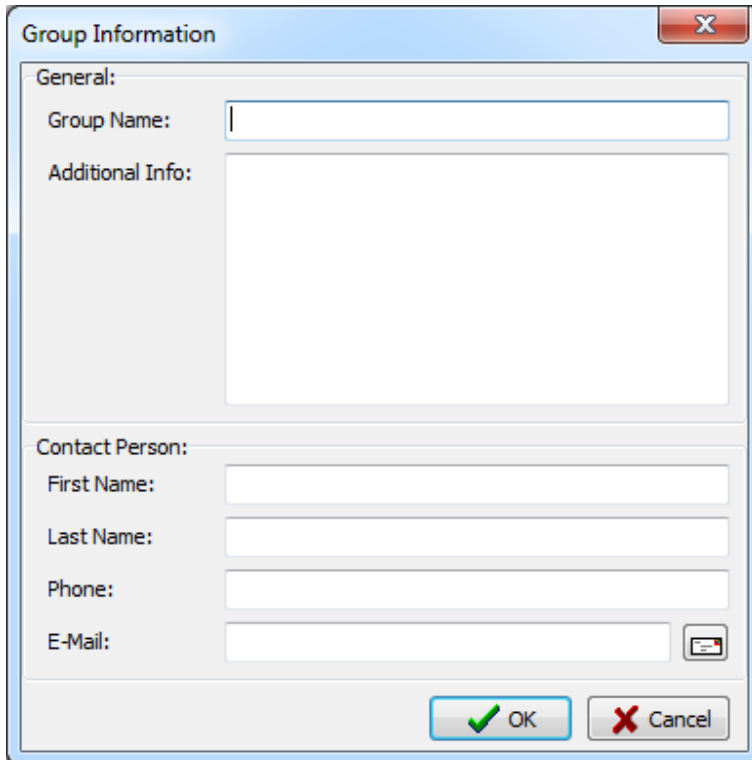
A screenshot of a 'Group Information' dialog box. The dialog has a title bar with a close button (X). It is divided into two main sections. The 'General' section contains a 'Group Name' text field and a larger 'Additional Info' text area. The 'Contact Person' section contains four text fields: 'First Name', 'Last Name', 'Phone', and 'E-Mail'. There is a small icon button to the right of the 'E-Mail' field. At the bottom right, there are two buttons: 'OK' with a green checkmark and 'Cancel' with a red X.

Figure 6: Adding group

Information about a certain group can be viewed or edited by right clicking on the group and selecting '**Edit Group**' from the popup menu. A dialog with group's information will appear. Group information can now be edited. Right click on a group and select '**Remove**' from the popup menu to remove it. An alternative way is to select the test and click on the '**Delete Selected Element**'-button, which is located on the main toolbar. Removing a group also removes all its persons. Basic group operations can also be found from '**File | Base DB Operations**' from the program's main menu.

6.4.2 Adding, Removing and Editing Persons

A new person can be added to a certain group by selecting the group from the tree view and clicking the **'Add New Person'**-button. A dialog, where information about the new person can be entered, will appear (Figure 7).

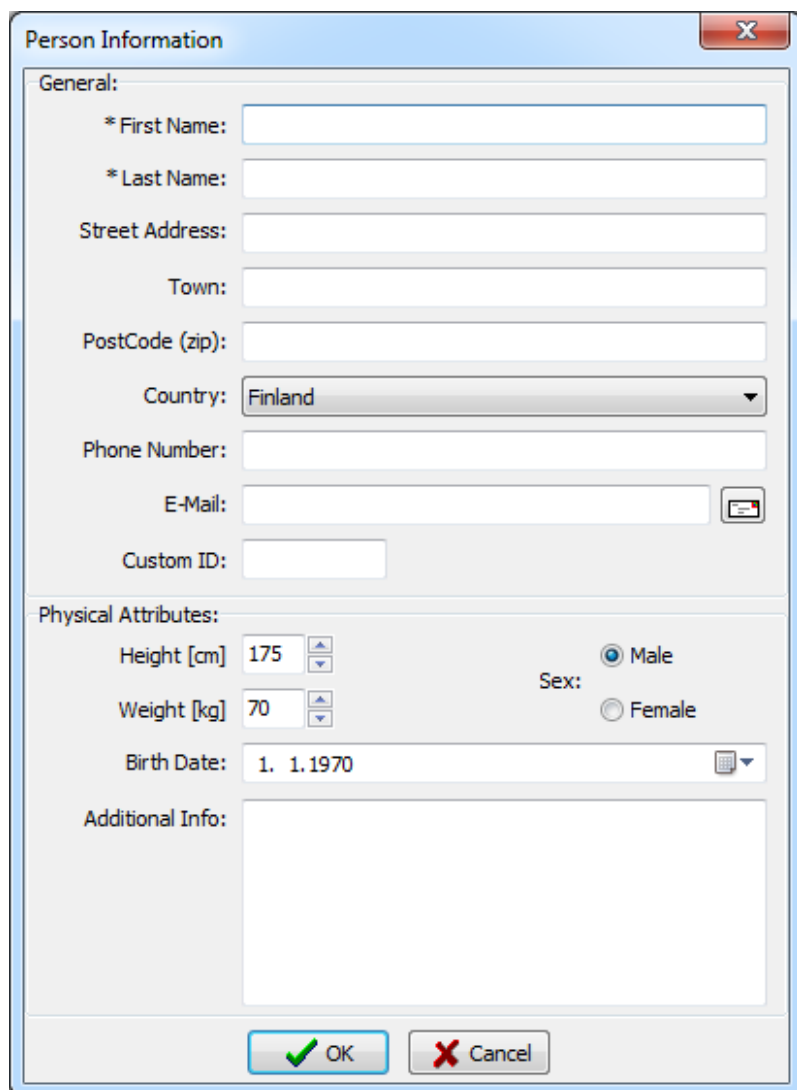
The image shows a 'Person Information' dialog box with a title bar and a close button. It is divided into two main sections: 'General' and 'Physical Attributes'. The 'General' section contains fields for *First Name, *Last Name, Street Address, Town, PostCode (zip), Country (a dropdown menu currently showing 'Finland'), Phone Number, E-Mail (with an email icon), and Custom ID. The 'Physical Attributes' section contains Height [cm] (175), Weight [kg] (70), Sex (radio buttons for Male and Female, with Male selected), Birth Date (1. 1. 1970 with a calendar icon), and an Additional Info text area. At the bottom are OK and Cancel buttons.

Figure 7: Person information

First name, last name, height, weight, gender and birth date are mandatory fields. Custom ID can be used for example if the person has a predefined ID in some other database. You need to input at least the first and last name of the person as indicated by "*" character.

Information about a certain person can be viewed or edited by right clicking on a person and selecting **'Edit Person'** from the popup menu. A dialog with person's information will appear. **Person information** can now be edited. Right click on a person and select **'Remove'** from the popup menu to remove a person. An alternative way is to select the test and click on the **'Delete Selected Element'**-button, which is located on the main toolbar. Removing a person also removes all its tests. Basic person operations can be also found from **'File|Base DB Operations'** from the program's main menu.

6.5 Searching the Database

Groups, persons or tests can be searched from the database by clicking '**Search**'-button. A search dialog will appear as seen in Figure 8.

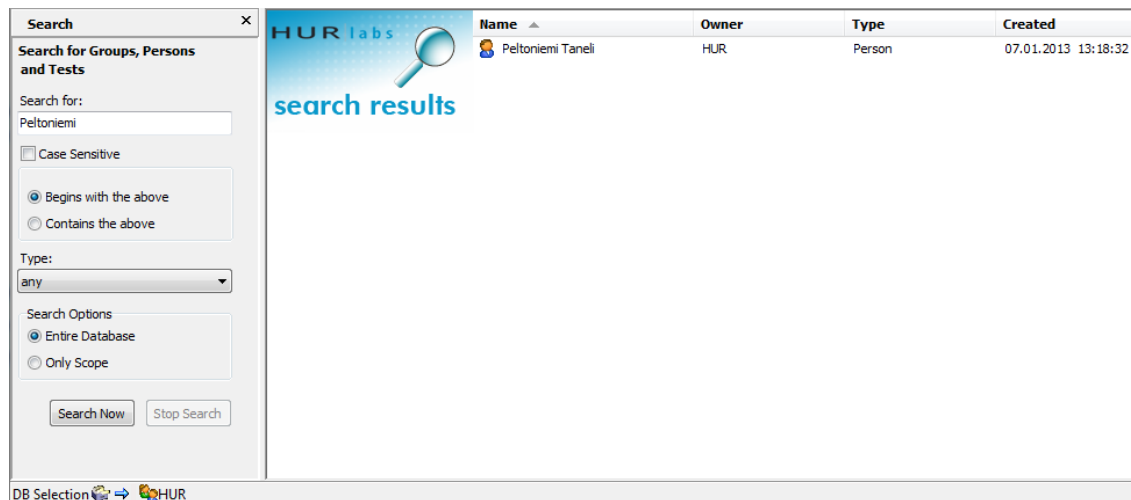


Figure 8: Searching the database

Enter the known information about the target to be searched in edit box on the top of the window and click '**Search Now**'-button to start search. Type can be group, person or test. In the search options, the '**Entire database**'-option means that the whole database is searched and the '**Only scope**'-option means that the view on the left will be only searched. The search results will be shown in the left side of the '**Search**'-window. This is the fastest way to locate a certain group, person or test in the database.

6.6 Working with Tests

Tests, which belong to a certain person, can be viewed by selecting the person from the database tree.

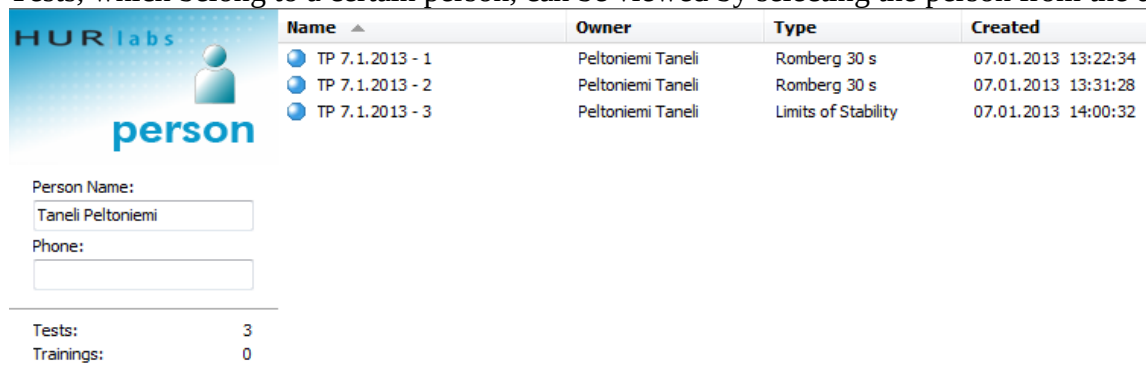


Figure 9: Tests

Owner means the person that made the test. Type tells you that what protocol was used when performing the test. Created is the time when the test was performed.

Tests can be analyzed by double clicking on it or by right clicking on it and selecting '**Analyse**' from the popup menu.

Right click on a test and select '**Remove**' from the popup menu to remove it. Alternative way is to select the test and click on the '**Delete Selected Element**'-button, which is located on the main toolbar.

6.7 Scope Data Filter

Clicking on the '**Compare**'-button or selecting '**File|Analyse Scope Data**' from the program's main menu will bring up a window (Figure 10) where you can select the type of data to be compared. It can be groups, persons, tests or tests by protocol. The items that are going to be filtered are the ones that are currently listed. Note that, Limits of Stability-tests won't be included when analyzing any test protocols.

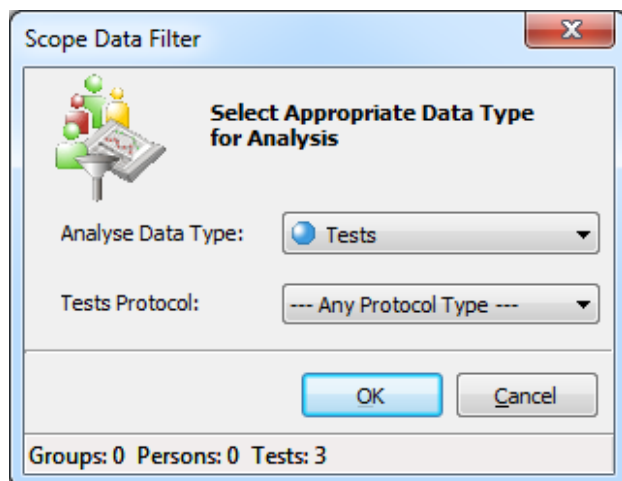


Figure 10: Scope Data Filter window

6.8 The Container

The container is a useful tool for selecting tests from different persons for comparison. Persons and groups can also be added to container. Items can be added to container by right clicking on items view and selecting '**Add to Container**' or '**Add all to Container**'. Right clicking on person or group gives an option to add all its tests to container.

