# Equi-Pro®

## Equine Gait Analysis System

### User Manual

v1.5.1

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# 1 Introduction

Equi-Pro is a mobile equine gait analysis system that provides objective and quantitative gait analysis. It can be used for lameness examinations, for longitudinal monitoring of horses and for research in the equine field.

The standard system uses seven wireless ProMove-V sensors: three sensors on the upper body (head, withers and pelvis) and four sensors on the limbs. Optionally, two sensors can be added to the left and right tuber-coxae. The system automatically detects the gaits (walk, trot, left-lead canter, right-lead canter, tölt and pace), the type of movement (straight line, left circle and right circle) and the type of surface (hard or soft). It measures the upper-body symmetry parameters, such as Symmetry Index Up, MinDiff, MaxDiff, and optionally Hip-Hike. It also measures the limb-related parameters, such as timing of footfalls, stride duration and number of strides, swing intensity, stance and swing duration per leg, duty factor, protraction and retraction, abduction and adduction. The system can also measure the speed of the horse using a GNSS receiver.

Please read the safety instructions in Section 2 carefully. Information about warranty and liability can be found at: https://inertia-technology.com/terms-and-conditions/.

# 2 Safety and Storage Instructions

To avoid a potential safety hazard, please follow the safety instructions below:

- Do not exceed the maximum input voltage of 5V.
- Only connect to CE-certified computers and USB-adapters.
- Operate the product at temperatures between 0 and 35°C.
- Do not charge the product if wet.
- Once fully charged, remove the product from the charger.
- Protect the product from violent handling, drops on hard surfaces, excessive shocks or mechanical stress.
- Do not open, crack, pinch or mutilate in any way the product.
- Do not use the product if it appears damaged or tampered with in any way.
- Do not attempt to replace the battery, open the enclosure or disassemble the product.
- Turn off the product before entering an area with potentially explosive atmosphere.
- Do not overheat the product by exposure to high temperatures or direct sunlight.
- Do not dispose the product in fire.
- Do not discard the product in the trash. Follow proper electronic and battery waste disposal protocol, as dictated by local authorities.
- Keep the product out of the reach of children.

The recommended storage conditions are:

- Ambient temperature range of 15°C. Do not store the product in temperatures below 0°C or above 30°C.
- Low humidity.
- Away from direct sunlight.
- Away from any mechanical hazards and potential sources of shocks or high vibrations.
- Sensor batteries at 50% to 60% state-of-charge (SOC).

# 3 System Overview

## 3.1 Hardware

ProMove-V wireless inertial sensors for capturing motion data are attached to the horse at different positions. They stream the sensor data to the Equi-Pro gateway device connected to the computer, as shown in Figure 1. The data transmission takes place in real-time and at high data-rates. The sensor data is strictly synchronized across the whole wireless network.


**Figure 1: Equi-Pro hardware overview**

## 3.2 Sensor Placement

The standard setup consists of seven sensors, placed on the head, withers, sacrum, and the four legs, as shown in Figure 2. The head sensor is placed in a custom-made leather pocket attached to the bridle. The sensor on the withers is attached to the girth using a hook & loop fastner. The sacrum sensor is stuck using double adhesive tape and animal polster. The sensors on the legs are placed in custom-made pockets fixed to brushing boots.

A GNSS sensor can be used to retrieve the speed of the horse while performing the measurements. This sensor can replace the head, withers or sacrum sensor.

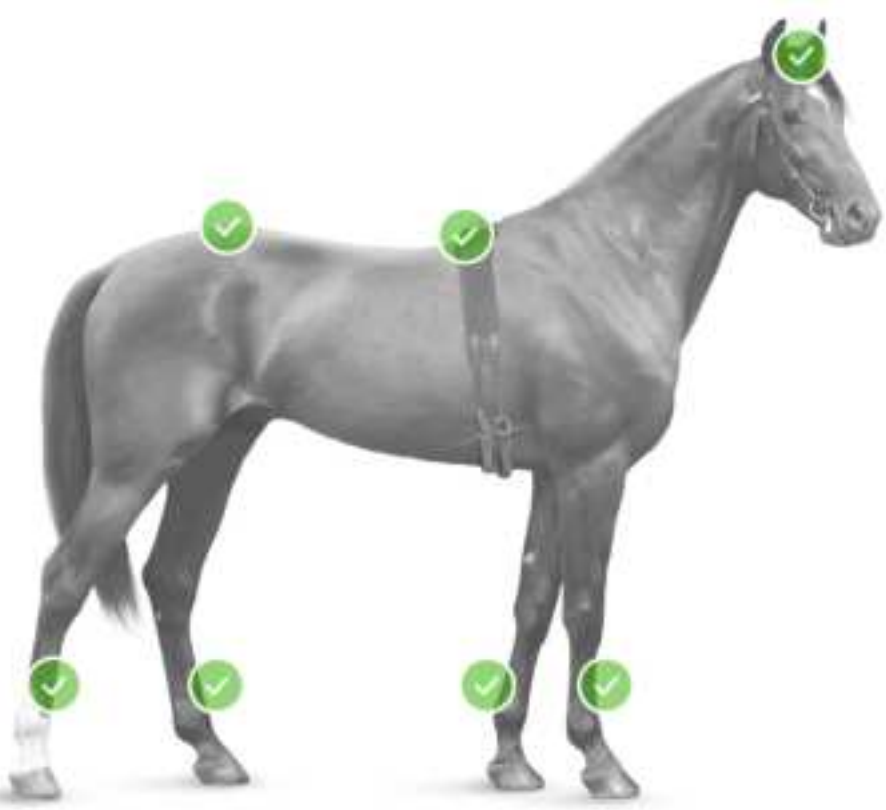

**Figure 2: Sensor placement on the head, withers, sacrum and legs**

Two additional sensors can be placed on the left and right tuber-coxae for the computation of the hip-hike parameter, as shown in Figure 3.

**Figure 3: Sensor placement on the left and right tuber-coxae - LTC and RTC**

## 3.3 Software

The desktop Equi-Pro application integrates the motion processing software, which computes the relevant parameters and analyzes the horse's gait for lameness and performance assessment. The system quantifies the asymmetries in an easy and understandable way and complements the veterinary's evaluation. The level of detail given by the results varies from high-level measurement overview to in-depth stride by stride information. Movements that can be close to impossible to detect with the naked eye are captured using sensor measurements.

Figure 4 shows the gateway connected to the laptop and the Equi-Pro desktop application.

**Figure 4: Equi-Pro desktop application**

## 3.4 Reports

The application generates reports with the main parameters computed from motion data, as illustrated in Figure 5.


**Figure 5: Equi-Pro reports**

# 4 Installation and Quick Start

## 4.1 Installing the Equi-Pro Application

The Equi-Pro application runs under Windows and macOS operating systems. In the following, we describe the installation procedure in each of these environments.

### *4.1.1 Windows*

On a Microsoft Windows computer, unzip and run the Equi-Pro setup executable. Choose a destination folder and press the **Install** button (Figure 6). During the setup process, the Inertia driver and the Visual C++ redistributable are installed. This may require a computer reboot. After the installation finishes, a notification window appears. Check the **Run Equi-Pro** checkbox and press the **Finish** button.

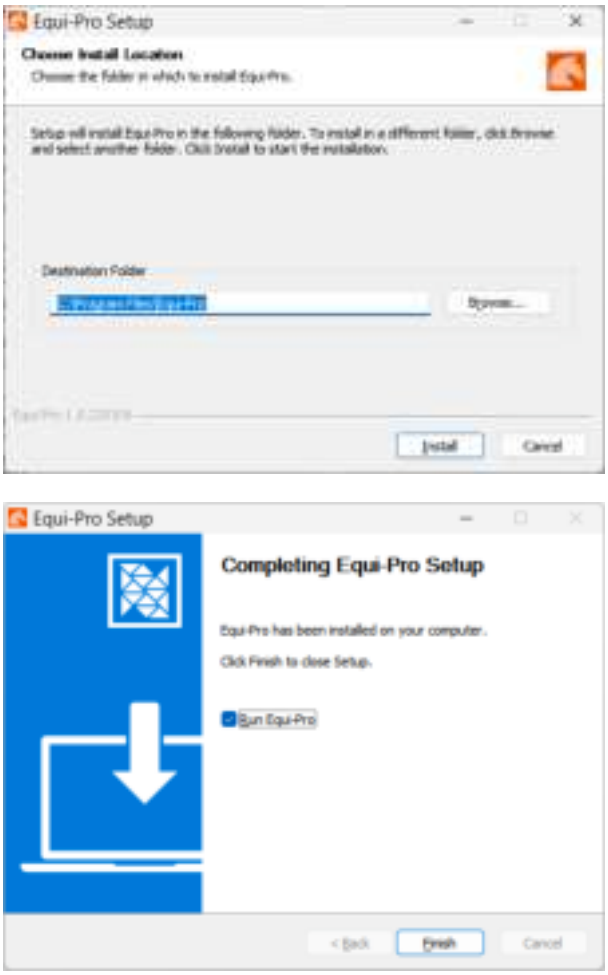


**Figure 6: Equi-Pro installation in Windows**

### 4.1.2 macOS

On a macOS device, open the **.dmg* file as follows:

- On an *Apple silicon* device, open the *arm64* version of the **.dmg* file.
- On an *Intel* device, open the version without *arm64* in the **.dmg* file name.

Afterwards, drag the Equi-Pro application to the Applications, as shown in Figure 7.

**Figure 7: Equi-Pro installation in macOS**

## 4.2 Preparing the Gateway

Gently connect the antenna to the gateway by using the screw-type coupling mechanism. Do not use too much torque to avoid breaking the antenna connector. Connect the gateway to the laptop using the mini-USB cable. The power light of the gateway turns blue.

## 4.3 Logging in to the Application

In the login screen (Figure 8) make sure the gateway is acknowledged as connected. Press the **LOGIN** button. The application enters the **Horses** screen.

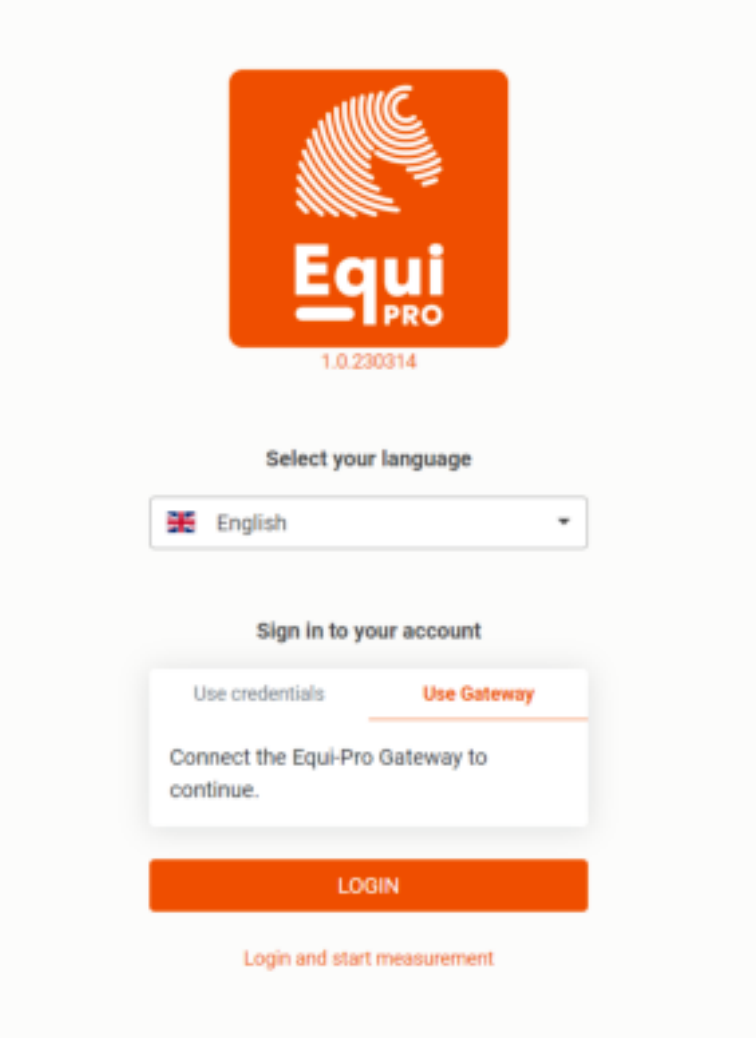


**Figure 8: Equi-Pro login screen**

## 4.4 Turning the Sensors On

Turn the ProMove-V sensors on by pressing the power button (see Figure 9). The blue LED of each sensor starts blinking.

**Figure 9: Turn on the ProMove-V sensor.**

## 4.5 Assigning Positions to Sensors

At first-time use, the sensors need to be assigned to the corresponding positions on the horse's body. This is done by selecting or filling in the node numbers in the positions table from **Settings** (Figure 10) and by sticking position labels to the sensors (Figure 12).

A pack of labels is provided in the sensor kit with positions on the horse's body. Two labels are available for each of the nine positions, as follows: **HEAD**, **WTH** (withers), **SAC** (sacrum), **LF** (left-front leg), **RF** (right-front leg), **LH** (left-hind leg), **RH** (right-hind leg), **LTC** (left tuber coxae) and **RTC** (right tuber coxae). One more label indicates that a sensor contains a **GNSS** module.

To assign positions to sensors, follow the steps given below:

1. Enter the **Settings** and open the **Positions** tab.
2. Locate the node number on the label at the back of the sensor. The node number is the last number of the S/N. In the example Figure 11 the node number is 51.
3. Decide on which part of the body the sensor is going to be attached to. If a GNSS sensor is present, assign it to the head, withers or sacrum.
4. Introduce the node number to the **Node №** field in the table, corresponding to the assigned body part.

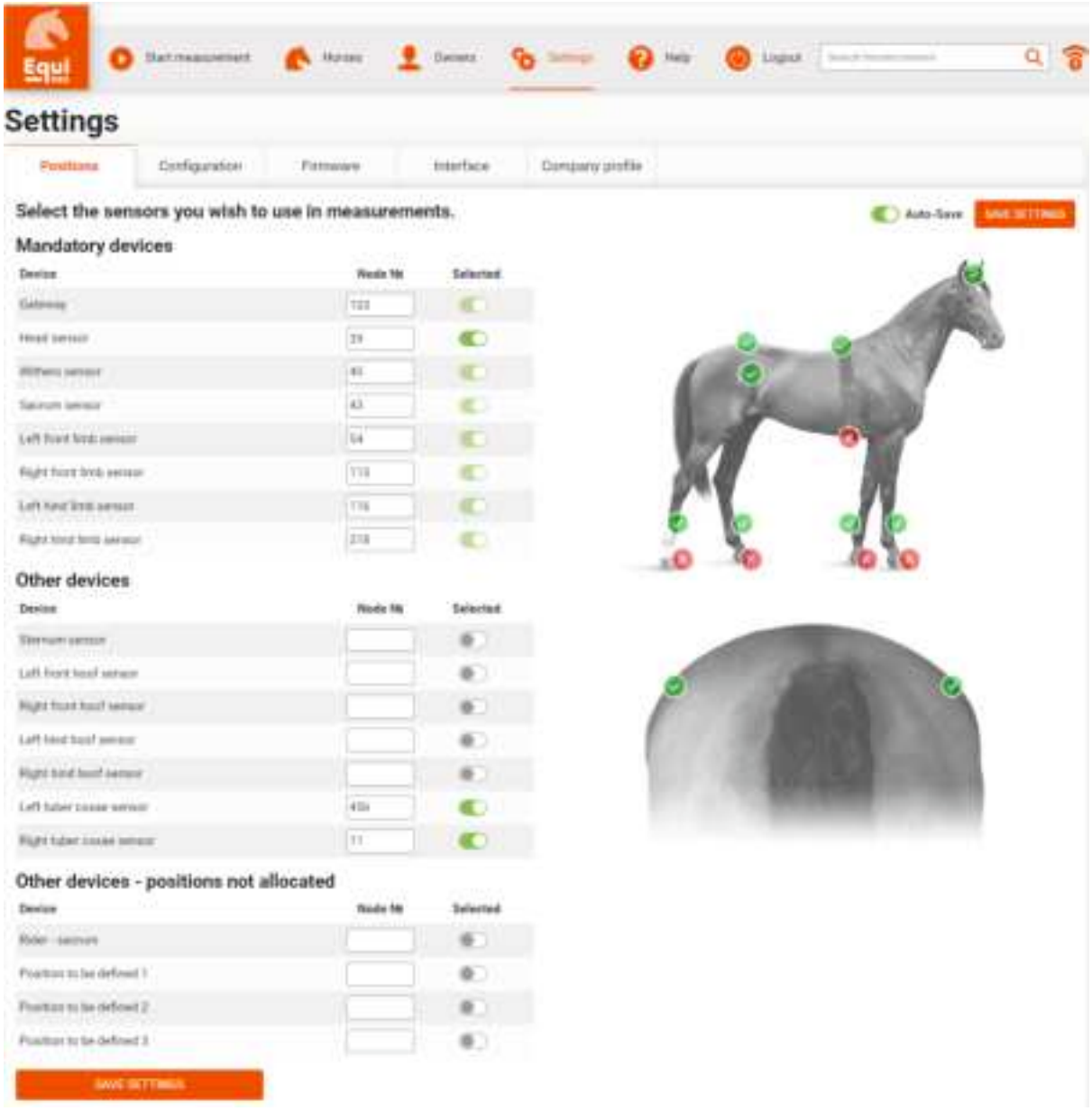


**Figure 10: Configuration of sensor positions**

5. Stick a label on the upper-part of the sensor with the corresponding position, as shown in Figure 12.
6. After all sensors are assigned, if **Auto-Save** is selected through the toggle button, then the locations are automatically saved. If **Auto-Save** is not selected, press one of the **SAVE SETTINGS** buttons at the top-right or bottom of the screen.

For more information about sensor assignments and options, please visit Section 5.8.1.


**Figure 11: Sensor label: the node number is the last number of the S/N**


**Figure 12: Placing labels on sensors depending on their position.**

## 4.6 Checking Connectivity

In the **Start measurement** screen, check that the sensors are connected to the gateway and the status icon is green, as shown in Figure 13.