The container can be viewed by clicking on the '**Container**'-button. In the container there are options for filtering items, removing duplicate items or clearing the list. To compare the contents of the container, click on the '**Analyse Scope Data**'-button.

6.9 Exporting Data

Clicking on the '**Export Data**'-button will open a save file dialog. To enable exporting, a test needs to be analysed or a comparison made by the scope data filter. Excel files, normal style is sufficient for normal use.

6.10 Making a Backup of the Database

A backup of the current database can be made by selecting '**File|Advanced Database Options|Backup**' from the program's main menu. A copy of the database will appear in a zip-file. The backup directory is defined in the program's settings (Chapter 5).

NOTE: Remember to make backups!

WARNING: A computer malfunction might result in data loss!

7 Working with the Balance Platform

7.1 Automatic Machine Identification

The program automatically 'knows' which machine is connected to the computer and adjusts the functions on the basis of the connected machine. Calibration information is stored in the platform. Every time the program is started, it tries to identify the connected machine.

When the machine connected to computer is changed to another, iBalance Premium Software need not be restarted. All that is needed is to select '**Platform|Identify**' from the program's main menu.

7.1.1 Proper Calibration

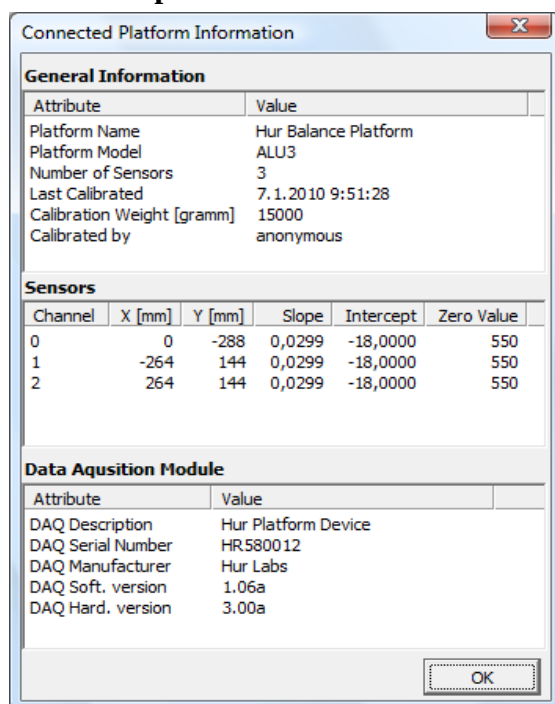


Figure 11: Platform Information

In order to get proper results from the Balance Platform, the sensor values need to be okay. Select '**Platform|Identify**' from the program's main menu to see the current calibration values. Figure 11 shows an example of sensor values. The calibration is definitely wrong if the slope values are over 0,04 or below 0,02.

General Data Acquisition is a helpful tool to see if the calibration was done properly. Measure the weight of your calibration weight after the calibration.

7.2 Calibration of the Balance Platform

The force transducers of the Balance Platform need not to be calibrated before any tests can be run with the unit. The initial calibration is done at the factory. The need of new calibration depends of how often the platform is used. Safest way is to calibrate the platform before every long test session. The need of new calibration can be checked by measuring a known weight with the General Data Acquisition.

Calibration can be started by selecting '**Platform|Calibrate**' from the program's main menu. The '**Calibrate Platform**'-window will appear as seen in Figure 12.

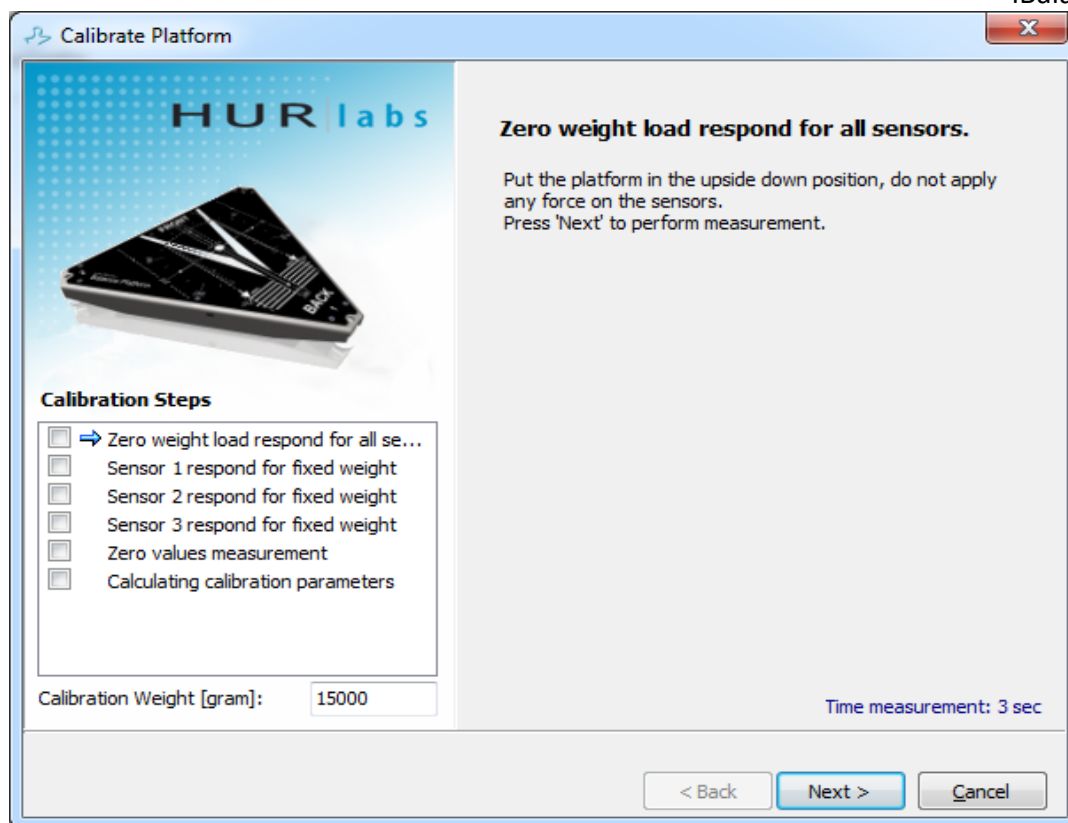


Figure 12: Calibrate Platform view

The Balance Platform calibration process consists of different phases: First the program registers the sensor values from the platform in upside-down position. The second phase is to put the calibration weight on every sensor. Both phases need to be successfully completed to get valid calibration data. Instructions on the screen will guide the user through the process.

Avoid using too light calibration weights. Calibration weight should be at least 10kg heavy. The heavier the calibration weight, the better the calibration should be. Note that the max weight is 200kg for a single sensor.

WARNING: A poor calibration can give incorrect results when performing the tests!

7.3 General Data Acquisition

Calibration can be started by selecting 'Platform|General Data Acquisition' from the program's main menu. The 'Calibrate Platform'-window will appear as seen in Figure 13.

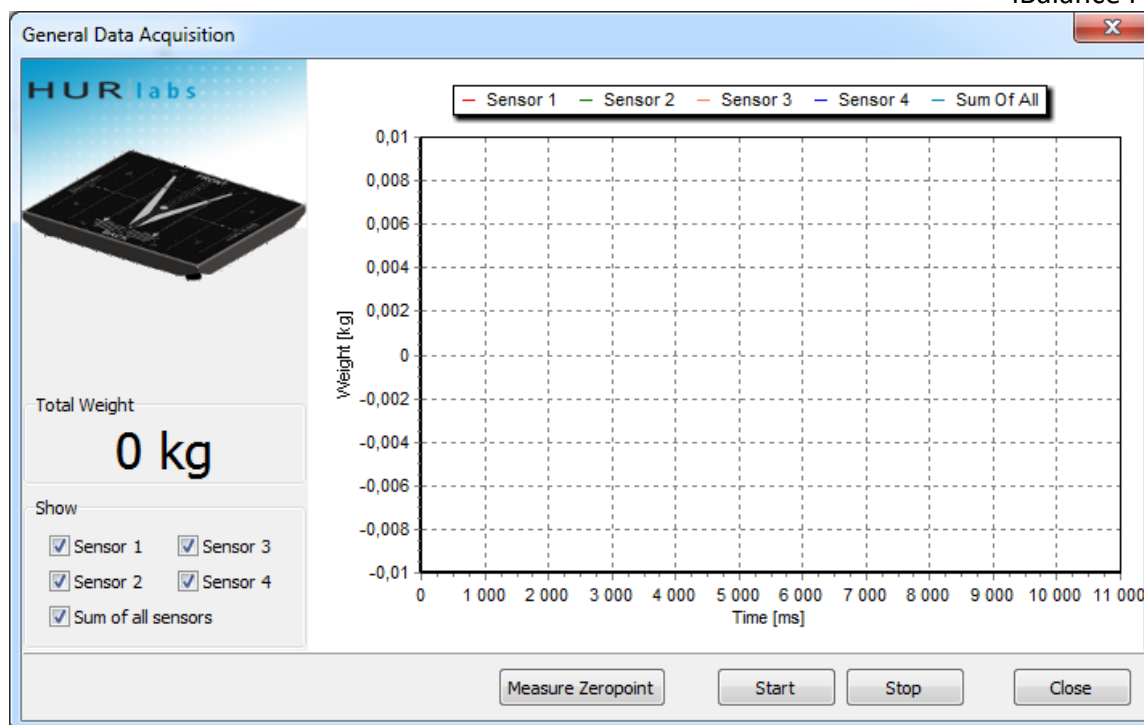


Figure 13: General Data Acquisition window

General Data Acquisition is a helpful tool to see what values you actually get from each sensor. For example you can adjust the the sensors so that they are approximately at the same level or you can just measure your own weight.

7.4 Test Preparations and Safety

Check the following things before starting the tests:

- The surface of the platform is clean and not slippery
- The platform is placed steadily on the floor
- Sensors are on the same hight with each others
- Calibration is done properly
- Clean testing area. USB cable or other objects shouldn't create risk of falling or tripping
- The platform is functioning properly
- The patient is fit for the test
- A trained instructor is supervising the patient during the test.

WARNING: Neglecting test safety instructions can result in considerable danger to the user!

WARNING: Improper test preparations can cause incorrect test results!

Examine chapter 11.2.2 for information about test circumstance recommendations.

7.5 Performing Tests

First select the person from the database and then click on the '**Perform Test**'-button. A window listing all available test protocols will appear. Select the test protocol from the list and click 'OK' to proceed to testing.

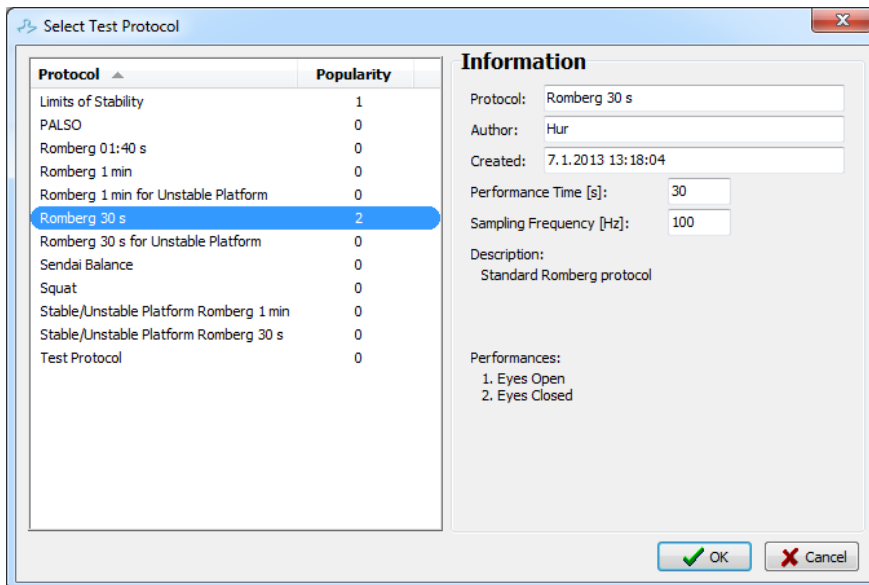


Figure 14: Select test protocol window

Before going to the actual test, the platform's weight need to be measured. This is called as the zero values measurement. Make sure that no weight is applied on the platform during this measurement. Zero values measurement is done once after the selected person was changed.

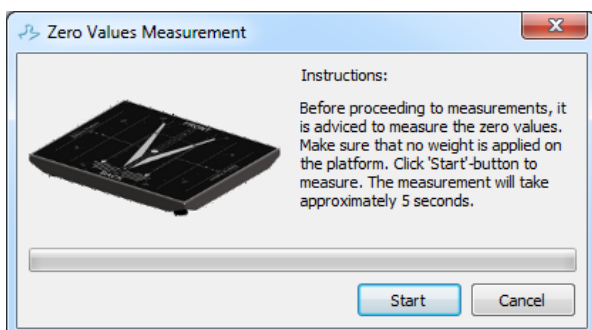


Figure 15: Measure Zero Values Window

After measuring the zero values, a window will appear as in Figure 16.