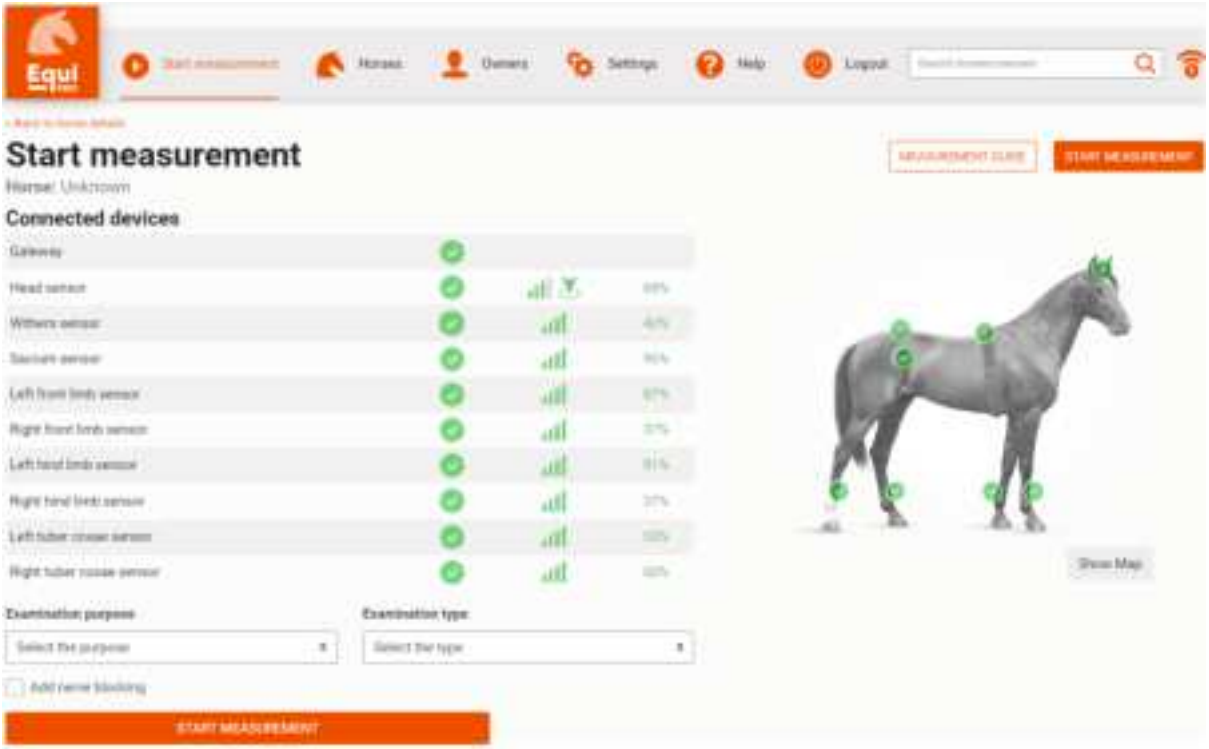


**Figure 13: Start measurement - all sensors are green**

The sensors themselves also show that they are connected: the blue LED of the power button **blinks twice**. Make sure the sensors' batteries are sufficiently charged. A green color of the battery status indicator (e.g. 85%) is ideal for a lameness examination. An orange color (e.g. 20%) is also in principle sufficient for an examination. The red color (e.g. 5%) signifies that the battery should be charged before the test.

## 4.7 Attaching the Head Sensor

Insert the head sensor in the pocket of the bridle, as shown in Figure 14. The blue LED should be visible, indicating that the node is ON. Put the bridle on the horse (Figure 15).

**Figure 14: Inserting the head sensor in the pocket of the bridle.**

**Figure 15: Horse with sensor bridle**

## 4.8 Attaching the Withers Sensor

Insert the powered sensor into the girth pocket, as shown in Figure 16. Attach the girth to the horse (Figure 17). Make sure that the withers sensor is on the mid-line of the horse.

**Figure 16: Insert the withers sensor in the girth pocket.**

**Figure 17: The withers sensor attached to the horse**

## 4.9 Attaching the Sacrum Sensor

Stick a few centimeters of double-sided adhesive tape on the sacrum sensor. Cut a small stretch of animal polster and fix the sensor on it. Locate the tuber sacrale of the horse and fix the sensor to the skin between the left and right tuber sacrale (Figure 18).

**Figure 18: Attaching the sacrum sensor**

## 4.10 Attaching the Tuber Coxae Sensors (Optional)

Two sensors can be attached to the left and right tuber coxae (LTC and RTC) for measuring the **Hip-Hike** symmetry parameter. Attach the sensors using animal polster and double-sided adhesive tape, as described in Section 4.9. The sensors should be positioned with the USB port pointing caudally and attached to the most proximal part of each tuber coxae and at the same height on both sides (see Figure 19).

**Figure 19: Attaching the RTC and LTC sensors**

## 4.11 Attaching the Leg Sensors

Insert the sensors in the sensor pockets, as shown in Figure 20.

**Figure 20: Inserting sensors in the leg pocket**

Attach the brushing boots to the horse (Figure 21). Check that each pocket is aligned with the cannon bone and on the mid-line of the leg.

**Figure 21: Horse with leg sensors**

## 4.12 Checking the Sensors Are Still Connected

Lead the horse to the start location of the examination, as close as possible to the gateway. Check that all sensors are still connected to the gateway, as shown in Figure 13. For the best connection, place the gateway high up from the ground and try to maintain a line of sight between the gateway and the horse.

## 4.13 Starting the Measurement

Press the **Start measurement** menu item on the top left side of the screen (Figure 13).

## 4.14 Calibrating the Sensors

Let the horse stand still for 5 seconds to calibrate the sensors. Wait until the calibration procedure is completed (see Figure 22). If the calibration procedure takes too much time due to the horse being restless, you can postpone it for later.

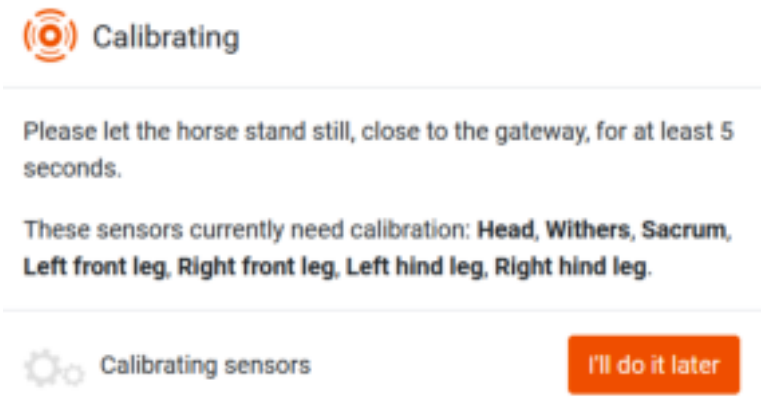


**Figure 22: Calibration window**

## 4.15 Performing the Measurement

The measurement can be done in the main gaits of the horse (walk, trot, right and left-lead canter), as well as tölt and pace. The horse can be measured on a straight line or in a circle, on either firm or soft surfaces.

The application requires a minimum of 5 strides per gait in order to present the graph of results. A good measurement should contain at least 20 strides of the same gait.

During the measurement, the computer does not need to stay close to the horse, as the sensors have on-board memory to store the data. At the end of the measurement, the application automatically retrieves the lost data from the on-board memory of the sensors.

**Figure 23: Performing the measurement**

## 4.16 Reconnecting the Sensors

Guide the horse back close to the gateway. Check again that all sensors are green connected to the gateway, as shown in Figure 13. If not, wait for all of them to reconnect.

## 4.17 Finalizing the Measurement

Press the **Stop measurement** button to end the measurement, as shown in Figure 24.


**Figure 24: Press the Stop measurement button to end the measurement.**

If the calibration was not finalized at the beginning of the measurement, wait a few seconds with the horse standing still, until the procedure is completed. Afterwards, wait until the data is synchronized, as shown in Figure 25. This can take up to a few minutes.


**Figure 25: Wait until the data is synchronized.**

## 4.18 Measurement Results

Wait for the data to be processed. This can take up to a few minutes. Check the results of the lameness examination (see Section 6 for more information). You can choose to make a report for the owner.

## 4.19 Removing and Powering Down the Sensors

After the measurement finishes, remove the sensors from the horse.

The sensors can be powered down one-by-one by pressing the power button for a few seconds. Alternatively, all sensors can be powered down at once, if they are close to the gateway: hover the mouse cursor over the top left icon and press the button **SWITCH OFF ALL SENSORS**.

## 4.20 Recharging the Sensors

The internal battery of the ProMove-V sensor node should be periodically recharged. This can be done by using a cable connecting the USB-C connector of the node to a computer or a standard USB charger.

Alternatively, a set of maximum ten ProMove-V nodes can be charged by using the ProMove-V charging cradle, see Figure 26.


**Figure 26: ProMove-V charging cradle**

To charge a set of ProMove-V sensor nodes using the charging cradle, follow the following instructions (see also Figure27):

1. Place each sensor in a charging pad of the cradle, with the charging port pointing towards the USB-C connector.
2. Slide the node into the USB-C connector until complete insertion.
3. Connect the charging cradle to the AC/DC power supply using the 4-PIN connector.
4. Connect the power supply to the mains.

During charging, the green LED of the ProMove-V node is on and the lightning bolt orange sign appears next to the battery percentage (see Figure 33 from Section 5).

To remove a sensor from the charging cradle, it must be first disconnected from the USB connector by pushing the sensor away from the connector. After that, the sensor can be removed from the cradle pad. See Figure 28 for more information about removing one sensor.


**Figure 27: Inserting a sensor into the charging cradle.**


**Figure 28: Removing a sensor from the charging cradle.**

The incorrect removal of the sensor while still plugged in the USB connector may cause damage to the cradle or sensor (see Figure 29).


**Figure 29: Incorrect removal of a sensor from the charging cradle.**

## 4.21 Application Auto-Update

Updates to the application are automatically downloaded. When starting the *Equi-Pro* application and an update is available, a notification message appears on the left-bottom of the login window (Figure 30).

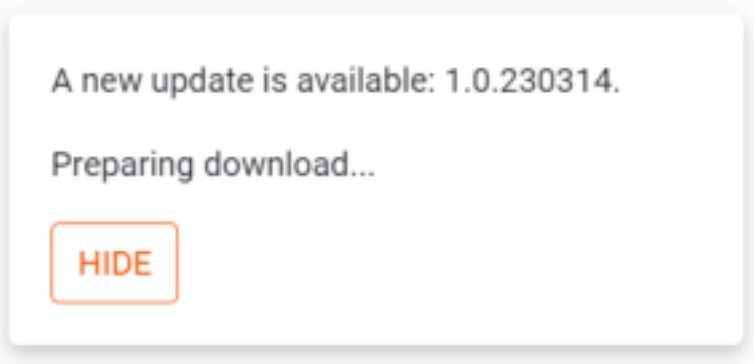


**Figure 30: Equi-Pro update available**

Press the **UPDATE NOW** button to install the update (Figure 31). To postpone the installation for the next time the application is started, press the **HIDE** button.

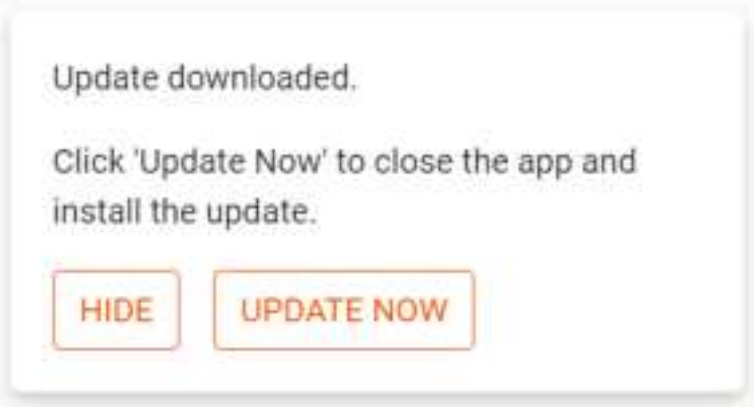


**Figure 31: Equi-Pro update downloaded**

# 5 Application Sections

## 5.1 Menu Bar

Through the top menu bar you can access the application sections, see Figure 32. You can log out from the application by pressing the menu item **Logout**. You can search for horses and owners by using the search area on the right. The number of sensors connected to the Equi-Pro application is displayed in the icon at the top right corner. Hovering the mouse cursor over this icon shows a pop-up window with a button that can be used to switch off all sensors in the network. Clicking the logo shows an empty screen.


**Figure 32: Application top menu bar**

## 5.2 Start Measurement

In this application section, an overview of the active sensors is shown and a measurement can be started, see Figure 33.

To associate a measurement with a specific horse, first select a horse from the **Horses** section and then start a measurement. If no horse is associated, it has to be selected or added after the measurement is finished.

On the left side of the screen, a list with sensors and their status overview is shown. The status gives the following information:

- **Connected** - A green circle signifies that the sensor is connected to the wireless network. A red circle means that the sensor is not connected (Figure 33). An exclamation mark in a triangle on the right indicates a possible problem with the sensor. For example, in Figure 33, the sensor needs formatting (Section 5.8.2).
- **Signal strength** - A four-line icon gives an impression about the quality of the wireless signal: one or two orange lines means that the signal is weak, whereas three or four green lines indicate a better quality. The GNSS sensor has a specific icon with an arrow pointing down. The green color of the GNSS icon signifies that the GNSS sensor has a location fix and the position is visible on the map (Figure 34).
- **Battery** - A green color of the battery status indicator (e.g. 85%) is ideal for a lameness examination. An orange color (e.g. 20%) is also in principle sufficient for an examination. The red color (e.g. 5%) signifies that the battery needs be charged before the test or the sensor should be replaced.

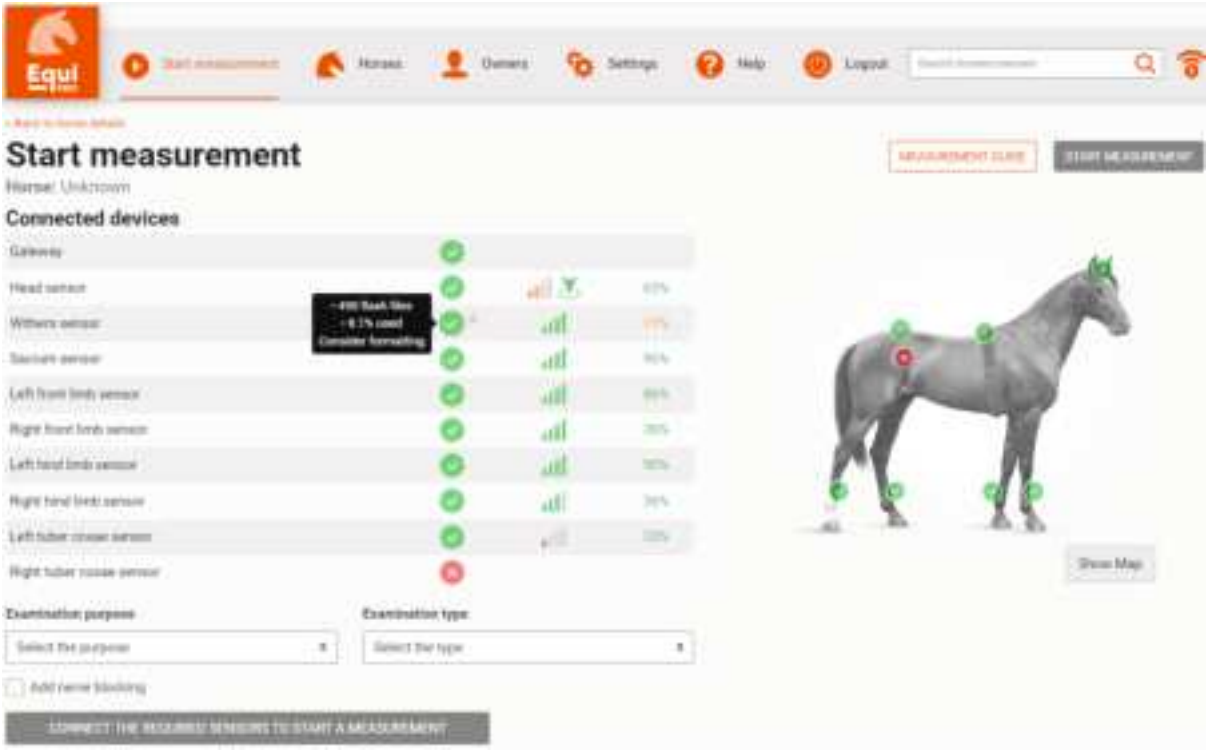


**Figure 33: Start measurement screen**

In case the GNSS sensor has a fix, the current position of the horse can be seen by pressing the button **Show Map**. If the GNSS sensor is indoors or does not have a fix (the GNSS icon is gray), a generic map is shown (Figure 34). To return to the horse and sensors view, press the **Show Sensors** button.

From the drop-down box **Examination purpose**, you can choose among **Lameness evaluation**, **Prepurchase exam**, **Sport Horse Monitoring** and **Research**. The **Examination type** can also be selected from **In hand**, **Ridden**, **Driven** and **Research**. If the examination purpose or the examination type differs from the suggestions, you can write it down in the measurement notes.

By checking the **Add nerve blocking** check-box, you can indicate whether a nerve block is performed. A list with checkboxes is revealed, where you can select the type of nerve blocking, as shown in Figure 35.

On the right side of the screen, a horse with indicative placement of the sensors and the connection status (green/red) is shown. By pressing the **MEASUREMENT GUIDE** button on top, you can quickly access the **Help** menu for guidance (Section 5.9). Start the measurement by pressing the **START MEASUREMENT** button.