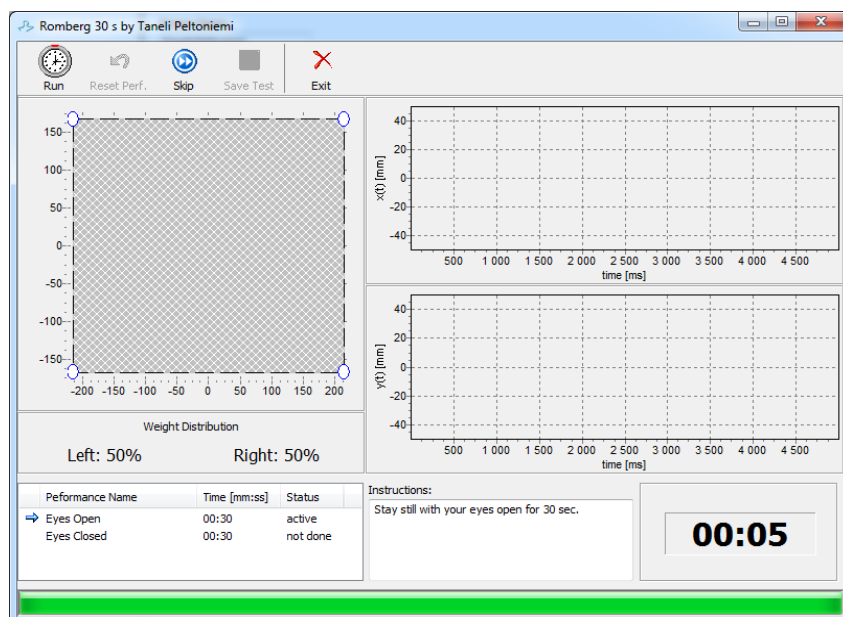


Figure 16: Perform Test Window

Protocol might have more than one performance. For example the Stable/Unstable Platform Romberg 30 s protocol consists of Eyes Open and Eyes Closed phases. Performances can be skipped. If the person fails to successfully perform the performance, then the performance can be marked as failed.

NOTE: If connection to the platform closes during the test, replug the USB cable to the PC and repeat the performance.

7.6 Limits of Stability(LoS) Test

First select the person from the database, click the '**Perform Test**'-button and then select the Limits of Stability protocol. A window will appear as in Figure 17.

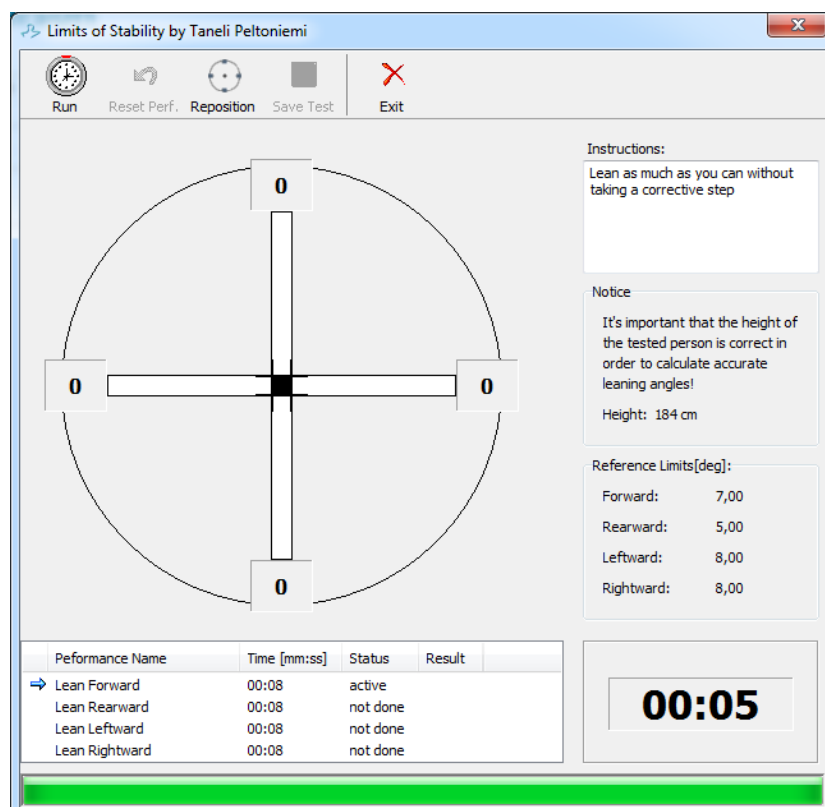


Figure 17: Limits of Stability Test Window

Reposition will recalculate the 'normal' position of the test person. This way the test person doesn't have stand exactly in the middle of the platform. Clicking on the '**Run**'-button will start the test. Follow the instructions on the screen.

This protocol is used to test the person's limits of stability in four directions. The tested person should stand in a normal standing position heels separately. Note that the reference limits are hard to reach even for someone who hasn't got balance problems! It is important that the tested person's height is correct in order to get calculate accurate leaning angles!

7.7 Protocols Manager

Click on the '**Protocols Manager**'-button or select '**Protocol | Protocols Manager**' from the program's main menu to open the '**Protocols Manager**'-window (Figure 18). From there you can see all the protocols that are available.

The following information is shown:

- Protocol Name
- How many tests are made with this protocol
- Author
- Created/Updated time and date
- Description
- Protocols performances
- Performance Time [s]
- Sampling Frequency [Hz]
- Instructions of the performances

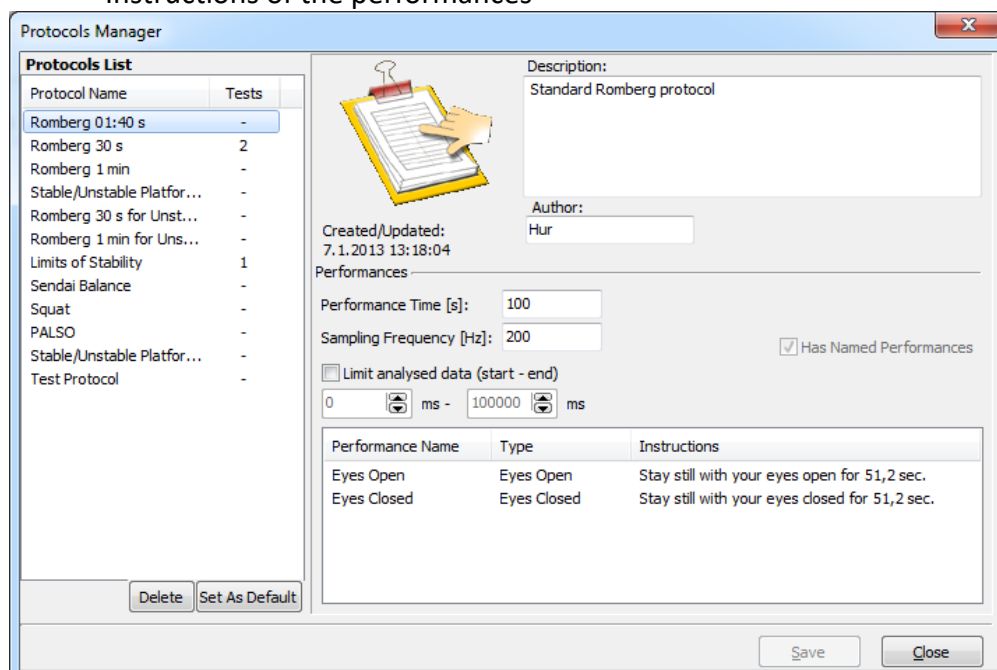


Figure 18: Protocols Manager Window

It is possible to delete protocol or set protocol as default. Also performance name, type and instructions can be changed. Right click on the performance and Performance Information window will appear.

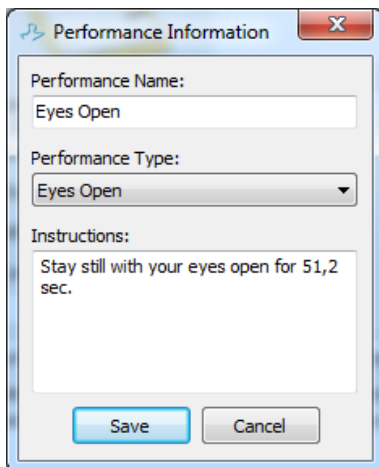


Figure 19: Performance Information

7.8 Protocol Wizard

iBalance Premium Software gives an opportunity to create your own protocols. This is handled by using the Protocol Wizard. Select '**Protocol | Protocol Wizard**' from the program's main menu to run the Protocol Wizard.

The Wizard includes five steps:

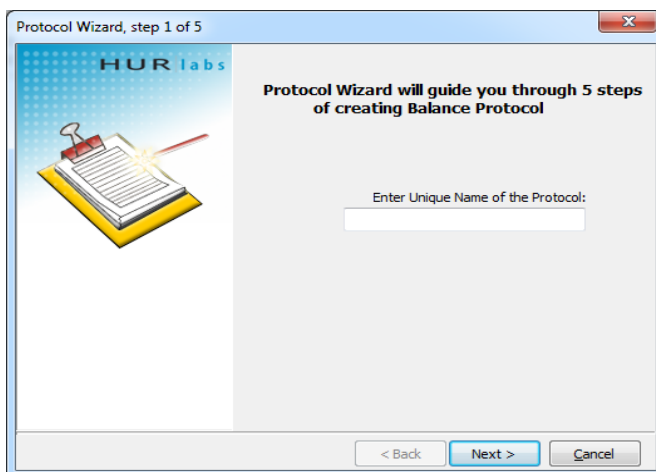


Figure 20: Protocol Wizard Step 1 window

- The first step is to give your protocol a unique name.
- Name the author and give some sort of description of the protocol
- Performance measurement parameters. Give the performance time [s] and select the Sampling Frequency [Hz]. It is recommended to select the 50 Hz setting since it's sufficient for balance type of data acquisition and reduces performance data size.

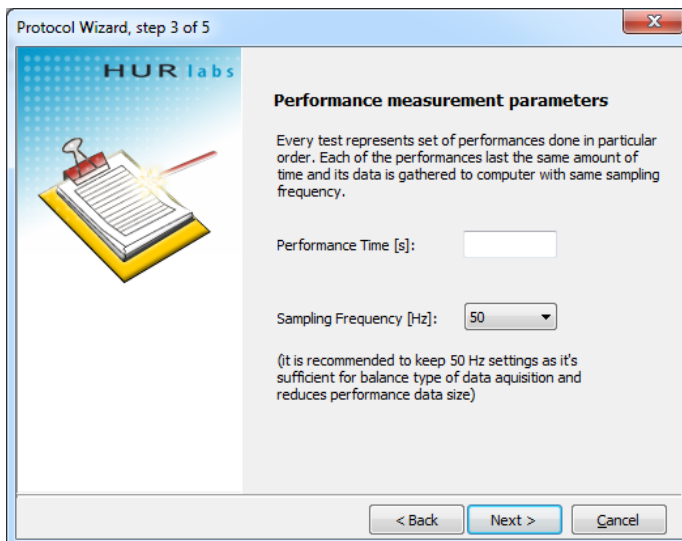


Figure 21: Protocol Wizard Step 3 window

- Performance definitions. At this point you can select to add performances to your protocol. Remember to name them and give them some sort of description. Each performance must be defined as a certain type performance, for example Eyes Open. Performance types are used when comparing performances.

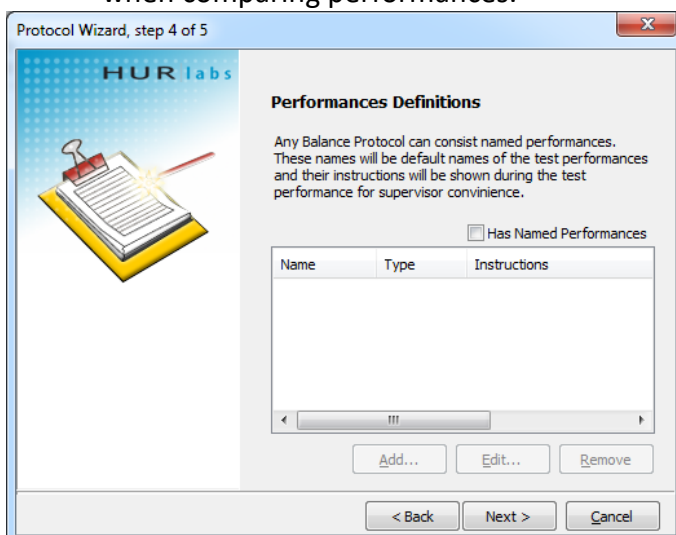


Figure 22: Protocol Wizard Step 4 window

- The final step is to save the protocol.