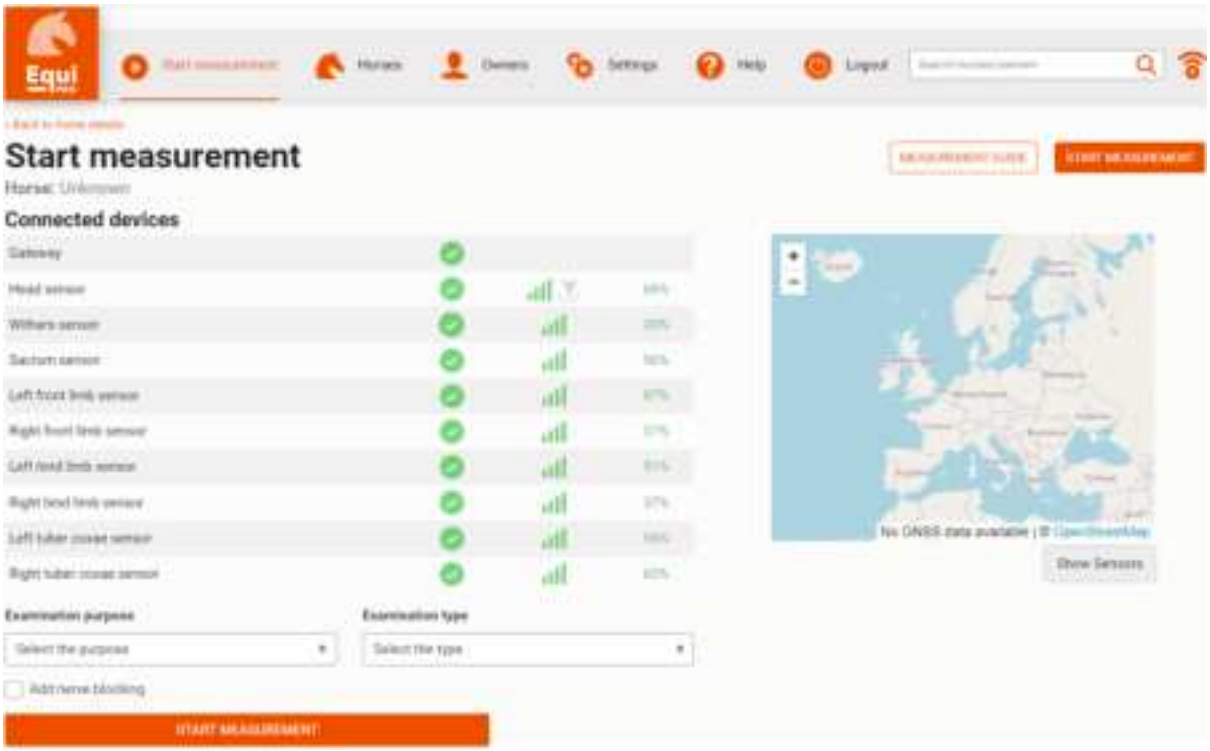


**Figure 34: Start measurement screen with map view**

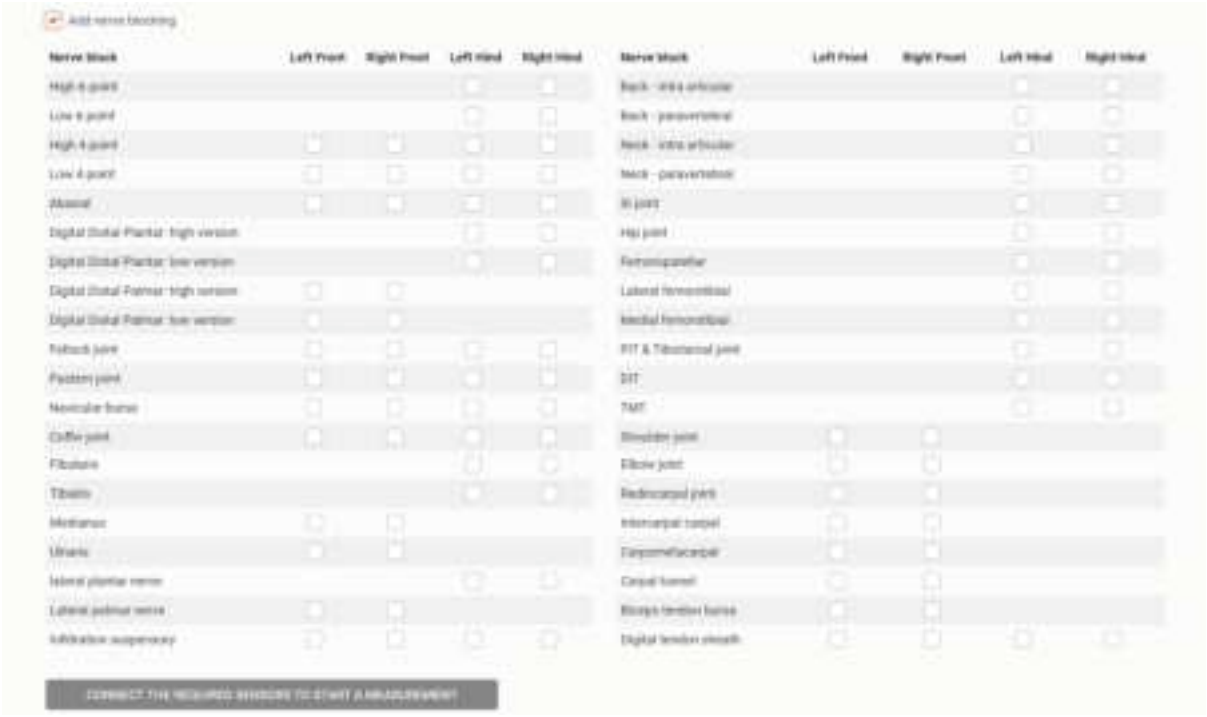


**Figure 35: Nerve blocking options**

## 5.3 Measurement in Progress

### *5.3.1 Calibration*

After the **START MEASUREMENT** button is pressed, the application prompts a pop-up window with a message to facilitate the calibration process, as shown in Figure 36. You can choose to make the horse stand still for at least 5 seconds, or decide to postpone the calibration for a later stage, by pressing the **I'll do it later** button.

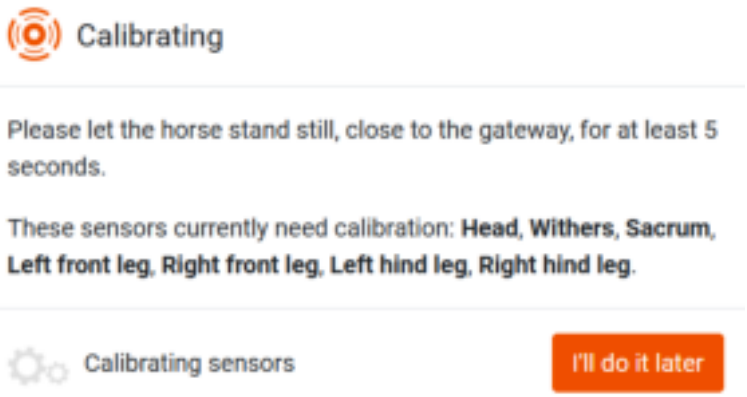


**Figure 36: Pop-up window for calibration**

If the calibration procedure was not fully completed, at the end of the measurement the application gives a warning that the sensors still need to be calibrated. This warning is displayed when hovering the mouse over the **STOP** button (see Figure 37) and by means of a pop-up window after pressing the **STOP** button (see Figure 38). You may choose to skip the calibration procedure by clicking on the button **Stop without calibrating** in Figure 38. However, this is not recommended as it will adversely effect the quality of the results.

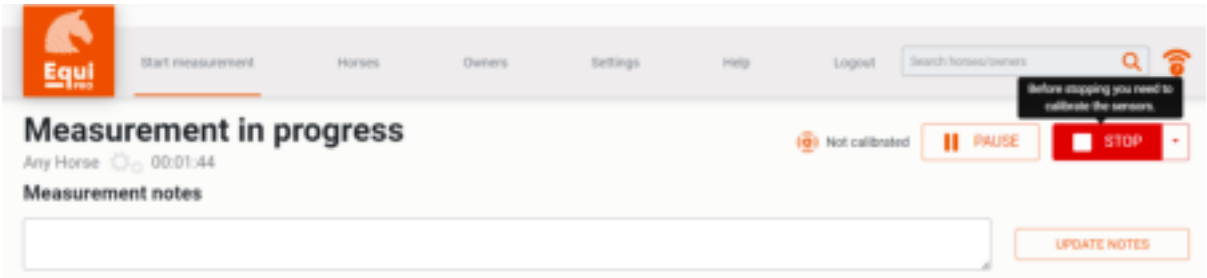


**Figure 37: Measurement in progress - calibration warning**

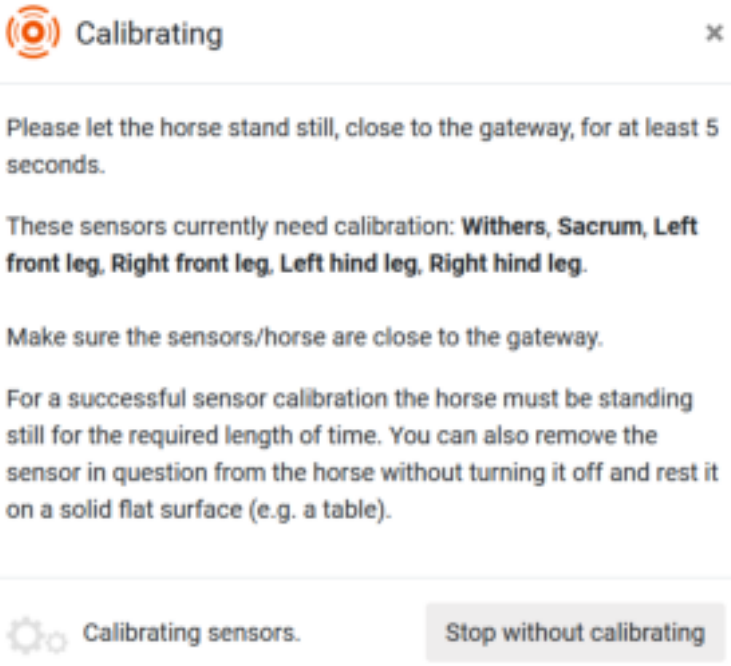


**Figure 38: Measurement in progress - calibration pop-up window at the end of the measurement**

### *5.3.2 Measuement Notes*

Once the measurement begins, the application starts to record the data from the sensors mounted on the horse. Some measurement nodes can be added in the **Measurement notes** field (see Figure 39). To save the added notes, press the **UPDATE NOTES** button.


**Figure 39: Measurement in progress**

### 5.3.3 PAUSE, RESUME and Discard

You can choose to pause the measurement by pressing the **PAUSE** button (see Figure 39).

By pressing the **RESUME** button (Figure 40), the measurement resumes and the calibration procedure needs to be redone.

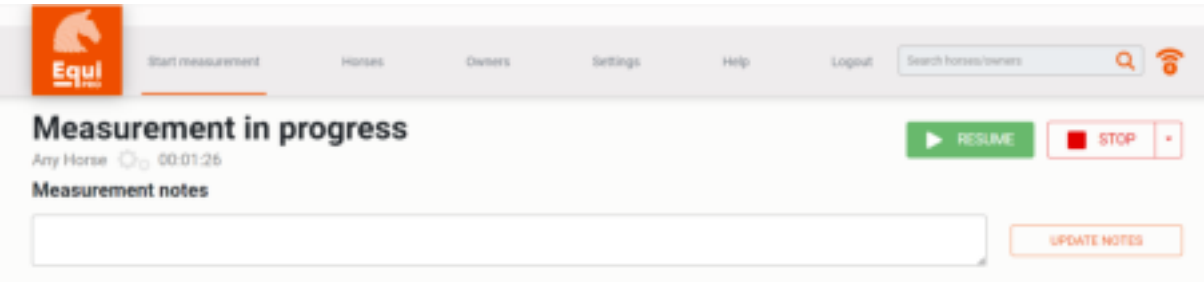


**Figure 40: Measurement in progress - PAUSE and RESUME**

A measurement in progress can be discarded by pressing on the arrow on the right-side of the **STOP** button and selecting the **Discard measurement** option, as shown in Figure 41.

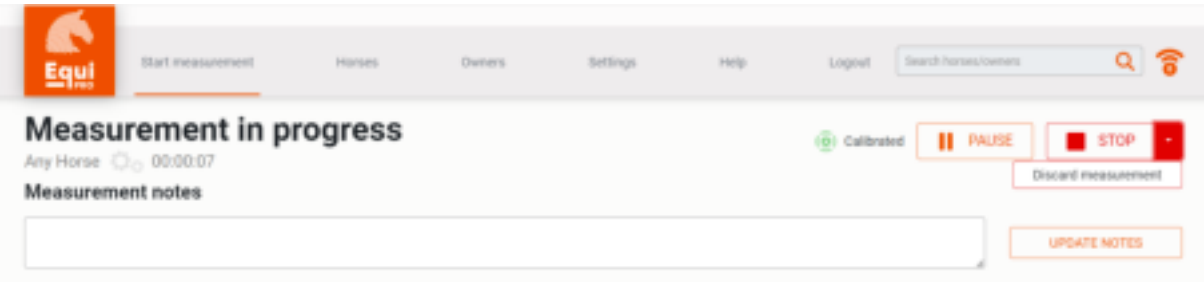


**Figure 41: Measurement in progress - Discard measurement**

### 5.3.4 *Flexion tests*

During the measurement, consecutive flexion tests can be performed. They are labeled in the measurement timeline (see Section 6.1). By checking the **Add flexion tests** checkbox, the application displays the available options, as shown in Figure 42. Select the limb (**Left Front**, **Right Front**, **Left Hind** or **Right Hind**), the type of test and press the **START** button to indicate the beginning of the test. Press the **STOP** button (Figure 43) at the end of the flexion test.

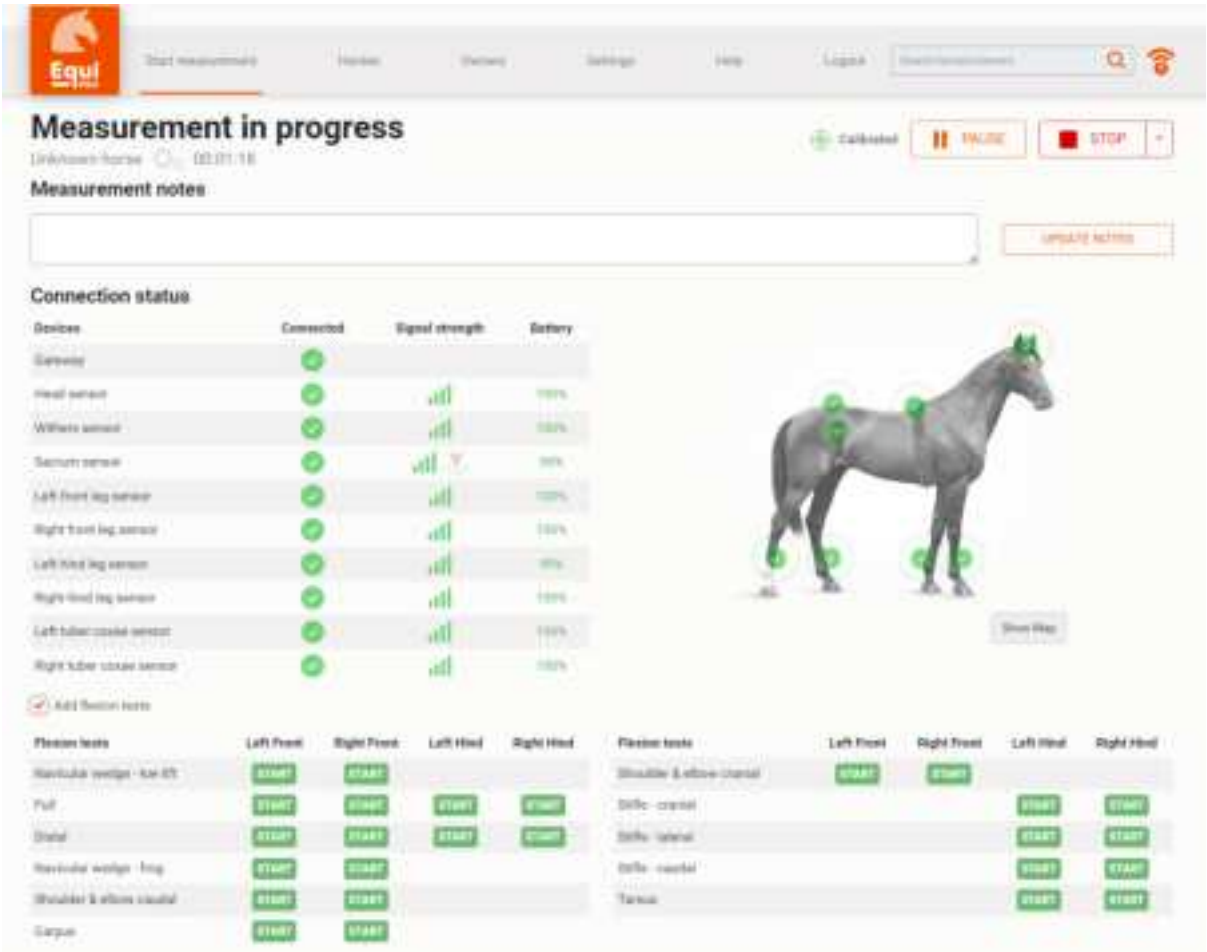


**Figure 42: Measurement in progress - start a flexion test**


**Figure 43: Measurement in progress - stop a flexion test**

### 5.3.5 *STOP, Synchronize and Process*

At the end of a valid measurement, press the **STOP** button, as shown in Figure 39.

Subsequently, the application starts synchronizing and processing the data from the sensors (Figure 44). Synchronizing can take several minutes. You may choose to cancel it by pressing the **CANCEL SYNC** button and manually synchronize at a later time.

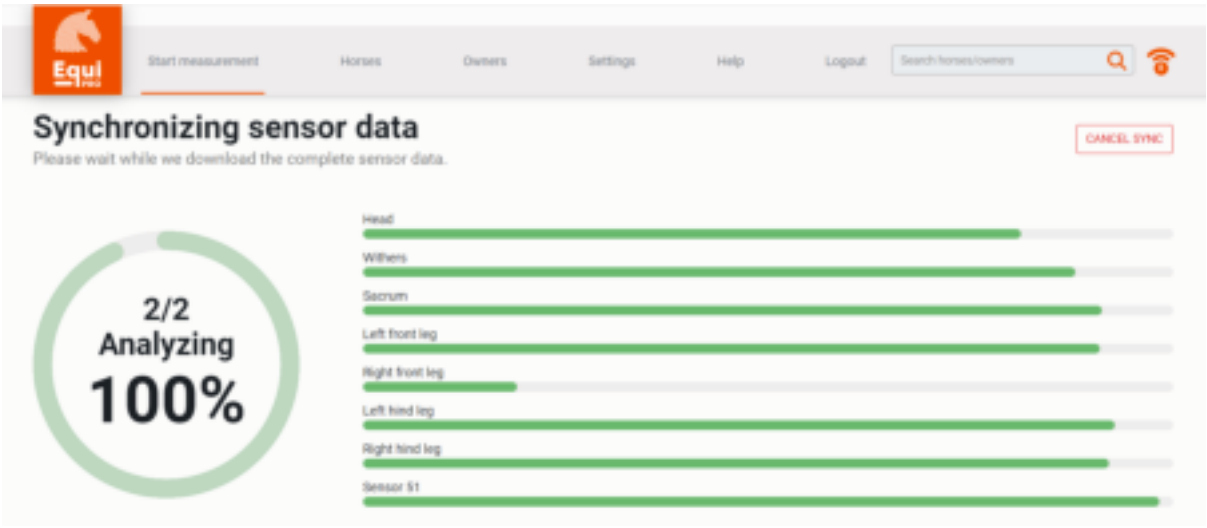


**Figure 44: Synchronizing the sensor data**

After synchronizing, the measurement is processed. If no horse was associated with the measurement, the association has to be done here. The application gives the option to associate the measurement to an **Existing horse** or to **Add a new horse** (Figure 45). If the **Existing horse** option is selected, you can choose one horse from the table of horses displayed at the bottom of the screen. If you choose to **Add a new horse**, a form is displayed and data about the horse can be filled in, as explained in Section 5.6. After one of these two options have been successfully completed, press the **SAVE** button to get to the **Measurement details** screen.