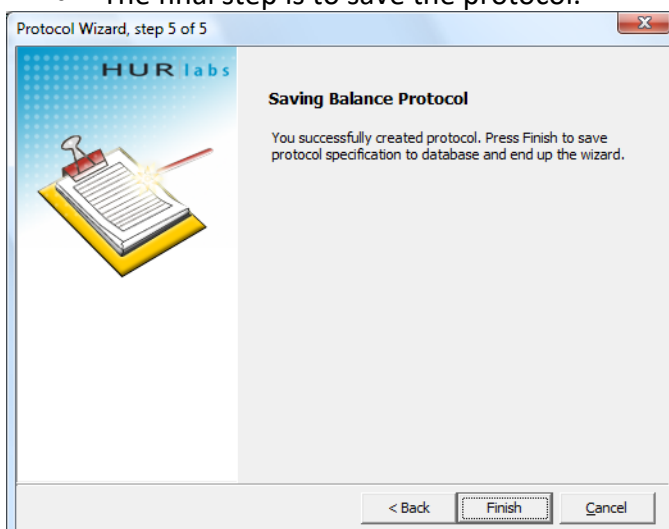


Figure 23: Protocol Wizard Step 5 window

8 Integration with HUR SmartTouch

Since the version 2.4.0.0 it's possible to integrate the iBalance Premium software with the HUR SmartTouch system. This means that you can perform tests and trainers with the iBalance Premium software and you will be able to see the results on the HUR SmartTouch web application. Only the results are sent to the server, so make sure you have all of the settings correct locally before sending the results.

NOTE: You should make sure that the HUR SmartTouch you have is set to handle the iBalance as equipment and the related activities. Please see the HUR SmartTouch manual for instructions on how to add iBalance related activities.

8.1 Settings

In order to establish a connection to the HUR SmartTouch you will need to know server address and the login credentials for the machine. To change these go to '**File | Settings | HUR SmartTouch**' (Figure 24). Fill in the address, username and the password fields. The username and password are determined when creating the machine on HUR SmartTouch, for more information please see the HUR SmartTouch manual.

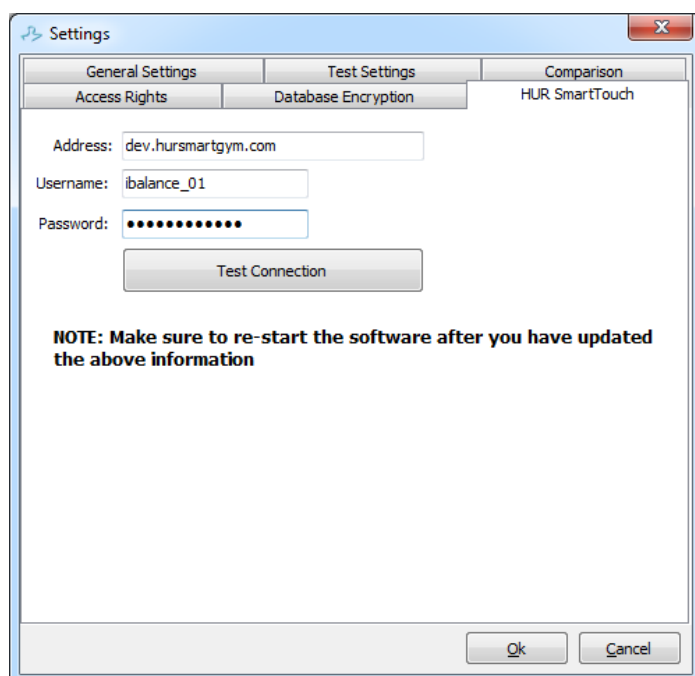


Figure 24: HUR SmartTouch settings

After you have made all of the settings you can click the OK-button to save these settings. You will need to restart the software after you have made these changes.

8.2 Importing persons

It's not possible currently to create persons in the iBalance Premium software and have them automatically be created on the HUR SmartTouch. To get access to the persons in HUR SmartTouch and the ability to do tests that are saved in the cloud, you will need to create the persons in the HUR SmartTouch system. For information on how to create the user in HUR SmartTouch please see manual for the system.

NOTE: You should also set the physical attributes for the person in HUR SmartTouch such as height.

After you have successfully created the persons in the HUR SmartTouch, you can import them from the iBalance Premium software by clicking the Database-button that is found over the treeview on the left

side and selecting “**Import from HUR SmartTouch**”. See Figure 25. This will start the person importing from HUR SmartTouch.

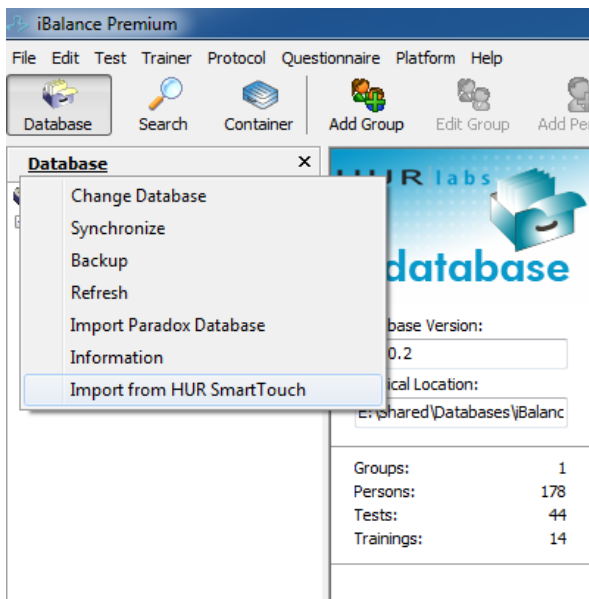


Figure 25: Importing HUR SmartTouch persons

The importing will create a new group called HUR SmartTouch to the software and create all the persons it can find from the HUR SmartTouch system. You are free to move these persons to another group after the importing has been finished and you will still be able to use them normally. When importing a person the software will automatically link the ID of the user in HUR SmartTouch to the local ID of the person. This allows you to test and train without the usage of RFID-tag. You can simply select the person from the list and start testing.

8.3 Performing Tests and Trainers

Performing Tests and Trainers is similar to how it normally works. The only difference is that the user will have access to only limited amount of protocols and all of the trainers. The protocols are (Figure 26):

- Stable / Unstable Romberg 30 s
- Limits of Stability
- Profy 65+
- PALSO
- Weight Distribution

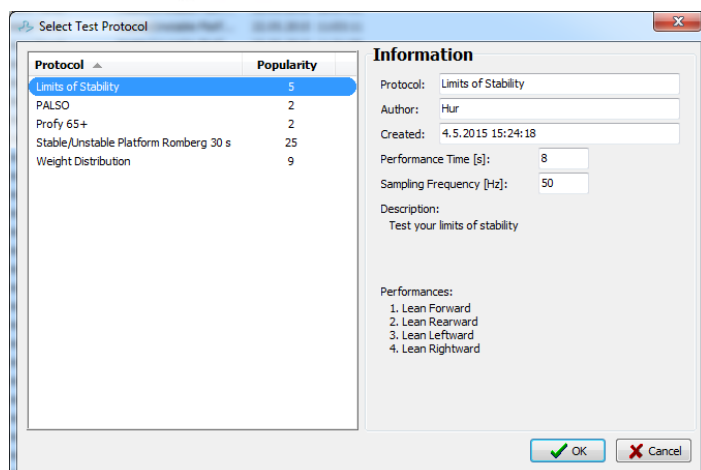


Figure 26: Protocol selection for HUR SmartTouch testing

If the user has more than 1 training program scheduled, they will be prompted to select one when first starting the testing (Figure 27). The training programs which contain activities for the current equipment will be in green.

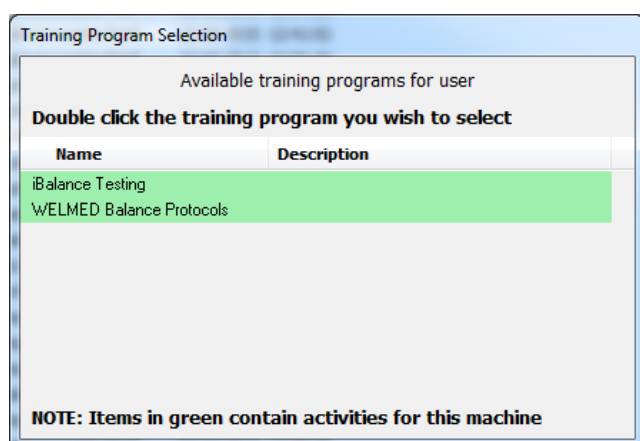


Figure 27: Training Program selection

After you have performed the test or trainer you will be prompted to enter information about the test such as the supervisor. If the user has a training program specified in the HUR SmartTouch, you will see a window popup such as seen in Figure 28. In this case the user has successfully performed the Stable / Unstable Romberg 30 s test and they still have left the Limits of Stability and the trainers. The user will have option to either continue the visit or end the visit. Choose Continue visit, if you wish to perform more tests or trainers. Otherwise select End visit, which will end the visit.

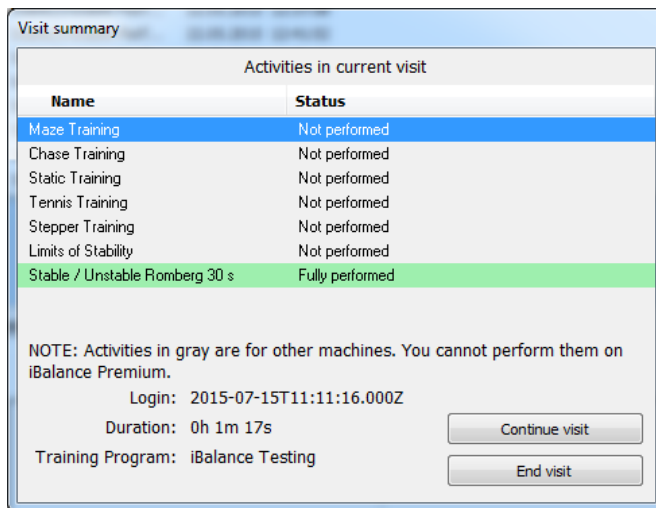


Figure 28: HUR SmartTouch visit summary

If at the end user does not have any more activities left for current equipment, they will be prompted to end the visit (Figure 29).

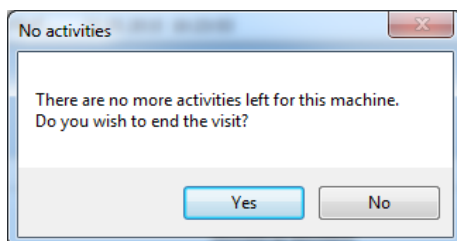


Figure 29: No activities left prompt

9 Analysis and Comparison of Test Results

9.1 The Analysis of Balance Test

'Balance Test Analysis'-window (Figure 30) shows results obtained from selected test. See chapter 11 Introduction to Balance for more detailed information.

In the header of the window there are following information concerning performed test:

- Test Name - name chosen when test was performed,
- Person Tested - name of the tested person as states database,
- Date - date and time when test was performed,
- Protocol - protocol used in the test,
- Supervisor - supervisor of the test, name entered when test was completed,
- Additional Info - specific information entered when test was completed (i.e. describing state of the person tested).

Lower part of the window shows detailed information and results obtained in each performance of the test.

Upper tabs allow switching between performances. Number of tabs indicates amount of performances in the analyzed test. The names of the tabs correspond to particular names of performances. Lower tabs allow switching between different analysis types of the data within selected performance.

9.1.1 Summary

The most important test results are shown on the summary tab sheet. Colors indicate how each result compares to compared results. By default comparison includes normative data, both genders, all age groups and results from the test person's group. Default comparison settings can be changed from the 'File|Settings'. Also current settings can be changed by right clicking on the chart.

Green (low fall risk) means the part where most of the results lay (0 – 90 %). Yellow (medium fall risk) is kind of a danger zone, meaning that 90 – 95 % of the compared results are in this zone. Red (high fall risk) zone marks the highest compared results (> 95 %). The lowest result would be at 0 % and the highest result would be at 100 %. Note that these limits can be changed from the settings.

Normative data includes test results made with BT3 or BT4 at HUR Labs reference locations. There are approximately 2900 test results in the normative database. Most of the tests are Romberg 30 s and PALSO tests.

NOTE: When looking at the results, remember the context. For example, if comparison includes only a group of gymnastics and no normative data, then the red zone wouldn't necessary mean high risk of falling.