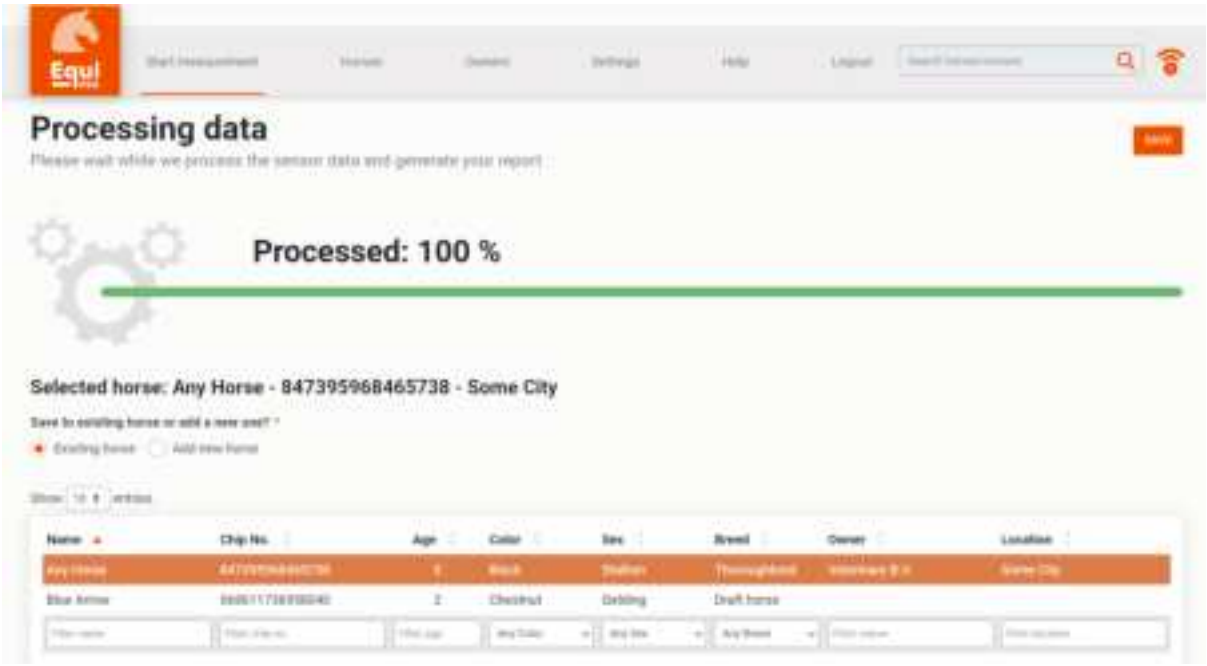


**Figure 45: Assign an unassociated measurement to an existing horse or add a new horse.**

## 5.4 Measurement Details

The **Measurement details** window shows the results of the measurement, see Figure 46. The name of the horse and the date and time of the measurement are displayed in the top-left corner of the screen.

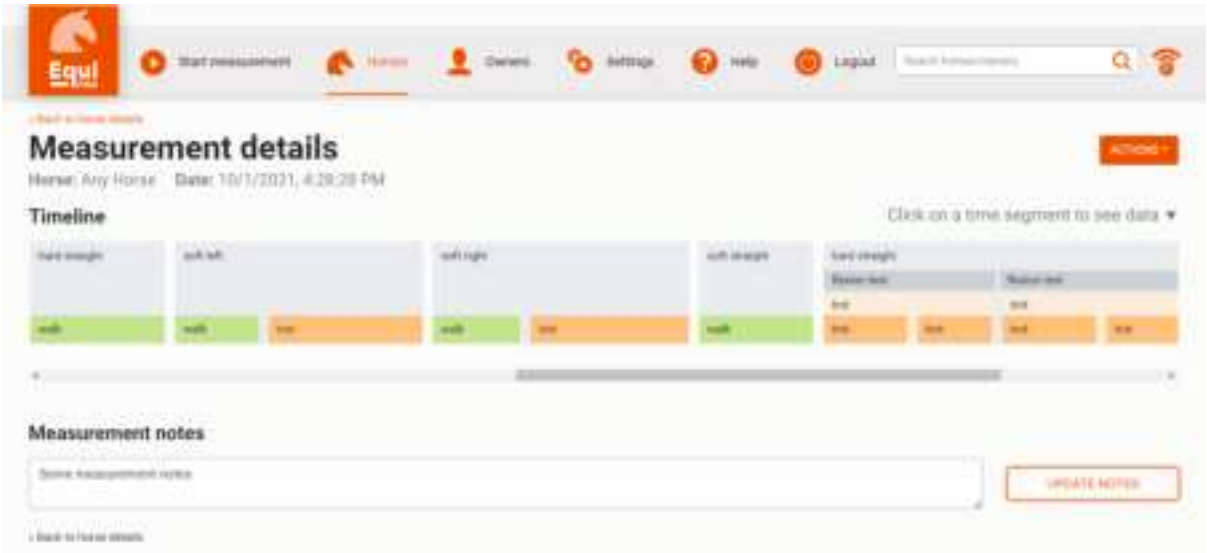


**Figure 46: Measurement details window**

Initially, the window is divided in two horizontal sections, the **Timeline** and **Measurement notes**. By clicking on a time segment, an **Analysis** of the selected time segment is shown between the **Timeline** and the **Measurement notes** sections. The **Analysis** is divided into four

tabs: **Overview**, **Upper body**, **Legs** and **Speed**. Clicking again on the same time segment hides the analysis and the window is back to the initial state. For details about the **Timeline** and other measurement results, please see Section 6.

The **Measurement notes** shows the notes made during the measurement. They can be modified or updated here. Click **UPDATE NOTES** to save the updated notes.

By pressing the button **ACTIONS**, a drop-down window is displayed as in Figure 47.


**Figure 47: Actions for a selected measurement.**

The first three options from the drop-down window are the following: **Add/Edit Conclusions**, **Generate Report** and **Export**. By pressing on any of these items, the **Conclusions & Export** window appears, which is detailed in Section 5.5.

By choosing the **Compare** option, more segments of the same gait can be selected and compared. Keep the *Ctrl* key pressed and choose with the mouse the desired segments for comparison. An error appears if a different gait is selected. See Section 6.6 for more details about comparison among measurements.

If the measurement is assigned to the wrong horse, you can move it to a different horse by selecting the **Change horse** action. A pop-up window appears with the list of horses, as shown in Figure 48.

By selecting the **Re-process** option, the processing of the sensor data is done again and the results of the measurement are re-computed. By selecting the **Re-sync** option, the synchronization of the sensor data with the local flash files is re-done, followed by re-processing of the data. Make sure the sensors that were used during the measurement are ON.

## 5.5 Conclusions & Export

The **Conclusions & Export** window shown in Figure 49 is divided in four sections.

In the first section, **Conclusions & remarks**, additional conclusions to the current measurement can be filled in, which, together with the **Measurement notes**, will appear in the final report.


**Figure 48: Move measurement to another horse**

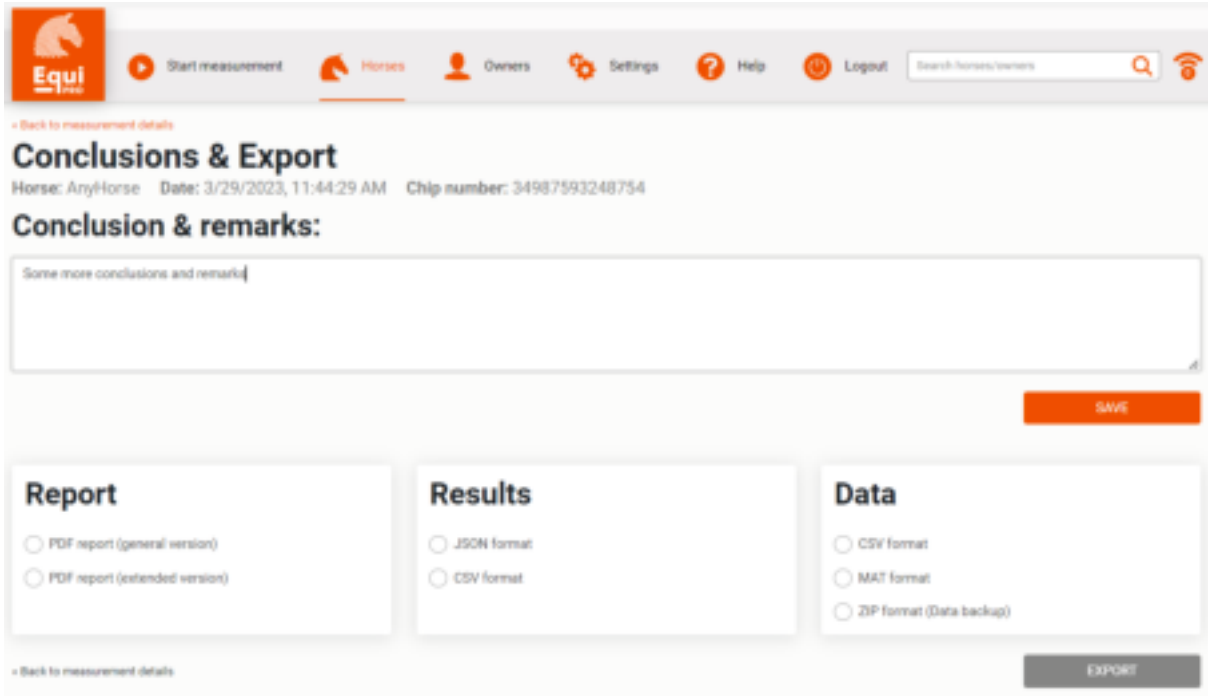


**Figure 49: Conclusions & Export window**

By pressing the **SAVE** button, the application saves the conclusions.

The second section is used to save a **Report** with the results of the measurement. This can be a shorter or a more extended report, as explained in Section 6.7. You have the option to choose the type of report by selecting the **PDF report (general version)** or **PDF report (extended version)**. By pressing on the **EXPORT** button the application generates the selected PDF report.

The third section allows saving the **Results** of the measurement in the following formats:

- **JSON** (JavaScript Object Notation) data file. JSON is a standard text-based format for representing structured data based on JavaScript object syntax. A Matlab script transforming the results file from JSON to CSV and MAT formats is available on the Equi-Pro®Downloads page of our website.
- **CSV** (Comma-Separated Values) text file that uses commas to separate values, and newlines to separate records. In the CSV file, one row with exported parameters represents one stride. Please see Appendix A for a description of the exported parameters in the CSV text file.

The fourth section allows saving the raw sensor **Data** in a log file that can be further used for research purposes. Three file formats are supported: CSV file, a Matlab file (MAT) and an archive (ZIP) file that contains the binary log files. See Appendix B for a description of the CSV raw data export. After selecting the desired format, press the **EXPORT** button for the application to generate the log file.

## 5.6 Horses

This section displays a table with all horses registered in the Equi-Pro application, as shown in Figure 50. The essential information about each horse is visible in the table, such as the name of the horse, the chip number, the age, the color, the sex, the breed, the date and location of the last visit and the name of the owner.


**Figure 50: Table with the horses registered in the application**

### *5.6.1 Appearance Options*

The information presented in the table can be personalized by pressing the button **COLUMN VISIBILITY** on the right-side of the screen. A pop-up window offers the possibility select or de-select the desired columns to be visible in the table, as shown in Figure 51.

At the bottom of the table there is a row that can be filled in with filtering information, which can be used to display only specific horses (for example, all horses with a certain age and color). The table can be sorted in ascending or descending way, based on each column, by pressing the up and down arrows on the right-side of the column name.

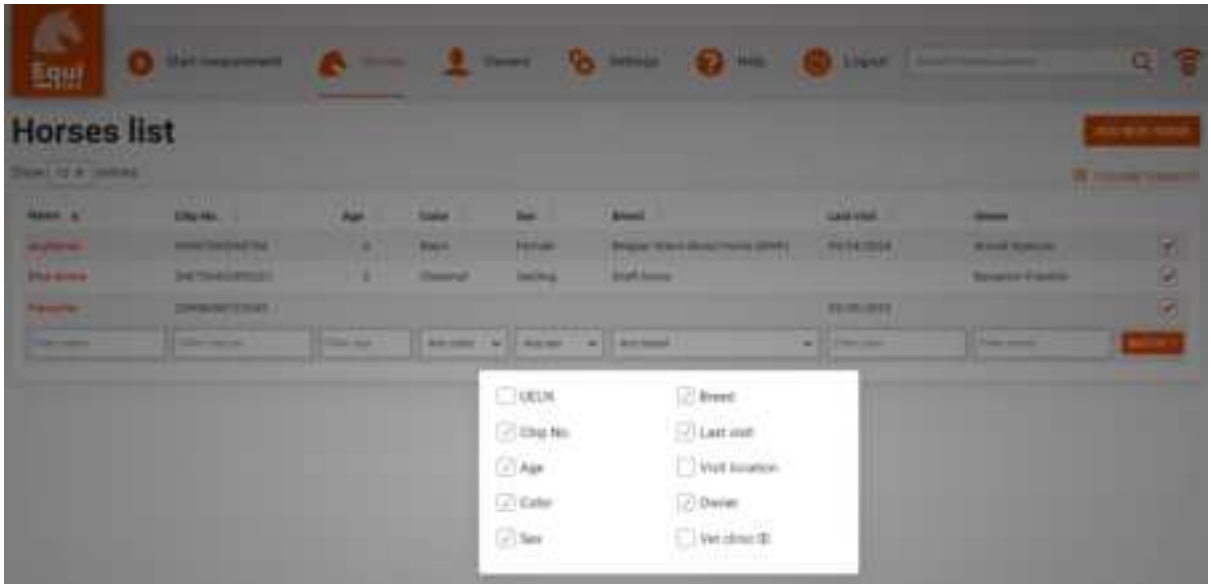


**Figure 51: Select the columns that are displayed in the table of horses.**

### *5.6.2 Add Horse*

By pressing the button **ADD NEW HORSE** on the right-side of the screen, the **Add horse** window appears. In this window, a new horse can be added to the table of horses, see Figure 52.

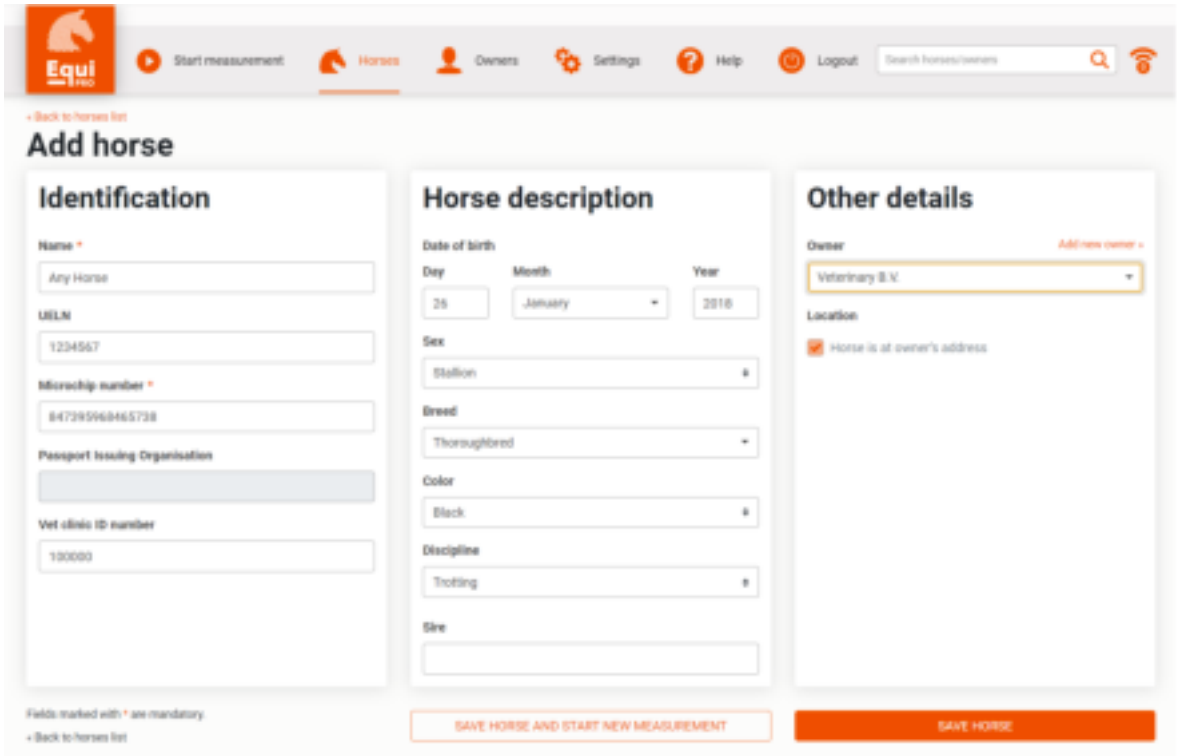


**Figure 52: Add a new horse**

The window is divided vertically in three sections: **Identification**, **Horse description** and **Other**

**details**. The **Name** and the **Microchip number** from **Identification** are mandatory fields. At **Horse description**, a series of characteristics of the horse can be filled in, such as date of birth, sex, breed, color, discipline and sire. At **Other details**, the owner of the horse can be selected from the list of owners. A new owner can be added directly by pressing the **Add new owner** button or by accessing the **Owners** application section, as explained in Section 5.7.

The information can be saved by pressing the **SAVE HORSE** button at the bottom right of the screen. Press the **SAVE HORSE AND START NEW MEASUREMENT** to save the details and enter the **Start measurement** window to start a new measurement with the selected horse. Press the **Back to horses list** button to return to the table with horses.

By pressing on the **Name** of a horse in the horse table (Figure 50), a window with details about the selected horse appears, as described in the next section.

### *5.6.3 Batch Processing*

Batch processing selects a list of horses for export or re-process in a group. If needed, the user can first apply a filter to the list of all horses using the bottom row of the table. The horses to be processed as a batch can then be selected by using the checkboxes on the right side of the **Horses list** table (Figure 53).

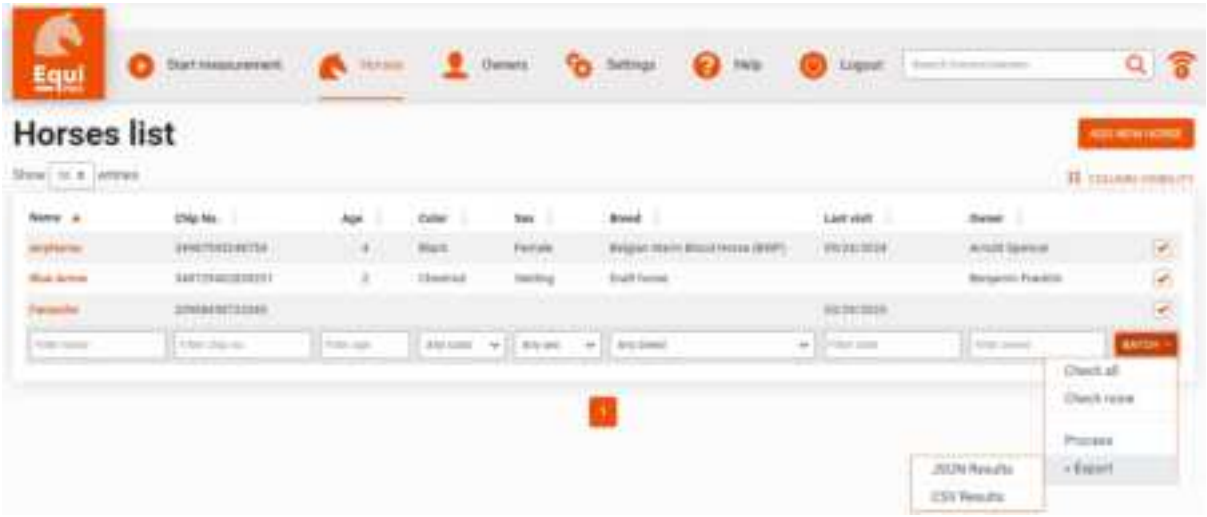


**Figure 53: Batch processing options**

For batch re-processing, click on the **BATCH** button and then on **Process**. The system fetches the relevant measurements and analyzes how many need to be re-processed (outdated measurements). You can choose to **Cancel**, **Process All** files or **Process Outdated** files only. The software processes the selected list and informs which file number is being processed, see Figure 54. The files are processed without interruptions. If errors occur during this step, they are listed below the measurement progress bar. At the end of the batch processing, press **CONTINUE**.


**Figure 54: Batch processing**

For batch export, click on the the **BATCH** button and then on **Process**. To select the type of export, chose between **JSON** or **CSV**. Select a folder to save the exported files. The name of the file will use the default format "measurementDate-HorseName-data-gps.csv/.json". The **measurementDate** follows the ISO 8601 filename notation format, YYYYMMDDThhmmss.

### *5.6.4 Horse Measurements*

Figure 55 shows the details of a specific horse. The window is divided vertically in two sections: **Details** and **Measurements**.

The **Details** section displays some information of the selected horse and its owner. By pressing the **Edit details** button at the bottom, the **Edit horse** window appears where these details can be changed, similar to the **Add horse** window shown in Figure 52.

The **Measurements** section presents a table with information about all measurements done with the selected horse. The table indicates the **Date**, the **Details** of the measurement and information about **Flexion Tests** and **Nerve Blocking**. The **Details** column include information related to the location of the measurement, notes, conclusion, type, purpose and log files. The table is ordered based on the **Date** of the measurements. The ascending or descending order can be changed by pressing the up and down arrows on the right-side of the column **Date**.

Each row in the table corresponds to a date when one or more measurements were performed. Pressing the down arrow on the right-side of the a specific date expands the row with information about all measurements done on that date, including the time for each measurement. For example, in Figure 55, three measurements were done on 11-08-2019.

The last column in the **Measurements** table, called **Select**, allows the selection of up to four measurements for comparison. By pressing the button **COMPARE MEASUREMENTS** at the top right of the screen, a new window **Comparison** appears, where different measurements of the same horse can be compared. See Section 6.6 for more details about measurement comparison.

Press the **START NEW MEASUREMENT** button to enter to the **Start measurement** window and start a new measurement with the selected horse.

On the left-side of the screen the maximum number of entries displayed on one page can be

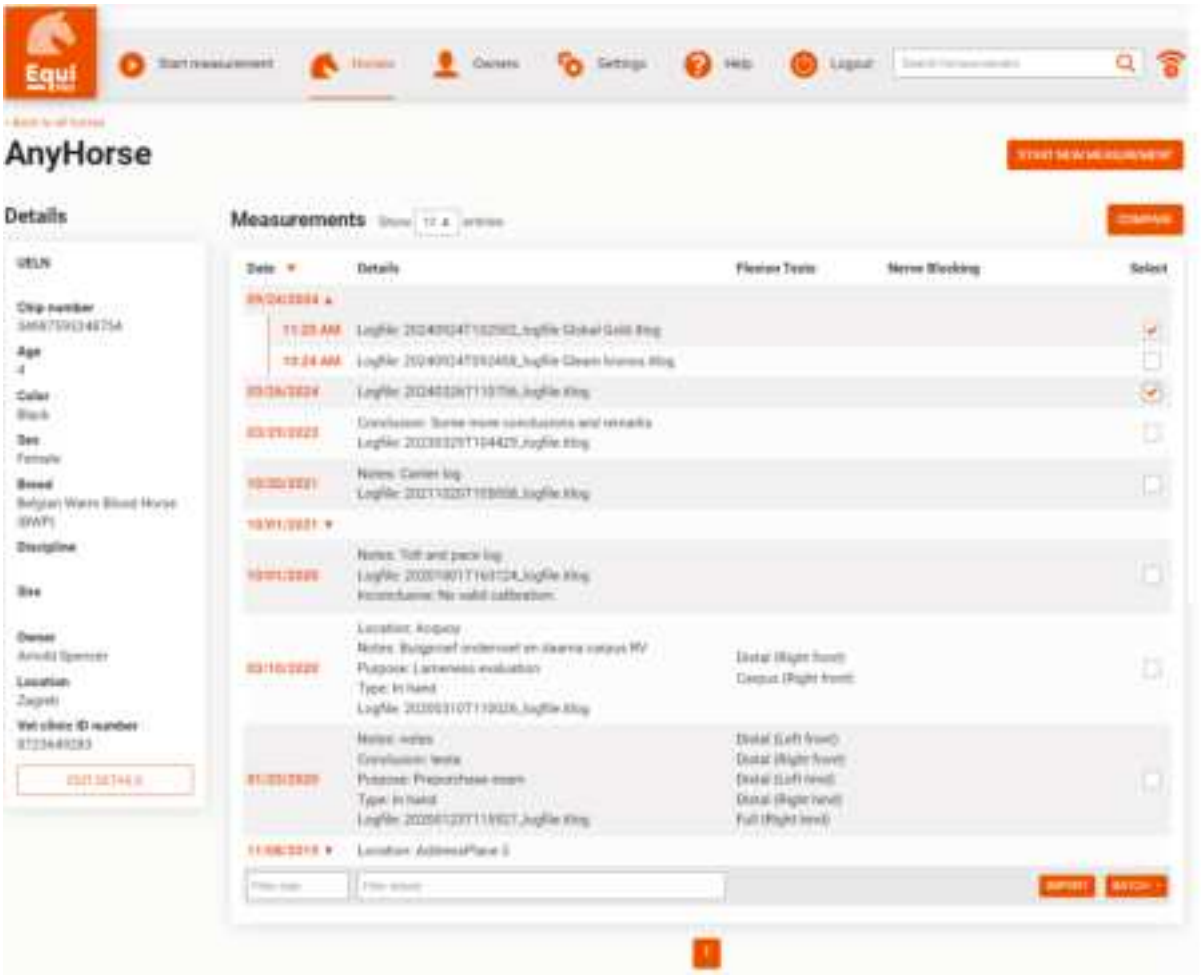


**Figure 55: Details of a specific horse**

selected among 5, 10, 20 or 30 entries. In Figure 55, the number of entries is 5. If the total number of horses is higher than the number of entries per page, you can switch to the next pages by pressing the buttons with page numbers at the bottom of the screen.

## 5.7 Owners

This section displays a table with all horse owners registered in the Equi-Pro application, see Figure 56. The essential information about each owner is visible in the table, such as the name, the phone number, the location, the address and the date of the last visit. By pressing the **See horses** button on the last column of the table, the table of horses associated with the specific owner is shown, as described in Section 5.6.


**Figure 56: Table with the horse owners registered in the application**

At the bottom of the table there is a row that can be filled in with filtering information, which can be used to display only a selection of owners (for example, all owners at a certain location). The table can be sorted in ascending or descending way, based on name, location or last visit, by pressing the up and down arrows on the right-side of the column name. In Figure 56, the list of owners is sorted based on their name in an ascending order.

On the left-side of the screen the maximum number of entries displayed on one page can be selected among 5, 10, 20 or 30 entries. In Figure 56, the number of entries is 5. If the total number of owners is higher than the number of entries per page, you can switch to other pages by pressing the buttons with page numbers at the bottom of the screen.

Pressing the button **ADD NEW OWNER** on the right-side of the screen enters a window where a new owner can be added, see the next section. Pressing on the **Name** of the owner in the owner table shows a window **Edit owner**, with the same fields and options as the **Add owner** window.

### *5.7.1 Add Owner*

Figure 57 shows a window where a new owner can be added. The window is divided vertically in three sections: **Identification**, **Address** and **Contact**. At **Identification**, you can choose between **Individual** and **Company**. For individuals, the **First name** and **Last name** fields are mandatory. For companies, the **Company name**, **First name of representative** and **Last name**

**of representative** are mandatory fields. Figure 57 shows the fields for adding a company. At **Address**, the address details can be filled in. At **Contact**, the phone number and email address can be filled in. The information can be saved by pressing the **SAVE OWNER** button at the bottom right of the screen. Press the **Back to owners list** button to return to the table with owners.

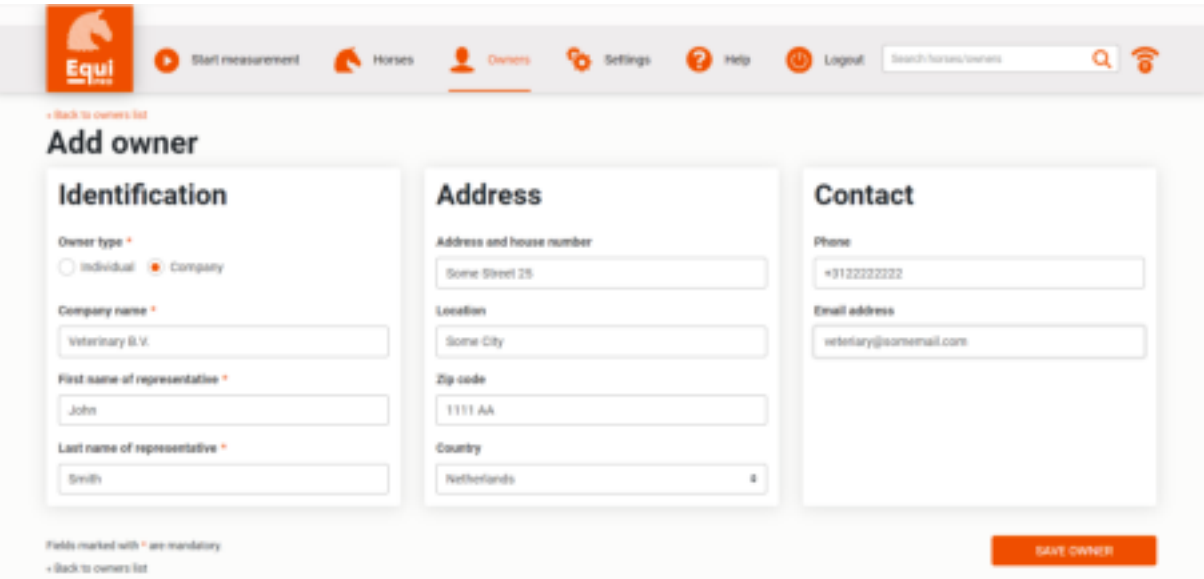


**Figure 57: Add a new horse owner**

## 5.8 Settings

In this section various settings are discussed, such as the position of the sensors on the horse, sensor configuration, sensor firmware information, interface options and company details.

### *5.8.1 Positions*

The **Positions** tab allows the assignment of sensors to different parts of the horse's body, as illustrated in Figure 58. The screen is divided horizontally in three parts: **Mandatory devices**, **Other devices** and **Other devices - positions not allocated**.

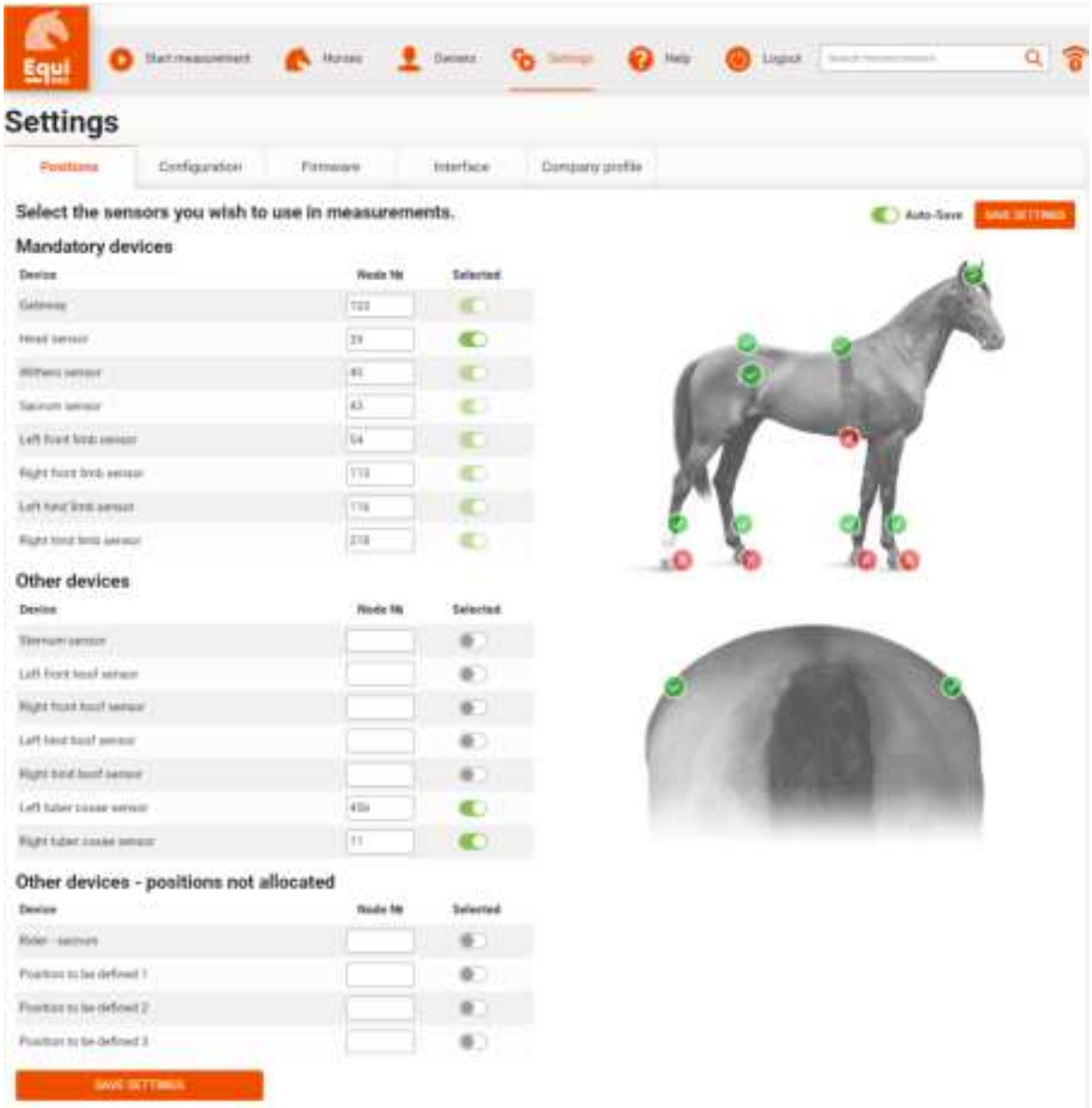


**Figure 58: Configuration of sensor positions**

There are seven **Mandatory devices**, which have to be assigned to the head, withers, sacrum

and the legs of the horse. The head sensor is a particular case, being mandatory to determine the upper-body parameters, but not required for the gait detection. A measurement cannot start until the withers, sacrum and the legs of the horse are assigned and connected to the network. In addition, the gateway is also mandatory and will be automatically selected and assigned by the application.

**Other devices** can be added to the network at pre-defined positions, such as the **Left tuber coxae sensor** (LTC) and **Right tuber coxae sensor** (RTC), sternum and hoof sensors. LTC and RTC are used for the computation of Hip-Hike. The other positions are currently not used for analysis, except for the sternum sensor, where the **CSV** results file will include **MinDiff**, **MaxDiff**, **Symmetry Index Up** and the range of motion (ROM) of the vertical displacement. Press the **Selected** knob corresponding to these positions and introduce the node number in the **Node №** field. When these sensor connect to the network, their position on the horse image on the right-side of the screen turns green.

Four other devices can be added to the network through the **Other devices - positions not allocated** section. Press the **Selected** knob corresponding to these positions and introduce the node number in the **Node №** field.

After all sensors are assigned, if **Auto-Save** is selected through the toggle button, then the locations are automatically saved. If **Auto-Save** is not selected, press one of the **SAVE SETTINGS** buttons at the top-right or bottom of the screen.

### *5.8.2 Configuration*

The **Configuration** tab (Figure 59) displays a table with information about each sensor connected to the wireless network. Depending on the position of the sensors, different default settings are applied to the radio channel, accelerometer, gyroscope and high-g accelerometer. These settings are automatically adjusted and cannot be changed, unless the user decides to override the default settings by pressing the toggle switch **Override defaults**.

Each row of the table contains the following information:

- **Device** shows the assignment to a body part. If the sensor is not yet assigned, the **N/A** abbreviation is displayed instead. A gateway device is denoted with **Gateway**.
- **Node №** shows the node number.
- **Sampling Rate (Hz)** specifies the sampling rate as the number of sensor samples per second. The sampling rate can be changed by pressing the down arrow on the right-side of the field. The default value is 200 Hz. Other possible values are: 100, 500 and 1000 Hz. For the application to work as expected, **all sensors need to have the same sampling rate**. For regular users, we recommend to leave this field unchanged.
- **Radio Channel** indicates the wireless channel on which the data transfer takes place between the gateway and the sensors. This is a value between 11 and 26. **All sensors**

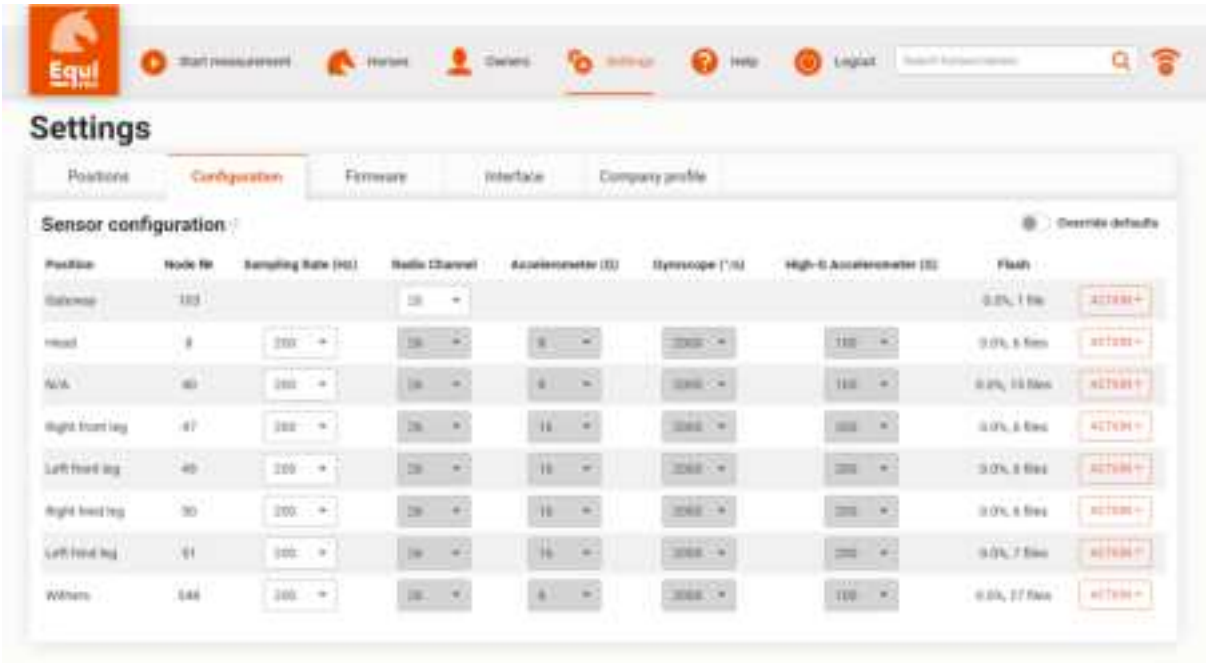


**Figure 59: Sensor configuration**

**need to operate on the same radio channel** in order to be part of the same network. We recommend to leave this field unchanged, unless the wireless connection is very bad, as shown by the **Signal strength** column in the **Start measurement** window (see Section 5.2).