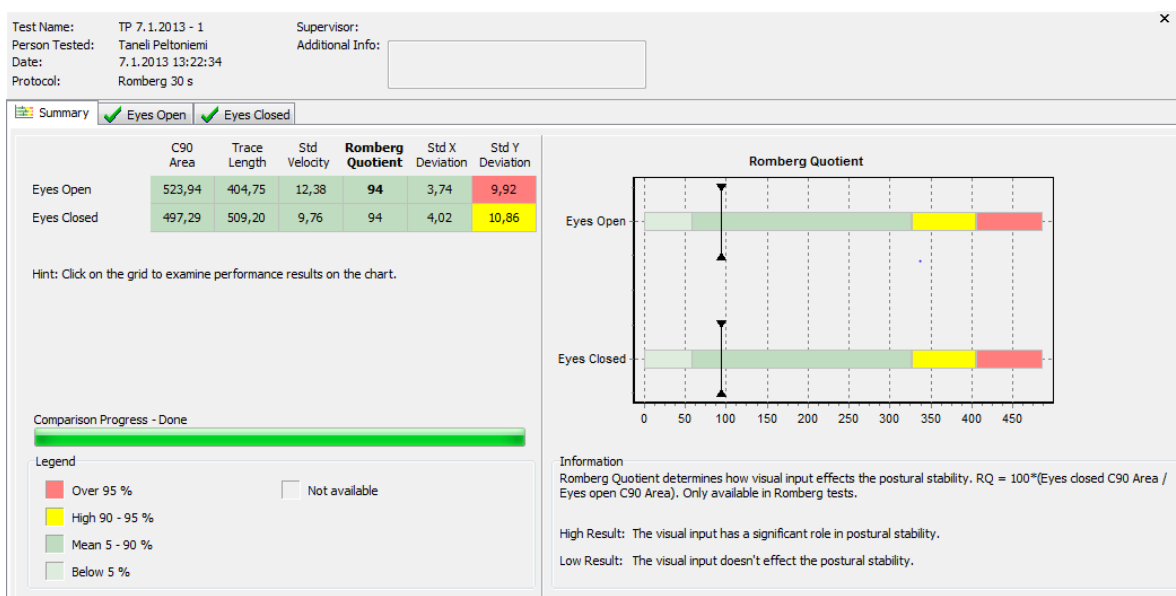


Figure 30: Analysis summary

9.1.2 Posturogram

The red curve traces how the center of pressure (COP) shifts with time. The 90-percent **confidence ellipse** is defined as the smallest ellipse containing about 90 percent of the COP-points. The ellipse thus gives a measure of the extension and area of the total sways during the measurement.

- **Trace length** of the posturogram is defined by summing the length of straight segments connecting points that follow in a succession and separated in time by 1/5th of a second. (The smaller time separation, the longer will the calculated trace length be, because the shorter segments will follow all the small wrinkles of the posturogram. Hence one has to choose a fixed time separation in order to make the calculations for different measurements comparable.)
- **C90 Area** is simply the area of the confidence ellipse. Generally, the bigger area the bigger sways.
- **C90 Angle** is the angle of the major axis of the ellipse relative the medial-lateral direction. If one has an elongated ellipse which significant tilt to either side this is an indication of asymmetry.
- **Velocity** is simply calculated by dividing the total trace length by the duration of the test.
- **STD Velocity** is derived by calculating the square root of the sum of the square of the deviations about the x- and y-coordinates, divided by the sample size minus 1.
- **Romberg Quotient**. Only available in Romberg tests. $RQ = 100 * (\text{Eyes closed C90 Area} / \text{Eyes open C90 Area})$.
- **Weight Distribution**. Shows the percentage of the force that was applied for the right and the left side of the platform.

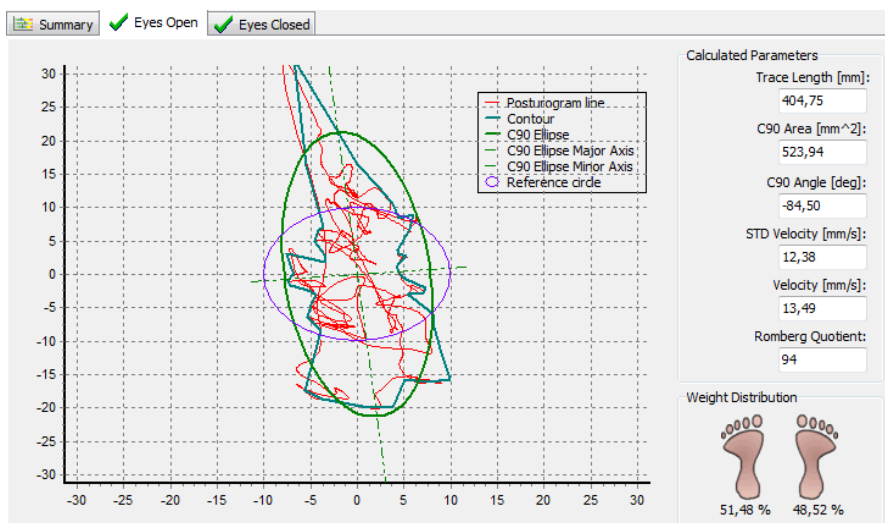


Figure 31: Balance Test Analysis window with posturogram

It is possible to export Posturogram line, Contour, C90 Ellipse, C90 Ellipse Major Axis, C90 Ellipse Minor Axis and Reference circle to clipboard by right-clicking on the chart and selecting the wanted option from the popup menu. The chart can also be zoomed by “painting” the area to be zoomed.

9.1.3 Stabilogram

The **stabilograms** display the COP-coordinates as a function of time. The sways in medial-lateral direction define the x-coordinate, and the sways in the anterior-posterior direction define the y-coordinate.

The x-histogram shows the distribution of the COP-position around the mean position ($x = 0$).

The y-histogram shows the distribution of the COP-position around the mean position ($y = 0$).

In the "ideal" case the distribution is close to the Gaussian shape (red curve). A histogram with e.g. two dominant peaks may indicate that the person oscillates between two quasi-stable points. **Standard deviation** is a measure, which characterizes the size of the sway from the average position.

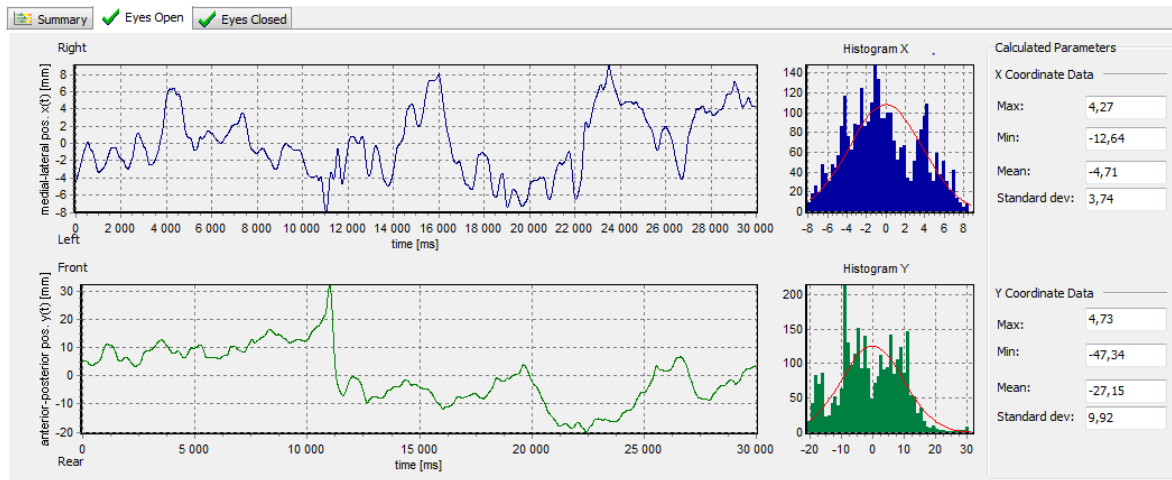


Figure 32: Balance test analysis window with stabilogram

It is possible to export Stabilogram X(t), Stabilogram Y(t), Histogram X Line, Histogram X bars, Histogram Y Line and Histogram Y Bars to clipboard by right-clicking on the corresponding chart and selecting the wanted option from the popup menu. The charts can also be zoomed by "painting" the area to be zoomed.

9.1.4 Power Spectrum

Note that the Power spectrum is only available when analyzing tests made with the 4 sensor Balance Platform. **Power spectrum** characterizes the frequency content of the stabilogram.

Regular oscillations may show up as peaks in the spectrum.

There is possibility of choosing axis of ordinates in logarithmic or linear scale.

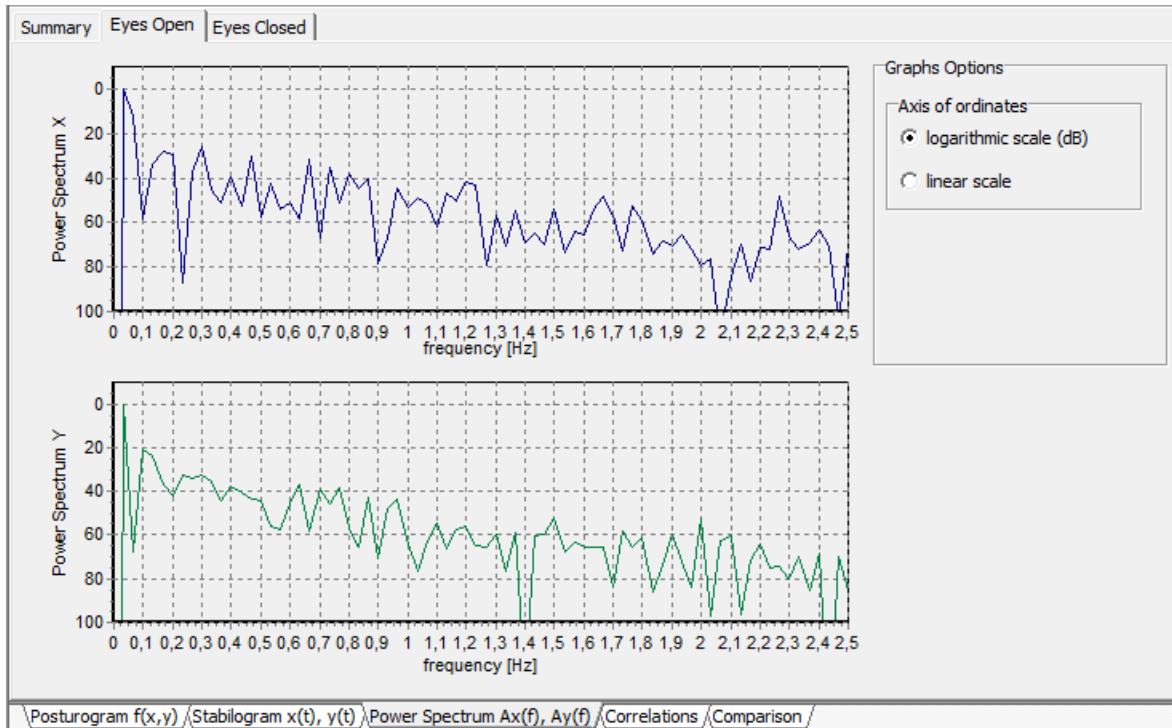


Figure 33: Balance test analysis window with power spectrum

It is possible to export Power Spectrum of $X(t)$ series and Power Spectrum of $Y(t)$ series to clipboard by right-clicking on the corresponding chart and selecting the wanted option from the popup menu. The charts can also be zoomed by “painting” the area to be zoomed.

9.1.5 Correlations

Note that the Correlations is only available when analyzing tests made with the 4 sensor Balance Platform. The **autocorrelation** measure is obtained by comparing a signal with its time-displaced copy; the more like they are each other the closer the correlation is to 1.

The horizontal axis in the correlation graph shows the time displacement. At the origin the time displacement is zero and the signal is compared with an exact copy with itself, therefore the correlation is 1 at this point. The time where the next peak in the autocorrelogram appears may describe a characteristic time scale of the sways. The intercorrelation is defined in a similar manner, but now we compare a signal x with a time-shifted copy of the signal y .

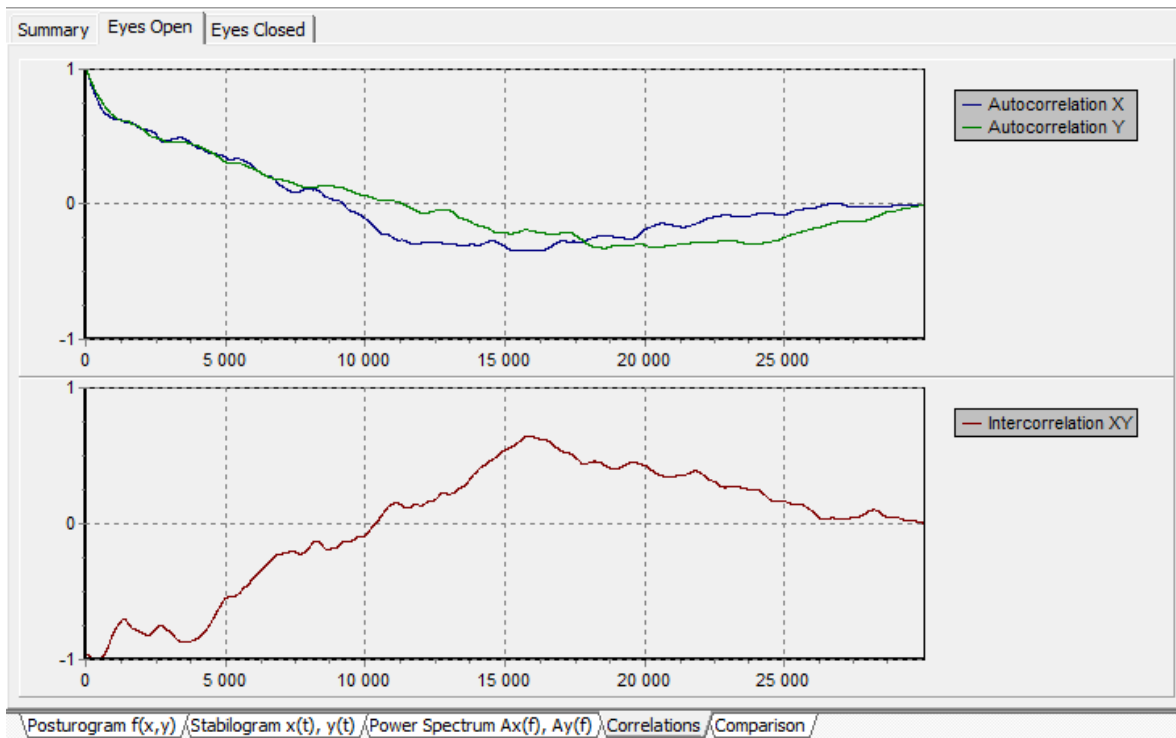


Figure 34: Balance test analysis window with correlations

It is possible to export Autocorrelation X, Autocorrelation Y and Intercorrelation XY to clipboard by right clicking on the corresponding chart and selecting the wanted option from the popup menu. The charts can also be zoomed by “painting” the area to be zoomed.

9.2 Analysis of LoS Tests

'LoS Test Analysis'-window (Figure 35) shows results obtained from selected LoS test.

In the header of the window there are following information concerning performed test:

- Test Name - name chosen when test was performed,
- Person Tested - name of the tested person as states database,
- Date - date and time when test was performed,
- Protocol - protocol used in the test,
- Supervisor - supervisor of the test, name entered when test was completed,
- Additional Info - specific information entered when test was completed (i.e. describing state of the person tested).

Lower part of the window shows results obtained. Graph shows results as bars. Circles describe reference limits. Bar is colored red if the reference limit is not achieved. Note that the reference limits are hard to reach even for someone who hasn't got balance problems! Blue arrow identifies the weakest leaning direction. In this example the test person cannot lean as much forward as to other directions. The arrow's length increases by the severity of the leaning imbalance.

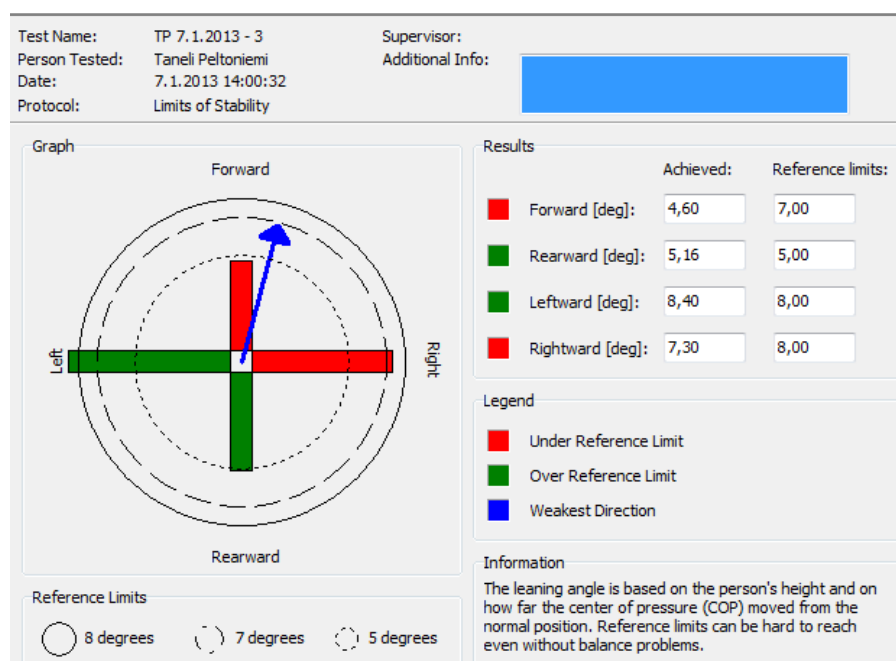


Figure 35: Limits of Stability analysis window

9.3 Comparison of Balance Tests

Use the Scope Data Filter (as explained earlier in the Chapter 6.7) to gather several tests for comparison.

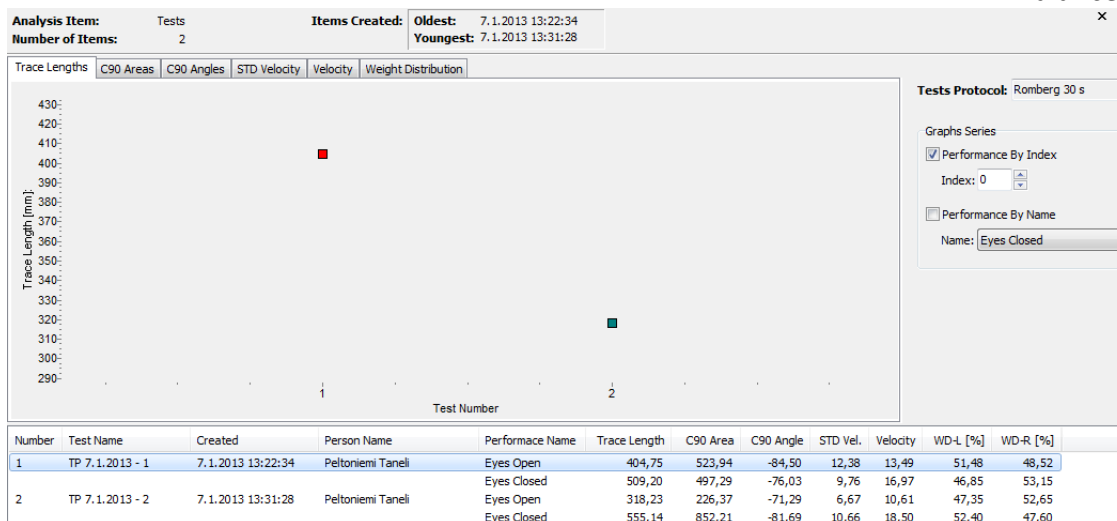


Figure 36: Comparing tests window

Left clicking on the points on the chart selects the corresponding performance from the list and vice versa.

Right clicking on the chart brings up a popup menu where you can select the corresponding data to be exported to the clipboard. **'Export Data'**-button will extract all the data to a file (see Chapter 6.9 for further information).

10 Trainer

10.1 Starting the Training

First select the person from the database and then click on the '**Perform Trainer**'-button. A window listing all available trainers will appear. Select the trainer by clicking it. Zero values measurement might be needed similarly as in normal testing.

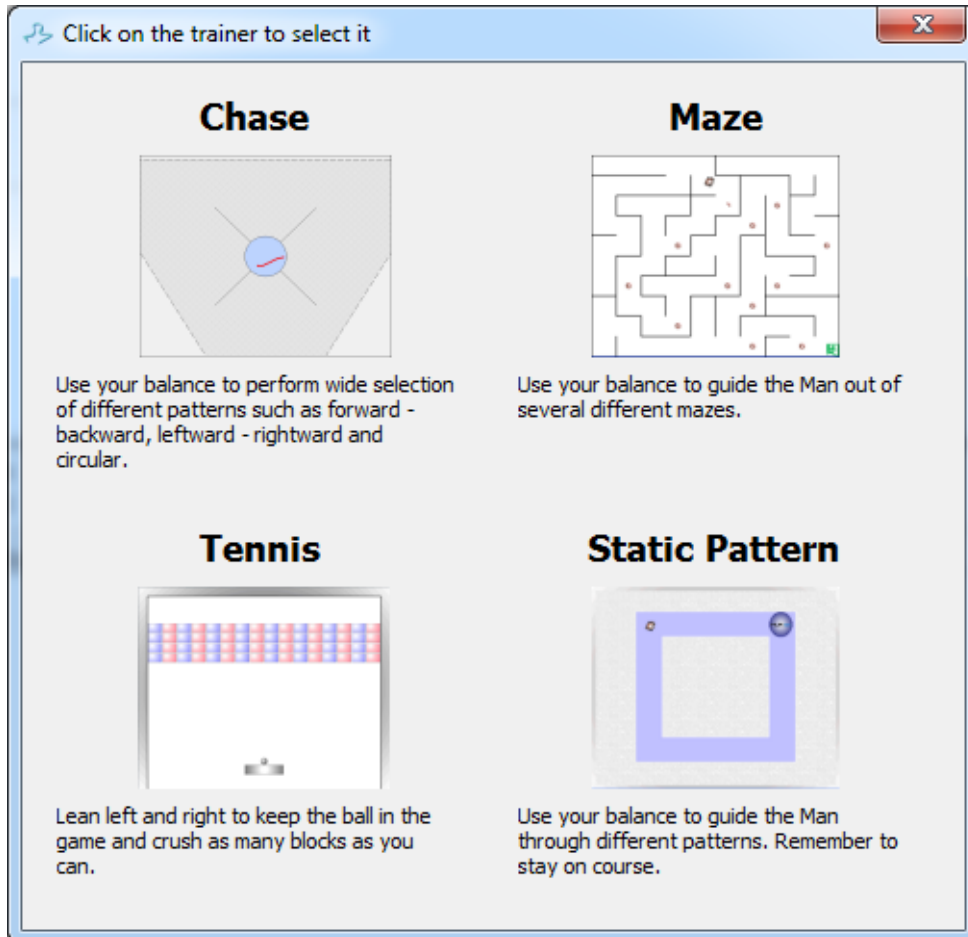


Figure 37: Select trainer window

All five trainings have same characteristics. As when performing tests, the first thing is to measure the zeropoints. After measuring the zeropoints, the test window will appear. When clicking the '**Start**'-button the countdown starts. Training starts after the countdown. The white bars indicate your position on the platform. This helps you to find the center point of platform. After finishing the training successfully you can save the training or start a new one.

NOTE: Stepper training is only available with platform's that have 4 sensors.

10.1.1 Chase

In the Chase Trainer the main idea is to stay on the blue area as it moves. The training takes 2 minutes. For the first minute the ball-shaped area moves clockwise and for the second minute it moves counter-clockwise. The short red line shows the COP. Result means the percentage of time you spend on the platform. The next options are available in the settings of the chase: Course(circle, cross, axis), Duration(60s, 120s, 180s), Size(Small, Normal, Large) and Speed(fast, medium, slow).

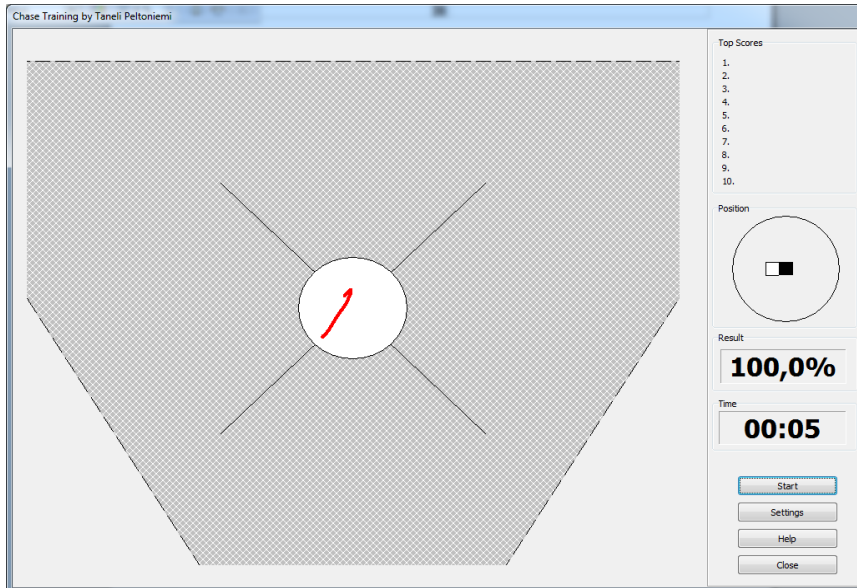


Figure 38: Chase Trainer window

10.1.2 Maze

In the Maze Trainer the main idea is to find the exit as soon as possible. You start from one of the corners and the exit is in the opposite corner. The result is the time that took you to find the exit. You can choose larger(15x15) or smaller(10x10) maze. It is possible to view the correct path to the exit by clicking the '**Checkpoints**'-checkbox. From the settings you can also select the starting corner and and mirror the maze horizontally or vertically.