- **Accelerometer (G)** gives the maximum acceleration that can be measured. Supported options are: ± 2, 4, 8 and 16 g. A lower range has a higher sensitivity. For regular users, we recommend to leave this field unchanged.
- **Gyroscope (°/s)** indicates the maximum rotational velocity the gyroscope can measure. Supported options are: ± 250, 500, 1000 and 2000 °/s. A lower range has a higher sensitivity. For regular users, we recommend to leave this field unchanged.
- **High-G Accelerometer (G)** shows the maximum acceleration the high-g accelerometer can measure. Supported options are: ± 100, 200 and 400 g. A lower range has a higher sensitivity. For regular users, we recommend to leave this field unchanged.
- **Flash** gives an overview of how much flash memory is occupied on the current device and how many measurement files are stored.
- **ACTION** - by pressing this button three actions are possible:
  - **Apply** - Click on this action in order to apply the changes to the current sensor.
  - **Refresh** - This action inquires the sensor about the current settings. This is useful to confirm whether a specific setting was applied.

– **Format...** - Perform this action if the memory of the sensor is almost full. It formats the flash memory and erases all measurement files.

### *5.8.3 Firmware*

This tab displays a table with information about the firmware on the gateway and sensors. Firmware updates can also be done, as shown in Figure 60.

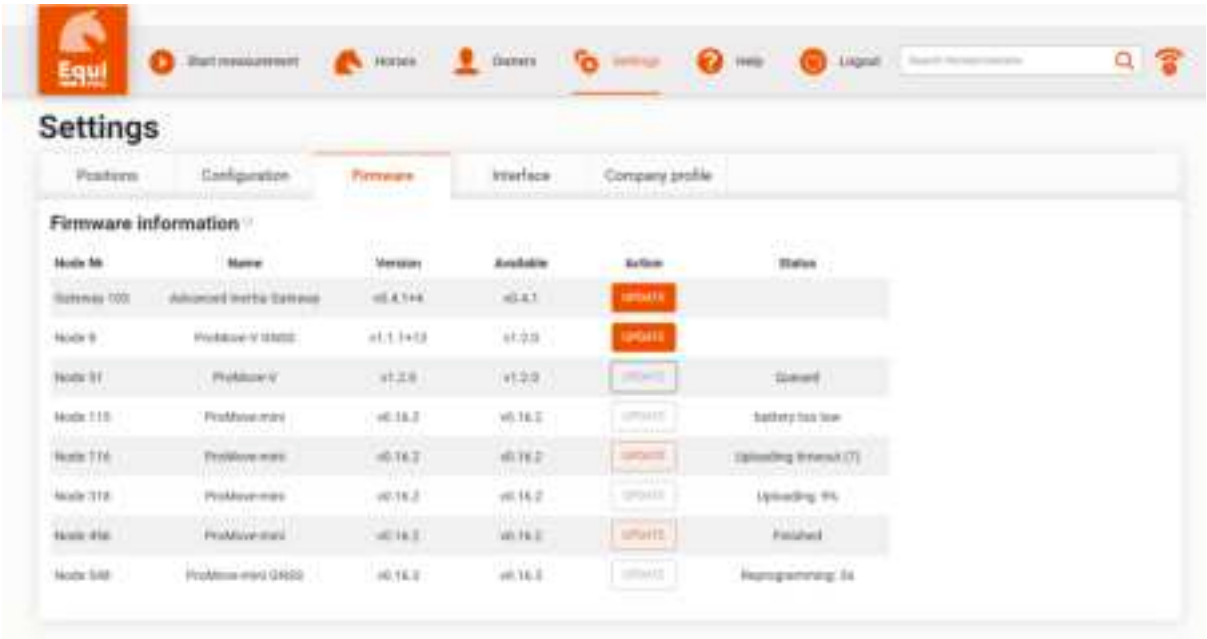


**Figure 60: Firmware information and update**

Each row of the table contains the following information:

- **Node №** shows the node number.
- **Name** indicates the type of device.
- **Version** specifies the firmware version on the current device.
- **Available** specifies the firmware version available for reprogramming.
- **Action** button starts the reprogramming of the current device with the firmware indicated in the **Available** field.
- **Status** shows the current status of the reprogramming: receiving information, uploading, updating, reprogramming, finished. It also indicates whether the battery status is too low to start the reprogramming procedure, if the upload procedure timed out due to bad wireless connection or if the reprogramming task was scheduled (queued) for later due to reprogramming of other nodes.

### 5.8.4 *Interface*

In this tab the desired zoom factor of the application interface can be changed, see Figure 61. The default value is 100 and can be changed within a range from 50 to 200 by pressing the **-** and **+** signs.


**Figure 61: Interface settings**

### 5.8.5 *Company profile*

In this tab you can fill in the **Company name** and **Company address** fields, as shown in Figure 62. This information appears in the reports, see Section 6.7

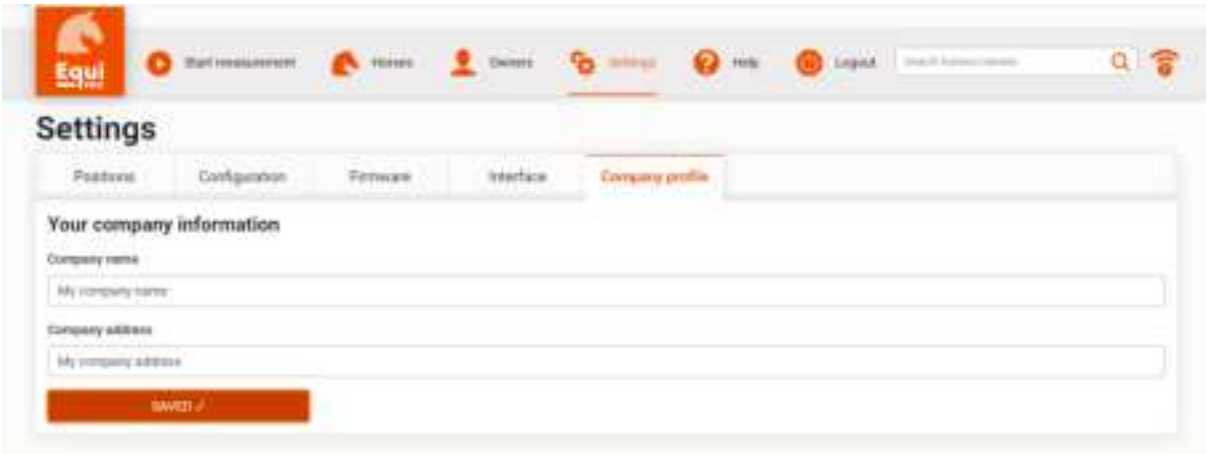


**Figure 62: Company information**

## 5.9 Help

This application section shows a quick guide about the sensor installation and measurement process, as shown in Figure 63.

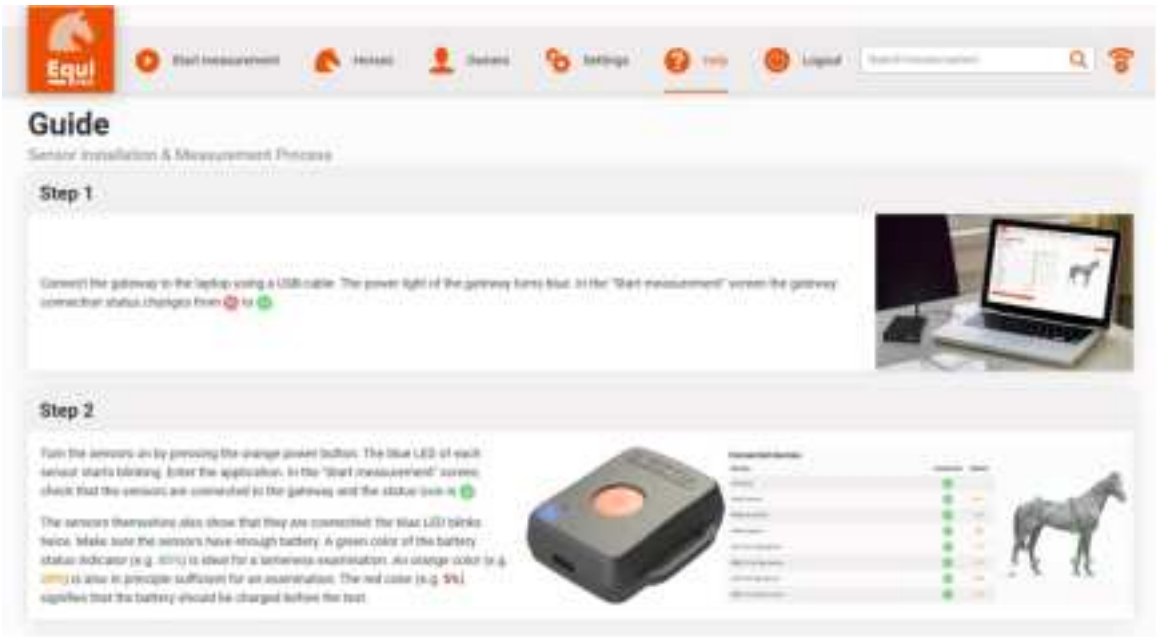


**Figure 63: Sensor installation and measurement guide**

# 6 Results

The results of a measurement are displayed in the **Measurement details** window (Figure 64). In the following, we describe the measurement results, including the timeline, the upper-body parameters, the limb-related parameters and the performance parameters.

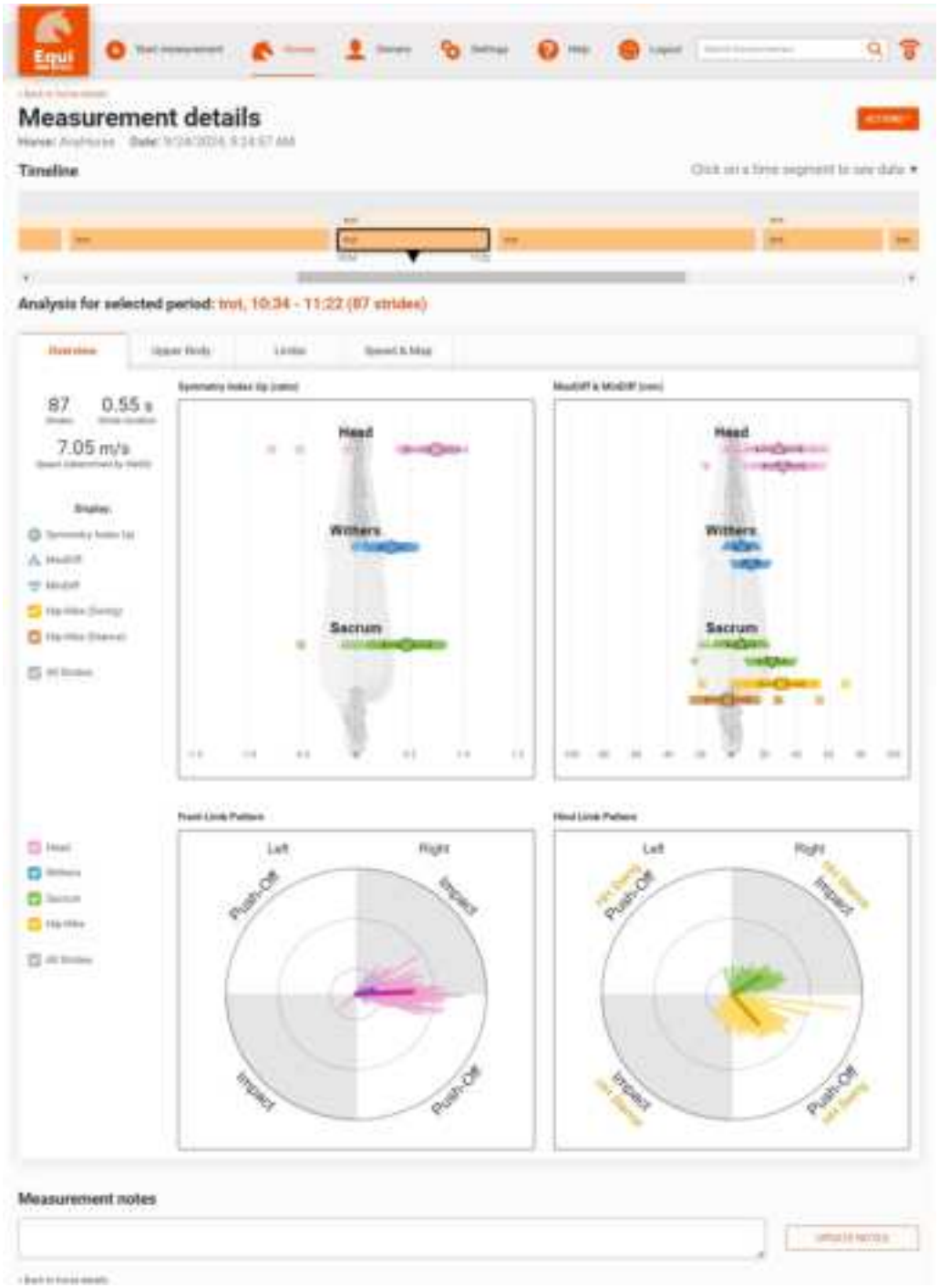


**Figure 64: Measurement details for a selected period**

## 6.1 Timeline

The application recognizes the following gaits: *walk*, *trot*, *left-lead canter*, *right-lead canter*, *tölt* and *pace*. Additionally, the application identifies the conditions, such as the type of surface (*hard* or *soft*) and direction (*straight* line or *left/right* circle). The timeline of the measurement displays all gaits and conditions, as shown in Figures 65 and 66.

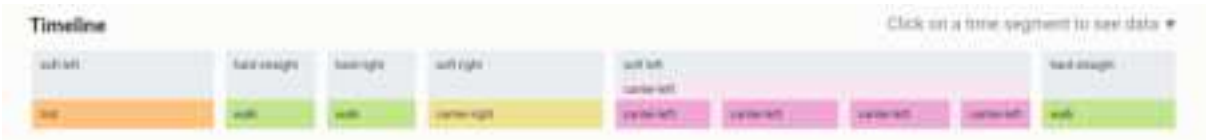


**Figure 65: Timeline with canter**


**Figure 66: Timeline with tölt and pace**

The timeline is split into **segments**, where every segment represents a continuous gait under the same conditions. Segments are separated by standing still situations or change of gait and conditions. The application requires a minimum of 5 strides in the same gait in order to create a segment. When there are multiple similar segments with the same gait and direction, and the time between segments is short enough, these segments are merged into one continuous, larger segment, as shown in Figure 65 for canter-left and Figure 66 for pace.

During the measurement, you can give information about nerve-block and flexion tests, which can be seen also in the timeline, as shown in Figure 67. More details about the test performed (limb, flexion test location) can be seen by hovering the mouse above the dark gray box of the flexion test.


**Figure 67: Timeline with flexion tests**

By clicking on one segment in the timeline, an analysis section is added to the window, with four information tabs: **Overview**, **Upper body**, **Limbs** and **Speed**. In the following, the information displayed on each of these tabs is presented in detail.

## 6.2 Overview

This tab gives an overview of the results, as shown in Figures 64, 68 and 69.

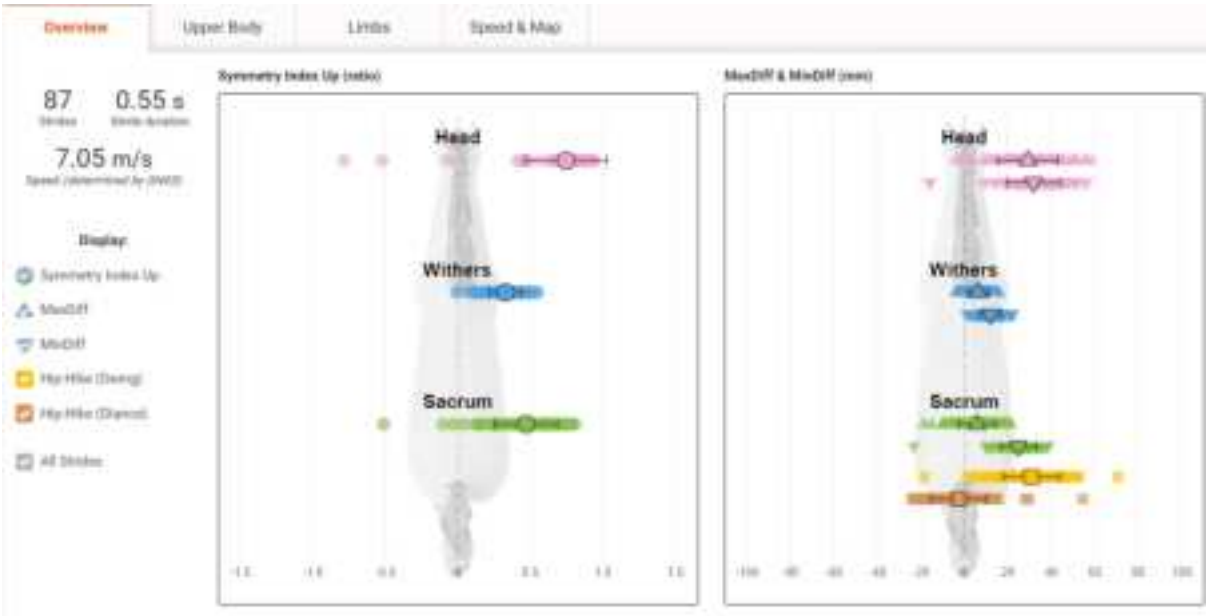


**Figure 68: Results overview: number of strides, stride duration, speed, Symmetry Index Up, MaxDiff, MinDiff and Hip-Hike.**

On the left-side there is a summary of limb-related parameters with number of strides and average stride duration, the mean speed of the horse (if a GNSS sensor was used during the measurement) and the legend of the two graphs on the right. For more information on limb-related parameters and speed, see Sections 6.4 and 6.5.

The two graphs of the right are shown only for the walk and trot gaits. They present the summary of results of the upper-body parameters, which are used to estimate to what extent the horse's gait is symmetrical at key positions on the upper body of the horse. These parameters are based on vertical motion and displacement. At each of these positions, the horse's body moves up and down in a cyclic fashion exactly two times each stride. It is generally assumed that in sound horses, this signal is symmetrical on the straight line.

The graphs show the mean value (with a filled colored shape) and the standard deviation (in the form of a segment) of the different parameters. The shape and color of the points in the graph vary depending on the type of sensor and its position on the horse's body (Head, Withers, Sacrum, Hip-Hike swing, Hip-Hike stance).

When the **All Strides** box at the bottom of the legend is checked, all individual result values are displayed with smaller, light colored shapes. A tooltip showing the mean, standard deviation and values of points are displayed below the mouse cursor when hovering the mouse over the value points.

The parameters displayed in the two graphs on the right are the following:

- The **Symmetry Index Up** (circle) ranges from -1 to 1. It is calculated by comparing the upward movement of the left and right push-off. A value of 0 indicates perfect symmetry. A value of ±1 indicates maximum asymmetry. The sign depends on the affected limb.
- **MinDiff** (triangle pointing down) is the difference between first and second minimum peaks in vertical displacement signal. **MaxDiff** (triangle pointing up) is the difference between first and second maximum peaks in vertical displacement signal. A value of 0 indicates perfect symmetry.
- **Hip-Hike** (square) is a symmetry parameter that measures the difference in vertical displacement of the left and right tuber-coxae in both the swing and stance phases of the stride. It requires the LTC and RTC sensors on the left and right tuber-coxae. A value of 0 indicates a perfect symmetry. This parameter is available only for trot.

The parameters can be made invisible by unchecking the checkboxes in the legend on the left.

The two *clock plots* displayed in Figure 69 are valid only for **trot** measurements. They represent the front limb asymmetry patterns (left) and the hind limb asymmetry patterns (right). Each clock plot is divided into four quadrants corresponding to the affected limb (left or right) and the asymmetry type (impact or push-off): **Left Push-Off** (top left), **Left Impact** (bottom left), **Right Push-Off** (bottom right) and **Right Impact** (top right). The legend on the left side follows the color code defined earlier.

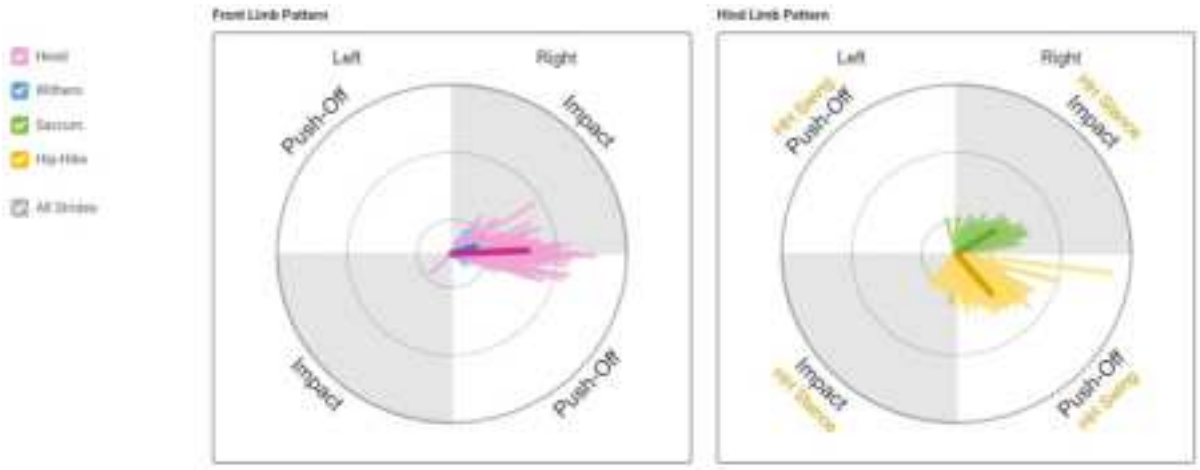


**Figure 69: Results overview: clock plots**

The *clock plots* display the **MinDiff** and **MaxDiff** values of the Head, Withers and Sacrum related to their clinical meaning: **Impact** and/or **Push-Off** asymmetries. **MinDiff** is usually related to **Impact** lameness while **MaxDiff** asymmetries are often present in **Push-Off** lameness representations. The Hip-Hike (HH) swing and stance components are shown in the **Hind Limb Pattern** clock plot (right).

The bold vectors are the average values and the lighter colors are the individual strides values. If the values of one sensor are hidden by the values of another sensor, the user can choose to

remove the sensor's data by unchecking the corresponding sensor box on the left. The user can also choose to show only the average values by unchecking the **All Strides** box.

## 6.3 Upper Body

The **Upper body** tab shows in more detail the upper-body parameters.

The top plot shows the vertical displacement of the head, withers and sacrum, alongside the timing of footfalls, as shown in Figure 70. In the footfall plot, the time interval when the hoof is on the ground is shown as a tooltip when hovering the mouse over a segment.


**Figure 70: Upper body: vertical displacement**

The middle plot shows the average of all steps in the selected time period. The dark color signifies the mean value of the measurements, while the light color presents the standard deviation. By checking the **All Strides** box, all strides will be displayed, superimposed (Figure 71).

The bottom plot shows the **MinDiff** and **MaxDiff** as average and standard deviation for all upper-body sensor positions (Figure 72).

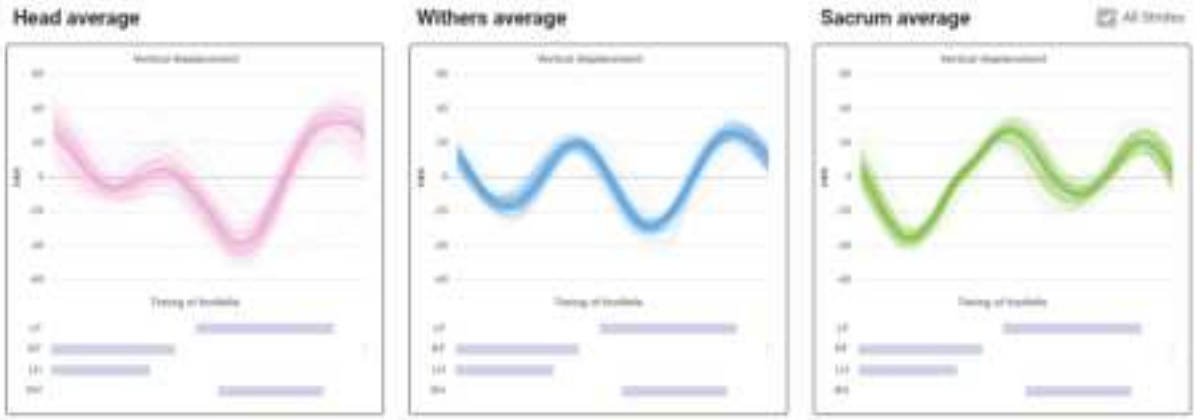


**Figure 71: Upper body: average of all strides**

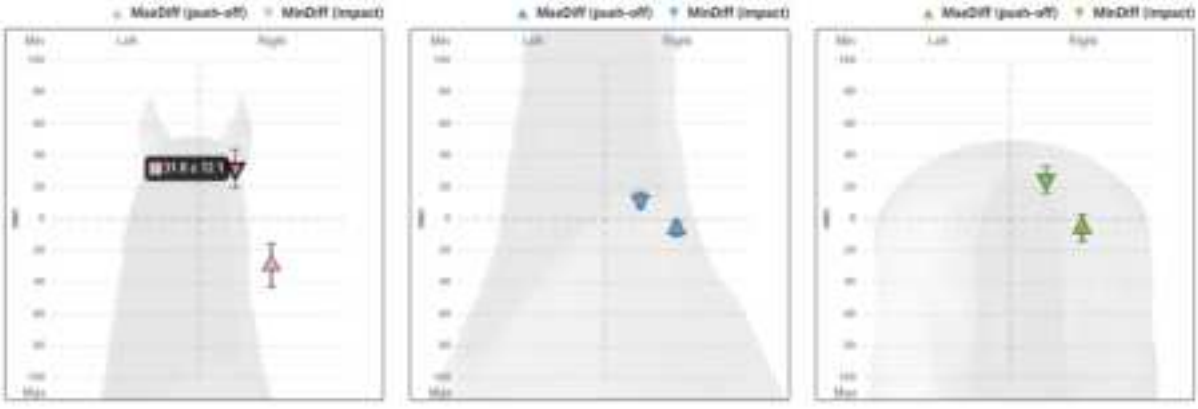

**Figure 72: Upper body: MinDiff and MaxDiff for head, withers and sacrum**

## 6.4 Limbs

### *6.4.1 Footfall*

In Figure 73 the following parameters are displayed:

- **Legs** shows the *timing of footfalls*, defined as the order of placing the hoofs on the ground in a complete stride. Each leg has a different color: **LF** (left front), **RF** (right front), **LH** (left hind) and **RH** (right hind). The filled rectangles indicate the stance periods that occur in between the swing periods. The beginning of a stance period is the *hoof-on* moment, i.e. the instant when the hoof touches the ground.
- **Swing intensity** is a measure for the force or intensity of the swing. It is the sum of the absolute values of angular velocity in the sagittal plane divided by the duration of the swing. The bars indicate the intensity of the swing at the end of the swing period for each leg.
- **Stride duration** is the time required to complete one stride. Stride duration is the inverse of **stride frequency**, defined as the number of strides per minute.
- **Duty factor** or *relative stance phase* is the average stance duration for all legs divided by the average stride duration. It shows the average duration of the stance phase as a proportion of the total limb cycle duration or stride duration.


**Figure 73: Timing of footfalls**

### *6.4.2 Average Stride*

In Figure 74 the following parameters are displayed:

- **Stance duration** per leg is the time in which the limb is in contact with the ground during the limb motion cycle.
- **Swing duration** per leg is the time in which the limb is free from contact with the ground during the limb motion cycle.
- **DAP** is the **Diagonal Advanced Placement**, which is the time difference between the landing moments of foots in a diagonal pair.
- **Suspension**, which is the time period when none of the horse's limbs is in contact with the ground.

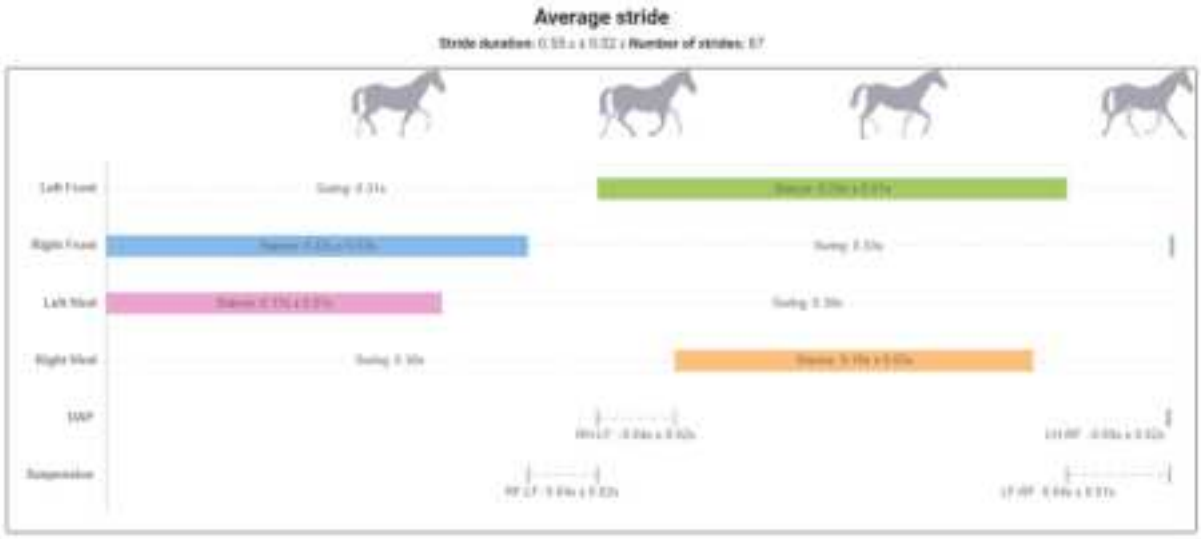


**Figure 74: Stance and Swing Duration per Leg**

### *6.4.3 Protraction and Retraction*

The application measures the protraction and retraction during the swing phase of a leg:

- **Protraction** is the angle of the cannon bone moving **forward** in the sagittal plane.
- **Retraction** is the angle of the cannon bone moving **backward** in the sagittal plane.

Figure 75 shows the superimposed left and right angles of the cannon bone of the front and hind limbs, for the average swing. By hovering the mouse cursor over the graph lines, the following information is displayed:

- **left: angle(°)**: the angle of the cannon bone of the left leg;
- **right: angle(°)**: the angle of the cannon bone of the right leg;
- **Hoof-off (right): 0%, angle(°)**: the moment when the right hoof leaves the ground, as equivalent to 0% of the swing phase, and the **angle** value;
- **Hoof-off (left): 0%, angle(°)**: the moment when the left hoof leaves the ground, as equivalent to 0% of the swing phase, and the **angle** value;
- **Sagittal min (left): percentage(%) angle(°)**: the minimum angle of the cannon bone (retraction) of the left leg at a certain **percentage** of the swing phase, and the **angle** value;
- **Sagittal min (right): percentage(%) angle(°)**: the minimum angle of the cannon bone (retraction) of the right leg at a certain **percentage** of the swing phase, and the **angle** value;
- **Sagittal max (left): percentage(%) angle(°)**: the maximum angle of the cannon bone (protraction) of the left leg at a certain **percentage** of the swing phase, and the **angle**

value;

- **Sagittal max (right): percentage(%) angle(°)**: the maximum angle of the cannon bone (protraction) of the right leg at a certain **percentage** of the swing phase, and the **angle** value;
- **Hoof-on (right): 100%, angle(°)**: the moment when the right hoof touches the ground, as equivalent to 100% of the swing phase, and the **angle** value;
- **Hoof-on (left): 100%, angle(°)**: the moment when the left hoof touches the ground, as equivalent to 100% of the swing phase, and the **angle** value.

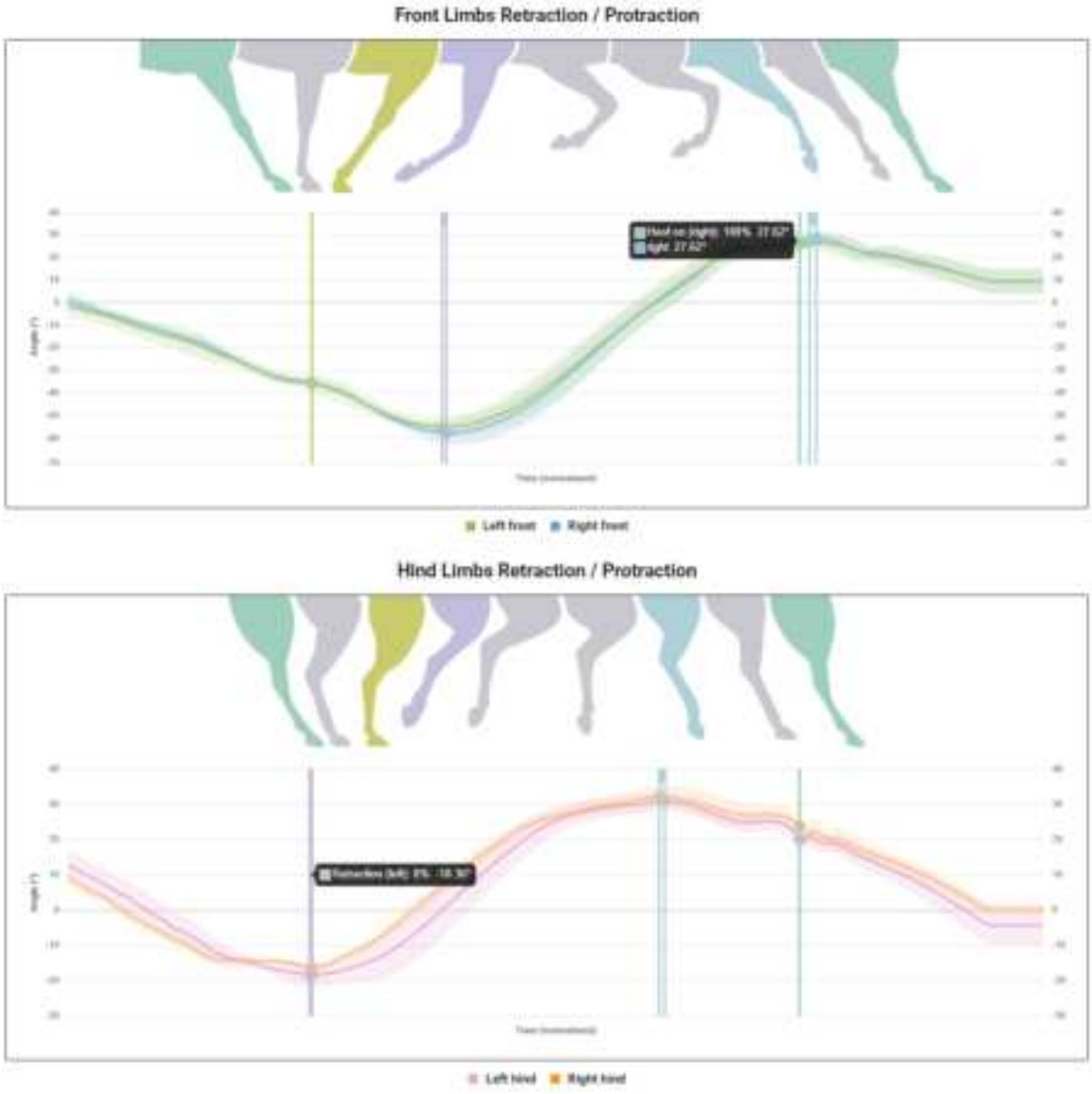


**Figure 75: Protraction and retraction**

### 6.4.4 *Abduction and Adduction*

Figure 76 shows the abduction and adduction parameters:

- **Abduction** is the angle of the cannon bone moving away from the midsagittal plane.
- **Adduction** is the angle of the cannon bone moving towards the midsagittal plane.

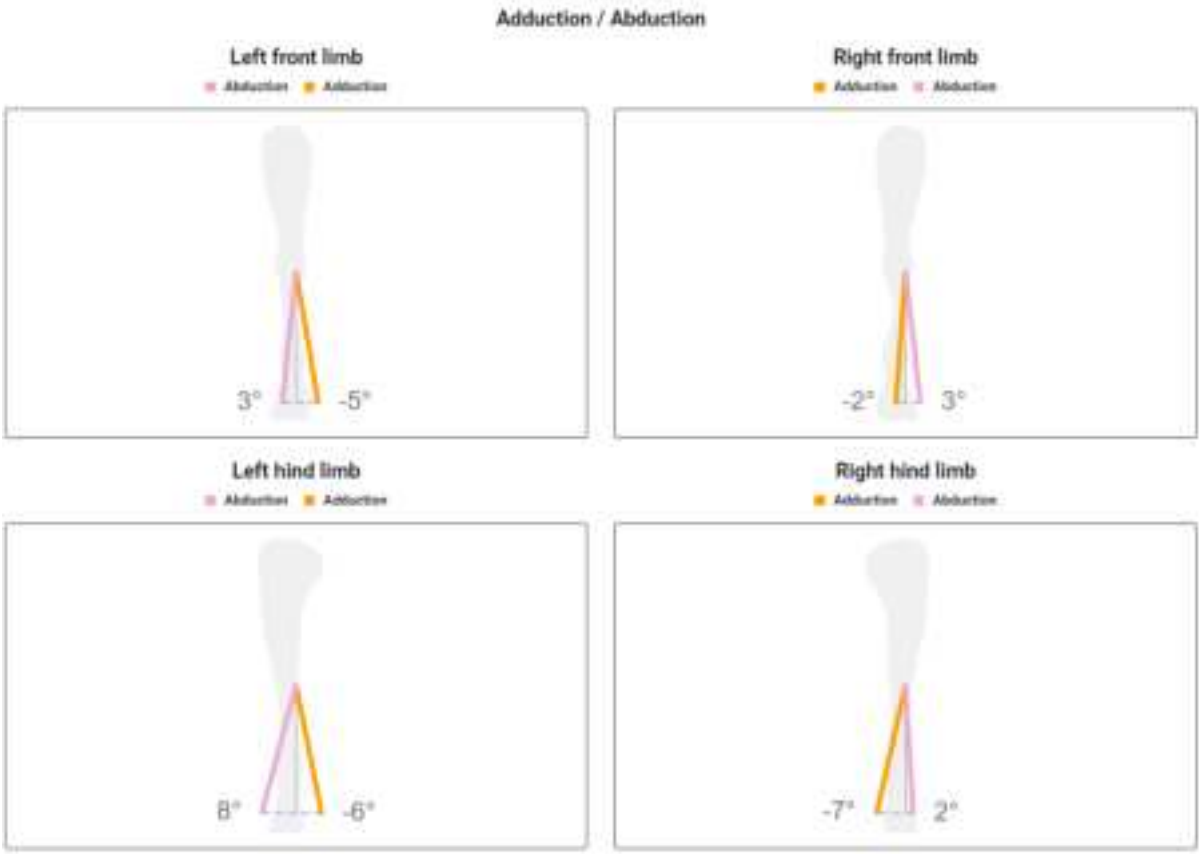


**Figure 76: Abduction and adduction**

## 6.5 Speed and Map

The speed and the trajectory of the horse are computed from a GNSS-enabled sensor. GNSS works outdoors and combines a constellation of satellites, including GPS, GLONASS and Galileo.