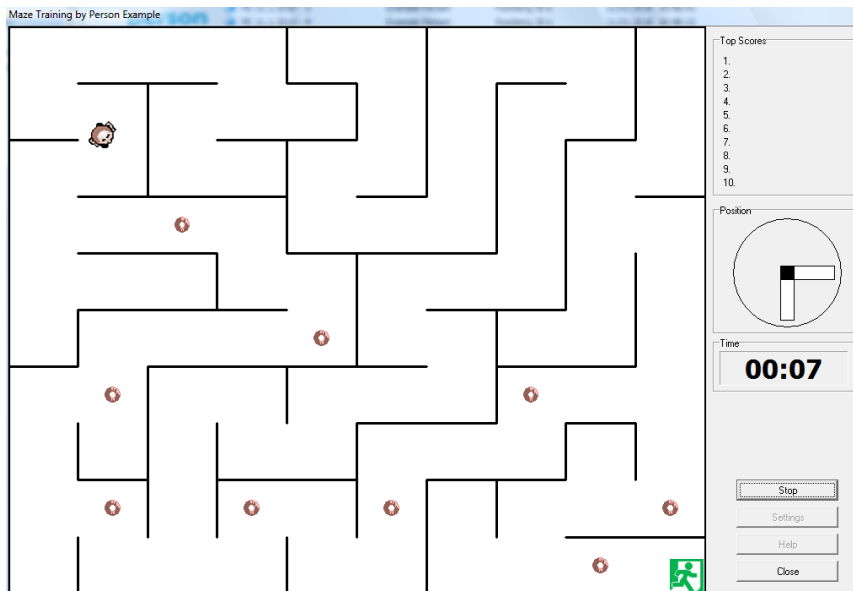


Figure 39: Maze Trainer window

From the Maze Settings window you can select to save the generated maze for later use. Click '**Browse**' in order to view saved mazes (Figure 40).

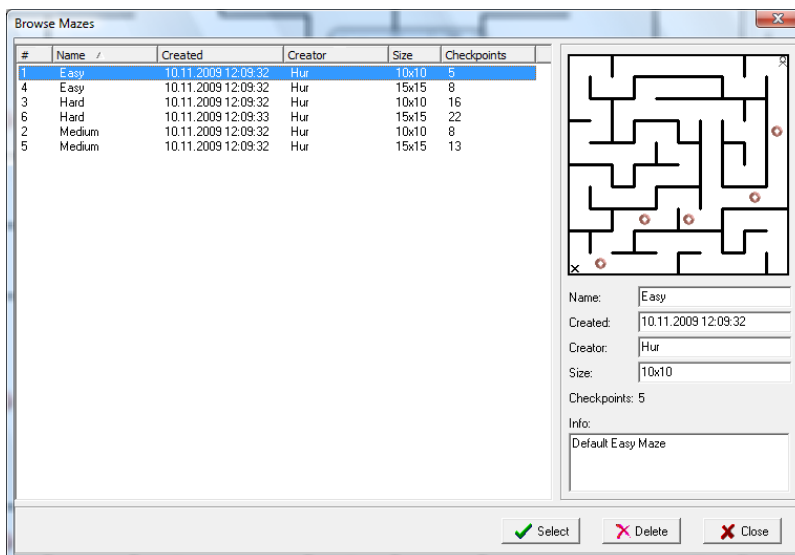


Figure 40: Browser Saved mazes

10.1.3 Stepper

The main idea of the Stepper Trainer is to step on the correct corners of the platform. The yellow star shows the next corner you need to step on. The foot shows the corner that you are currently stepping on. Remember that the COP needs to go beyond 100 mm or -100 mm (from the center point of the platform) horizontally and vertically. The training takes one minute. The result is the number of collected stars.

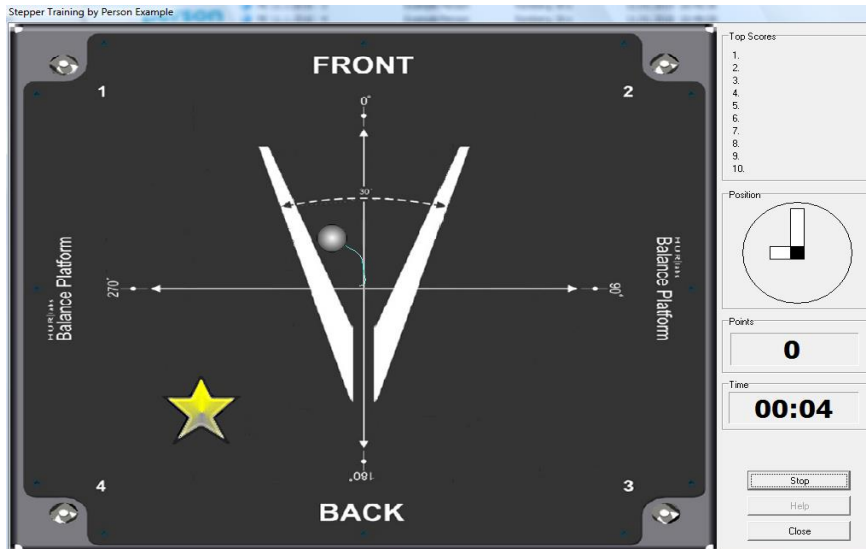


Figure 41: Stepper Trainer window

10.1.4 Tennis

The main idea of the Tennis Trainer is to keep the ball in the game and collect points by smashing blocks with the ball. Move horizontally to move the platform. Lean forward to release the ball. Smashing blocks gives you points. After destroying all the blocks you will be rewarded with one extra platform. You will start the training with two extra platforms. The next options are available from the Tennis settings: Size of the platform (large, small) and Speed of the ball (fast, slow). More difficulty means more points from smashing blocks.

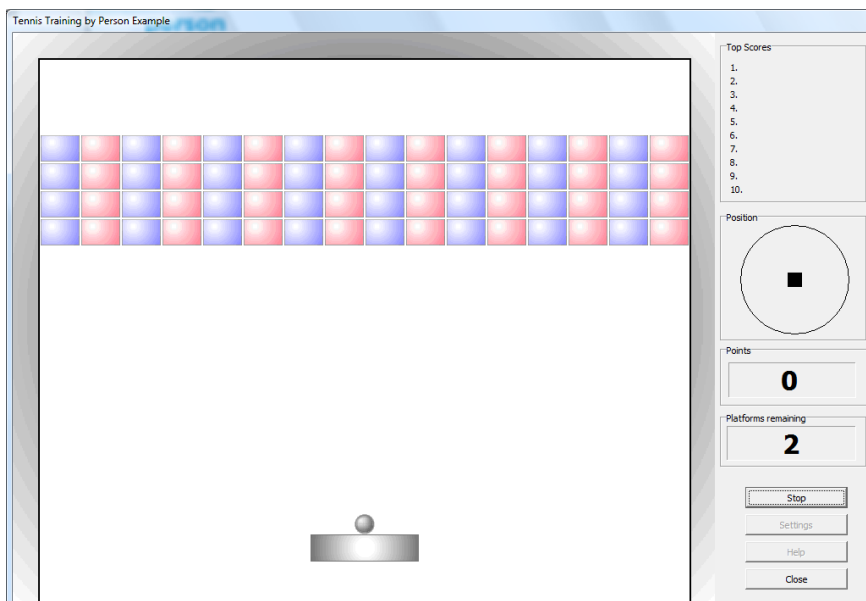


Figure 42: Tennis Trainer window

10.1.5 Static Pattern

The main idea of Static Pattern training is to move steady as possible inside the blue track. The speed is not the most important factor. It is possible to select the track from the following: Square, Circle, Cross and Axis. It is also possible to set the duration of the training.

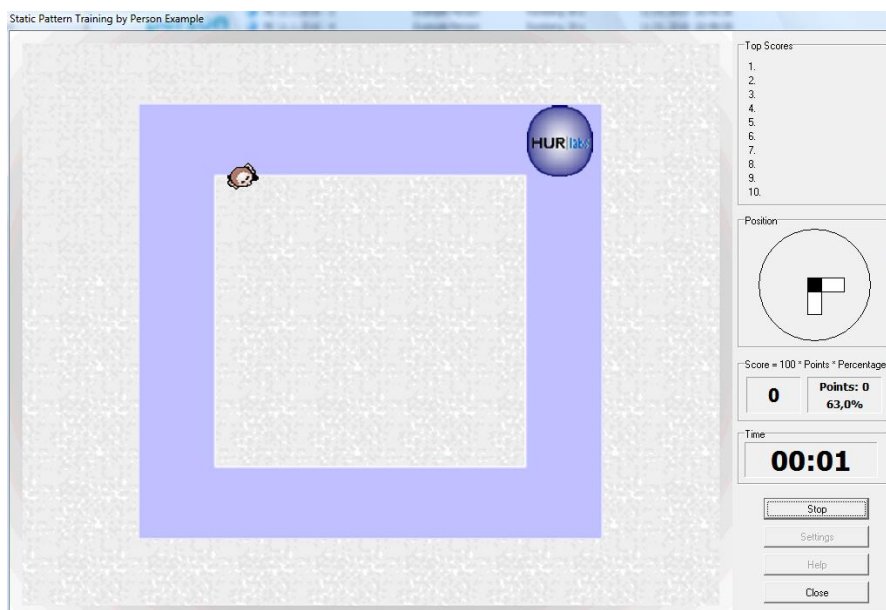


Figure 43: Static Pattern Trainer window

10.2 High Scores

High Scores can be found by selecting '**Trainer | High Scores**' from the program's main menu or by clicking the '**Top Trainings**'-button. A window will appear as in Figure 44. Right click on the list to print or export the results.

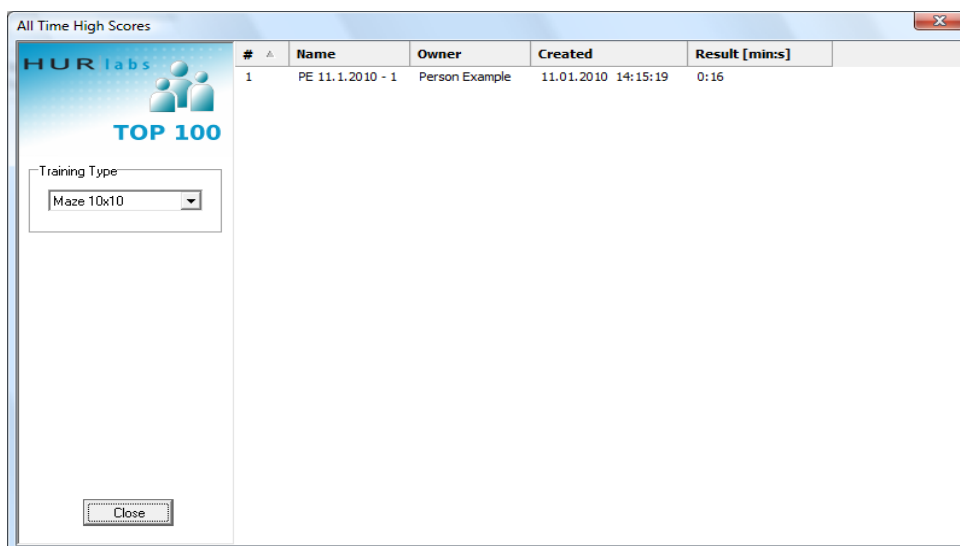


Figure 44: High Scores window

11 Introduction to Balance

Balance is one of the human motor skills that are of great importance in the activities of daily life. Thus, it has become an important object for scientific studies. Studying the human balance is also of great economic importance when linked for instance to the prevention of falling accidents among senior citizens.

Balance can be measured and trained through different physiotherapeutical and technical methods. The functional balance can be studied through test batteries developed for this purpose. The aim of these batteries, e.g. Berg balance scale is to find out the individuals functional capacity and to predict her ability to manage the activities of daily living. The improvement of balance skills needs well planned and targeted interventions. To ensure the efficacy of the intervention one needs a follow-up system that is reliable and easy to accomplish. Through the Balance Platform and iBalance Premium Software this becomes possible.

11.1 Elements of postural analysis

To be able to perform a postural analysis one needs to be aware of some fundamentals related to postural control.

11.1.1 Body sway

One of the characteristics of human balance is the constant swaying during quiet stance. Body sway and its control mechanisms has been the target of interest in several studies since the late 19th century.

Body sway in quiet stance can be described by the model of an inverted pendulum pivoted at the ankles. This is the case if the sway is controlled “traditionally”, i.e. through the ankle strategy. In the ankle strategy the subject controls the swaying of the body by co-activating the muscles around the ankle, hip and knee joints as well as the postural muscles in the neck and the trunk; by freezing the degrees of freedom in all the other body parts besides the ankle joint, so that the rotation of the body is concentrated around the ankle. The ankle strategy is common for controlling posture in quiet stance. In severe balance disorders, e.g. due to neurological illness other control strategies than ankle strategy are possible. In perturbed stance, as the body center of mass (COM) gets close to the edge of the base of support (BOS) other strategies - such as hip flexion or upper limb movements - are shown also by healthy subjects.

For the best outcome of the postural analysis one should be familiar with the control mechanisms behind the sway. See the list of literature for further reading.

11.1.2 Center of pressure – COP

The body weight of the person standing on the Balance Platform exerts a force on the platform via the feet. The force transducers attached in every corner of the platform register vertical force ($F_1...F_4$). From the load distribution between the force transducers one can calculate the COP of the person standing on the platform. This is done by the iBalance Premium Software. In literature the COP-point is defined as the point in the plane of the platform where the total force F of the person is acting on the platform. The total force is dependent on the person's body weight and possible movements while standing.

Body sway causes a fluctuation of the COP of the person standing on the platform. Analysis of this fluctuation gives information for instance about the range, velocity and symmetry of the body sway. A simple measurement with the Balance Platform makes all this possible.

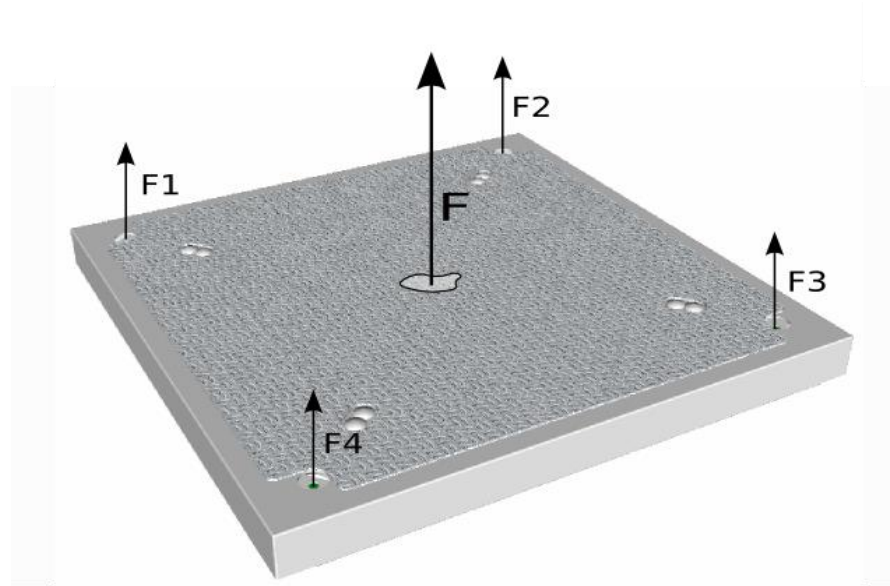


Figure 45: Vectors for weight distribution on the platform. The total force F acts in the COP-point which fluctuates as a result of the body sway.

11.2 Performing measurements with the Balance Platform

Putting up a reliable balance measurement requires standardized test circumstances and well defined parameters extracted from the data. The calibration of the equipment makes a significant difference in a valid measurement as well (see chapter 7.2 for calibration instructions).

11.2.1 Romberg test

In the Romberg test the same balance test is performed eyes open and eyes closed. The standard Romberg test consists of a 52-second-measurement of both, but due to practical reasons the length of the measurement is usually 60 seconds. A positive Romberg test/sign occurs when there is an increased amount of sway or a loss of balance when a person is asked to stand with the feet placed close together with his or her eyes closed, as compared with the amount of sway with the eyes open.

11.2.2 Recommendations about the test circumstances

The recommendations about the test circumstances are given by *The Committee for Standardization of Stabilometric Methods and Presentations* to make the stabilometric measurements comparable (Kapteyn et al. 1983):

- a) The subject should remove his/her shoes and stand on the stabilometric platform with the heels together, at an angle of 30 degrees between the medial sides of the feet. According to Morton (1935) this foot position provides about the equal support in both medio-lateral and antero-posterior directions. Gagey and Weber (1995) suggest keeping a separation of 2 cm between the heels to avoid that the balance is stimulated by the foot-to-foot contact. It is also recommended to keep the arms at the sides in a relaxed position.

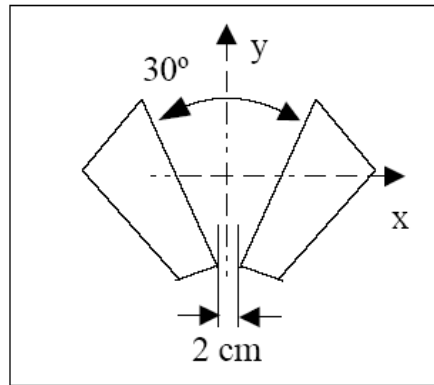


Figure 46: Morton's foot position

- b) No fixed sound sources should deliver information for spatial orientation in the room used for posturography; the noise level in the room should preferably be below ISO 40 dB(A).
- c) The room should be large enough to prevent acoustic spatial orientation, the minimum area being preferably 3 - 4 meters. The stabilometer should be placed at least 1 meter from any wall.
- d) During registrations with eyes open, the subject should focus on a circular area with a diameter of approx. 5 cm, at a distance of 3 meters straight ahead. Gagey and Weber (1995) recommend the participant to be instructed to slowly count from 1 to 100, say, in order to help take the mind off the test.
- e) For recordings of visual postural stabilization the peripheral field of vision should provide information on the vertical, and the room should have normal (diffuse) illumination of least 40 lux (lumen per square meter).
- f) During registrations with the eyes closed, some low-level dim light (about 20 lux) should be presented in the room in order to put the subject at ease and enable the investigator to observe her (him).

The points (a) – (e) summarizes the *Standard Test Condition* (SC) for stabilometric measurements. In addition a few other things should be considered:

- The effect of electromagnetic interference; e.g. cellular phones may cause disturbances in the data and should therefore not be kept close to the electronics.
- The order in which the *eyes open*- and *eyes closed*-tests are performed in the Romberg test; it should be considered whether and how the order influences the results.
- The position of the raised leg in one-foot stance should be carefully considered and standardized within the test group. Gill et al. (2001) suggest that the participants should not be allowed to stabilize their raised leg against their support leg.
- There should be enough time between the tests in order to avoid effects e.g. due to fatigue.

11.3 Analysing the results

Body sway is known to be an utterly individual attribute of the postural balance among the population. The reason behind the sway is still a bit twisted. The latest studies show that the sway might be a result of the characteristics of the muscle-tendon system. Thus one should be careful not to make any strict conclusions about the numeric results as such. Instead a statistical analysis within a test group should be considered (Borg & Herrala 2004).

Of the parameters below the "C90 Area" is the classical parameter. The surface area for a person varies from test to test due to the inherent variability. Thus, comparing the absolute values of the sway areas is less significant than comparing areas for tests under various conditions (eyes open, eyes closed, compliant surface, ortosis, etc) or tracking its changes e.g. due to training and rehabilitation ("before/after"). The area can be useful too for studying variations between groups.

With iBalance Premium Software analysis through following parameters is possible:

Posturogram (Figure 31)

The red curve traces how the center of pressure (COP) shifts with time. The 90-percent **confidence ellipse** is defined as the smallest ellipse containing about 90 percent of the COP-points. The ellipse thus gives a measure of the extension and area of the total sways during the measurement.

- **Trace length** of the posturogram is defined by summing the length of straight segments connecting points that follow in a succession and separated in time by 1/5th of a second. (The smaller time separation, the longer will the calculated trace length be, because the shorter segments will follow all the small wrinkles of the posturogram. Hence one has to choose a fixed time separation in order to make the calculations for different measurements comparable.)
- **C90 Area** is simply the area of the confidence ellipse. Generally, the bigger area the bigger sways.
- **C90 Angle** is the angle of the major axis of the ellipse relative the medial-lateral direction. If one has an elongated ellipse which significant tilt to either side this is an indication of asymmetry
- **Sway average velocity** [mm/s]: The average velocity is simply calculated by dividing the total trace length by the duration of the test. This parameter contains information about the person's ability to control the sway and to correct the balance. Usually a high average velocity is related to an increased risk of falling among elderly (Ferne et al. 1982).
- **Standard deviation velocity** [mm/s]: The standard deviation velocity is derived by calculating the square root of the sum of the square of the deviations about the x- and y-coordinates, divided by the sample size minus 1. For the calculations and coordinates the sampling rate of 5 is applied. This parameter also contains information about the person's ability to control the sway and to correct the balance.

Stabilogram (Figure 32)

- The **stabilograms** display the COP-coordinates as a function of time. The sways in medial-lateral direction define the x-coordinate, and the sways in the anterior-posterior direction define the y-coordinate.
- The x-histogram shows the distribution of the COP-position around the mean position ($x = 0$).
- The y-histogram shows the distribution of the COP-position around the mean position ($y = 0$).
- In the "ideal" case the distribution is close to the Gaussian shape (red curve). A histogram with e.g. two dominant peaks may indicate that the person oscillates between two quasi-stable points. The shape of the histogram becomes especially interesting in connection with orthosis as a "good balance" is characterized by an almost Gaussian distribution. To ensure the perfect fit of an orthosis changes are made until the COP-distribution is ideal.
- **Standard deviation** is a measure, which characterizes the size of the sway from the average position.
-

Romberg quotient (RQ): A standard parameter is the Romberg quotient, the ratio between the area for eyes closed on eyes open condition, $Area (EC) : Area (EO)$. This is generally greater than 1 since people

tend to improve their balance by using visual feedback. Again there can be a considerable individual variation but the table below suggests that the ratio increases with age. This would support the idea that the sensor inputs (from skin, joint receptors, etc) generally are reduced with age and thus, persons become more dependent on visual cues.

Group	N	C90Area	RQ(Area)
Morton (Students, Oulu Finland)	15	268,0 ± 110,2 (EO)	NA
Chydenius (Staff, Chydenius Institute, Kokkola Finland)	17	150.9 ± 55.9 (EO) 190.2 ± 88.2 (EC)	1,49 ± 1,131
Elderly aged 55+, Kuopio Finland	47	425.2 ± 221.7 (EO) 667.6 ± 382.5 (EC)	1,701 ± 0.707

Chart 1: Comparisons of the C90Area and the RO between three test groups. The data

12 Normative Data

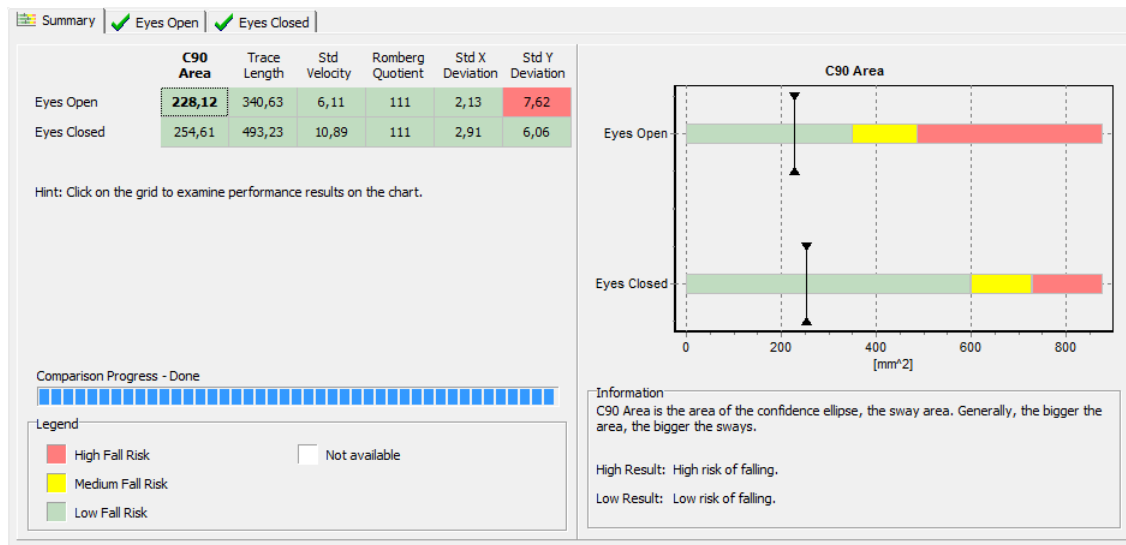


Figure 47: Normative Data in summary

Normative data includes the following research done with the HUR Balance Platform:

There are approximately 2900 test results in the normative database.

Fall risk limits can be changed from the program's settings.

Note that in some cases there might not be enough test data available to make the comparisons. Most of the test results are for the Romberg and Palso protocols.

13 Contact Information

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14 Datasheet

Balance Platform (BTG4)

Balance measuring device

Measuring unit	lb
Measuring range	0-440 lb/sensor
Sensor type	Force Transducer
Manufacturer type	TY2002
Non linearity	+/- 0,02% FS
Combined error	0,03%
Sensitivity	2mV/V +/- 0,25%
Overload capacity	150% / sensor
Operating voltage	Taken from USB
USB connection	B-type plug
Resolution	16 bits*
DAQ software	Updated via USB
Maximum sampling rate	400 Hz
Application software	iBalance Premium
Operating System	Windows
EMC	SGS EMC test report 240268-1
Storage conditions	Dry, room temperature.
Operating conditions	Indoors
Dimensions (h x l x w)	2.36 x 26.97 x 37.79 in
Weight (without package)	40.12 lb
Weight (with package and accessories)	44.09 lb
Bag weight	4,409 lb
Bag dimensions (h x l x w)	39.37 x 27.56 x 2.95 in
Warranty	1 year

* depends on the sampling rate

Note:

When device lifecycle ends, pay respect to local waste disposal rules.



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HUR|labs

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