The top part of Figure 77 shows the evolution of the speed of the horse during the selected time segment, along with information regarding stride duration and length. The bottom part displays a map with the whole trajectory of the measurement. Thick blue arrows highlight the trajectory of the selected segment or the selected merged segment.

When clicking on a data point on a trajectory, a window with information appears. The window displays the date and time, the position of the GNSS sensor on the horse, the heading, latitude, longitude, altitude, speed, number of satelites used for detemining the location, and the detected gait. The user has the option to select the time segment that includes the specific data point by pressing the **GAIT** button. Alternatively, if the segment is part of a merged segment, the user can select the merged segment by pressing the **MERGED GAIT** button. The selected (merged) segment is shown with blue thick arrows and is highlighted with a black rectangle on the timeline.

Figure 77 shows a merged time segment composed of three segments of walk, visible on the map as three areas marked with thick blue arrows.


**Figure 77: Speed and map**

## 6.6 Compare Measurements

Two or more measurement segments can be selected for comparison. The segments can belong to a single measurement or to different measurements. Select the measurements for comparison from the **Measurements** table (Figure 55 from Section 5.6). From the timeline of these measurements, select the segments that you want to compare. In the following example, two segments from the same measurement are selected and the results are shown side-by-side.

The **Overview** tab displays the graphs of the **Symmetry Index Up**, **MaxDiff**, **MinDiff** and **Hip-Hike** (Figure 78).

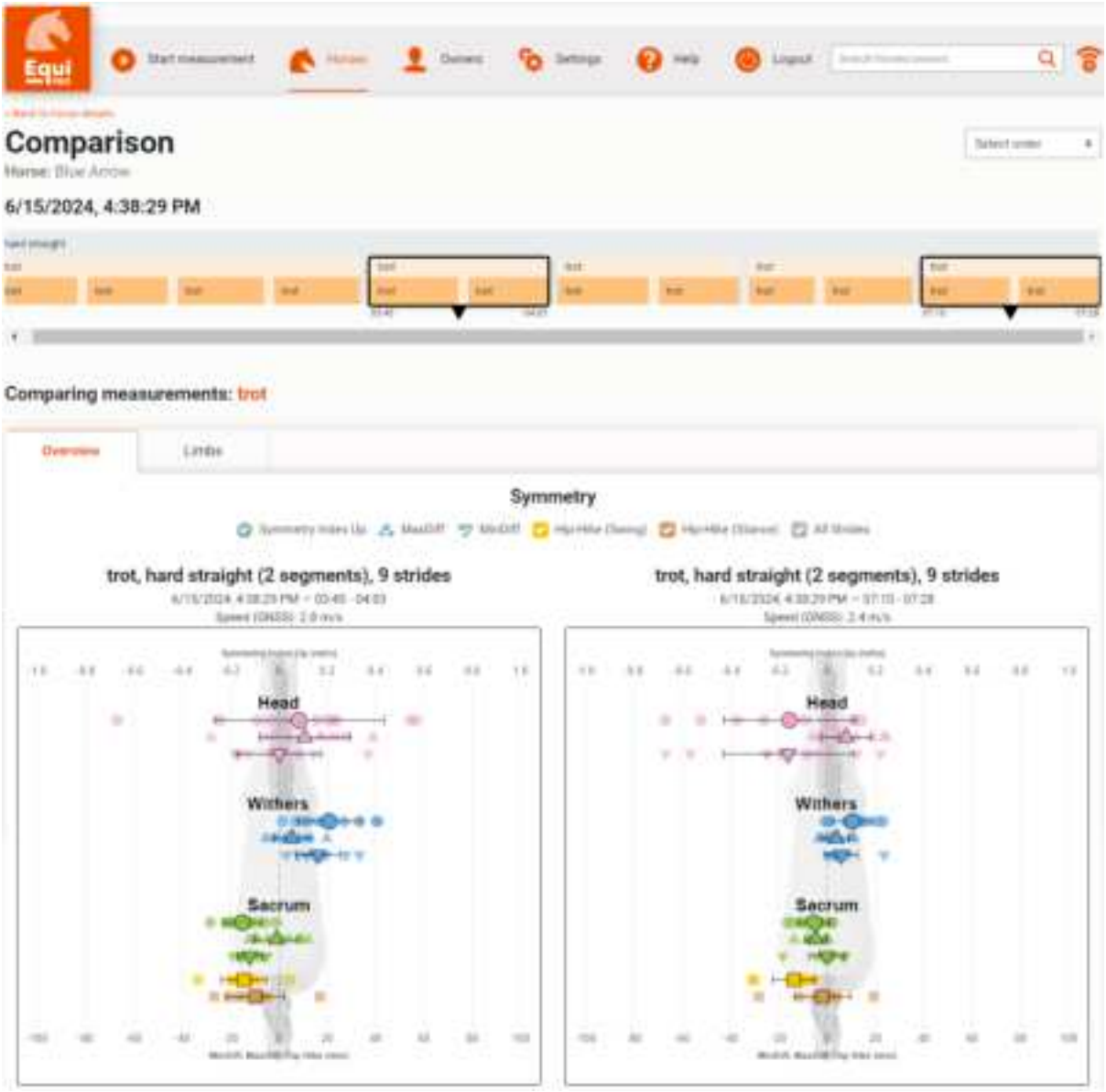


**Figure 78: Comparing different measurements - symmetry graphs**

A summary table (Figure 79) shows number of strides detected in the selected segments, together with a comparison of the average and standard deviation of the **Symmetry Index Up**, **MaxDiff**, **MinDiff**, **Hip-Hike**, **Stride duration** and **Speed** (if GNSS is available). The **Difference (%)** is computed as the ratio between the difference between the two rows and the absolute value of the first row: *(row2-row1)/ABS(row1) * 100*.

For trot measurements, the clockplots associated with the selected segments are presented below the table.

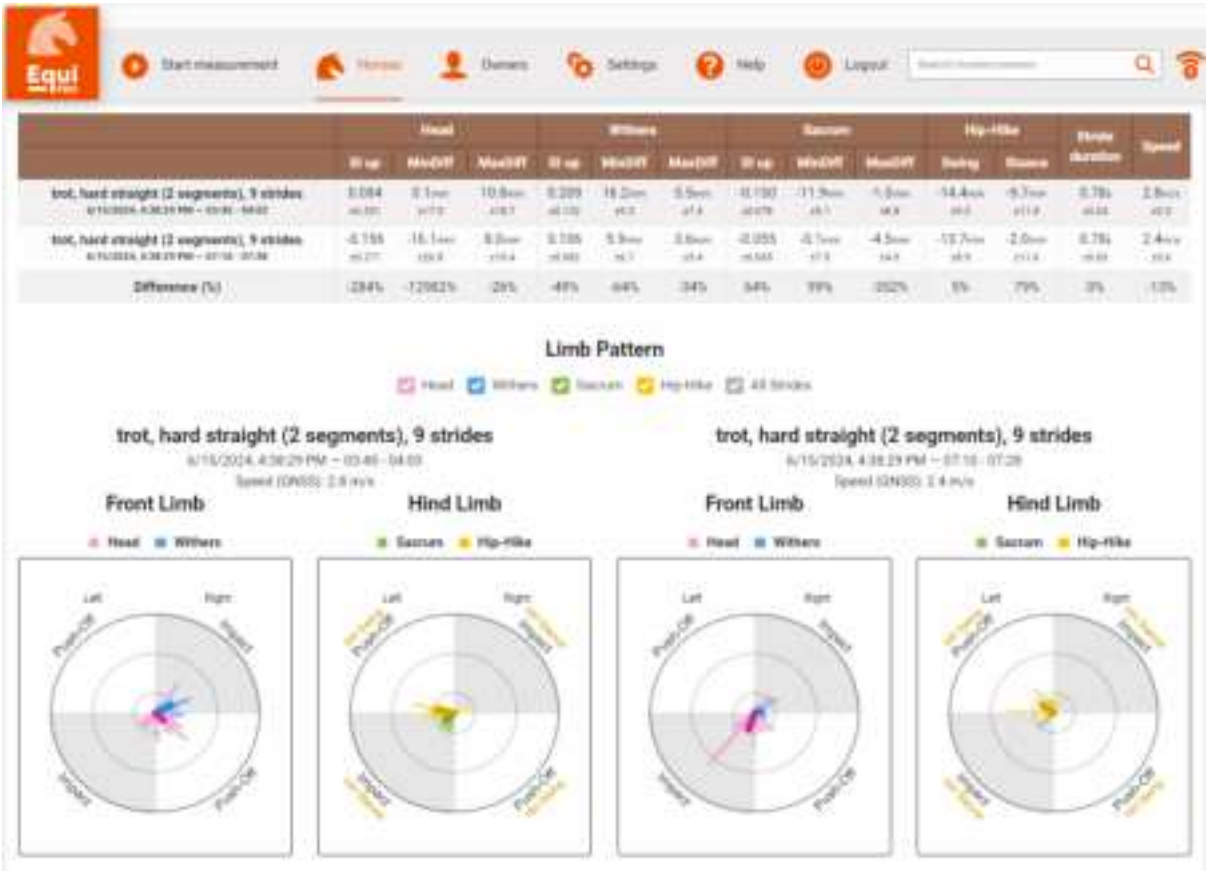


**Figure 79: Comparing different measurements - comparison table and clock plots**

In the **Limbs** tab (Figures 80, 81 and 82), the limb parameters are illustrated in adjacent graphs. Summary information tables are presented for the retraction and protraction angles.

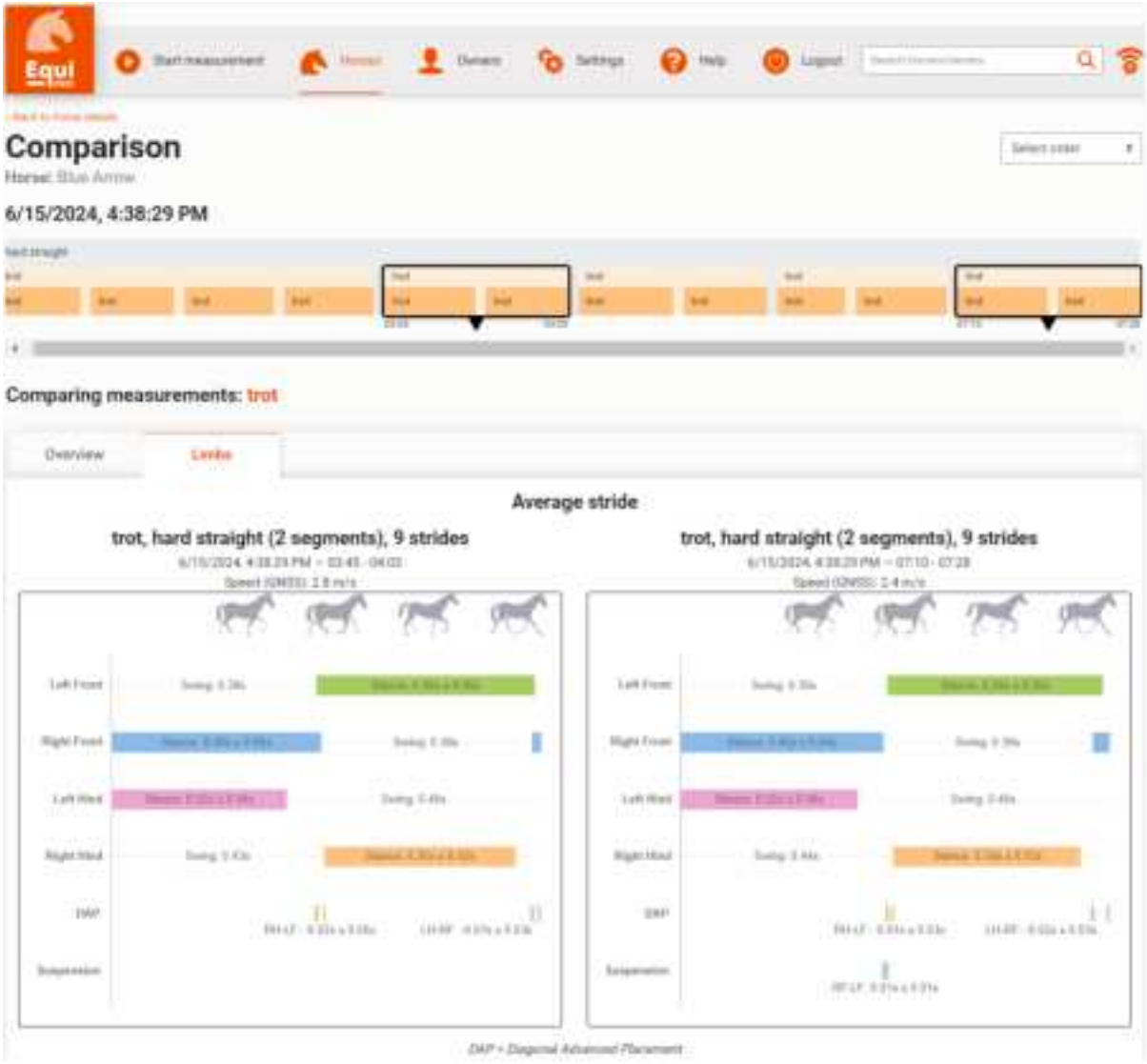


**Figure 80: Comparing different measurements - average stride**

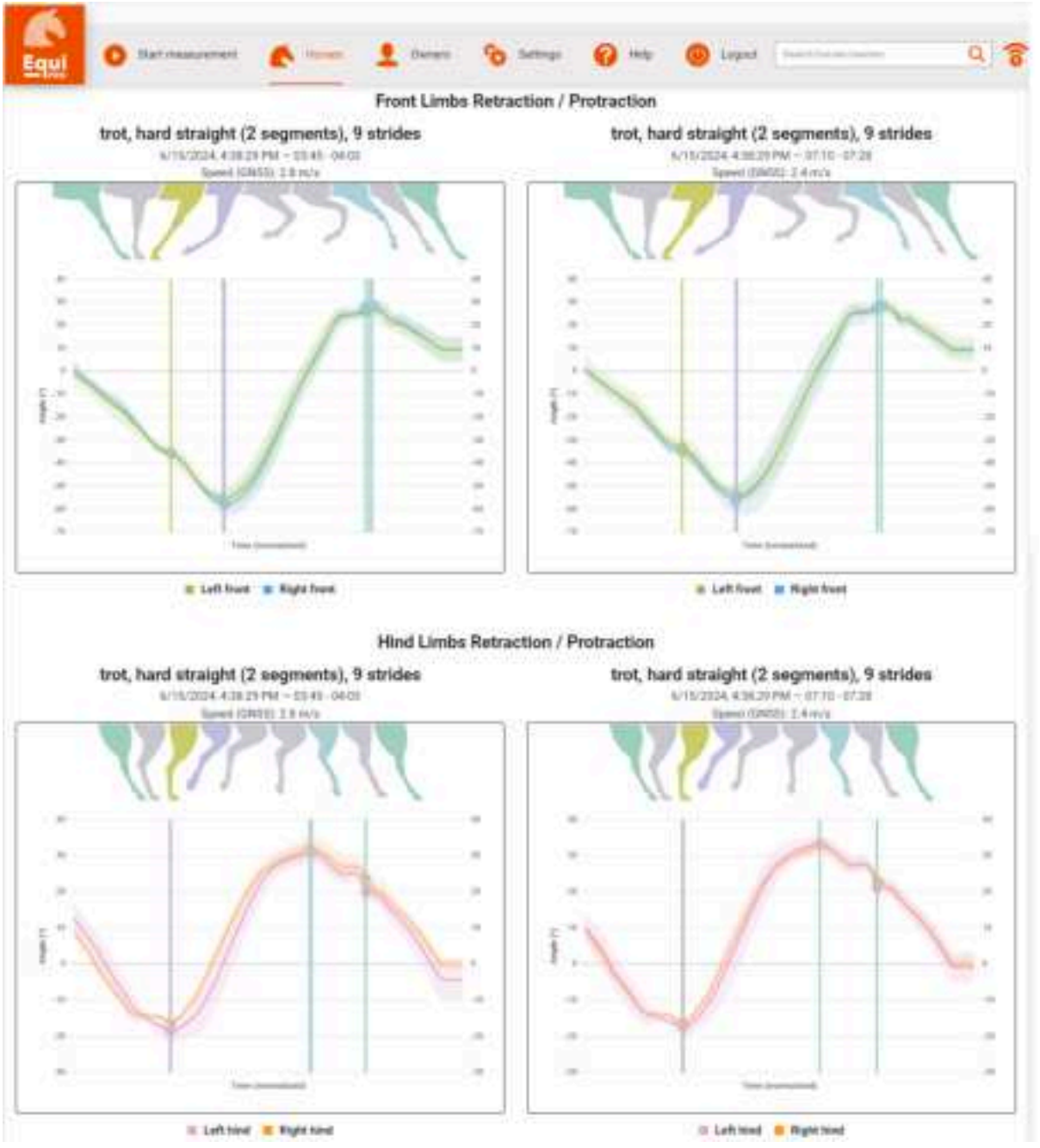


**Figure 81: Comparing different measurements - retraction/protraction plots**


**Figure 82: Comparing different measurements - retraction/protraction summary table and adduction/abduction plots**

## 6.7 Reports

The software generates a report of the measurements, split in events and gaits (see Figure 83), with the following contents:

- **General version**: measurement summary, upper-body symmetry, timing of footfalls, protraction and retraction angles, adduction and abduction angles in trot.
- **Extended version**: measurement summary, upper-body statistics for trot and results for all types of examination gaits: timing of footfalls, protraction and retraction angles, adduction and abduction angles.

# Gait analysis report

## Any Horse, 10/1/2021, 4:28:28 PM

5 y.o. Black Thoroughbred Stallion

| Name | Age | Breed | Location |
|---|---|---|---|
| Any Horse | 5 | Thoroughbred | Some City |
| **UELN** | **Color** | **Discipline** | **Vet clinic ID number** |
| 528003201308352567 3 | Black | Trotting | |
| **Chip number** | **Sex** | **Sire** | |
| 847395968465738 | Stallion | | |

**Nerve block:**

**Measurement notes:**
Some measurement notes

**Conclusion & remarks:**
Some more conclusions and remarks.

### Measurement overview


### Timeline

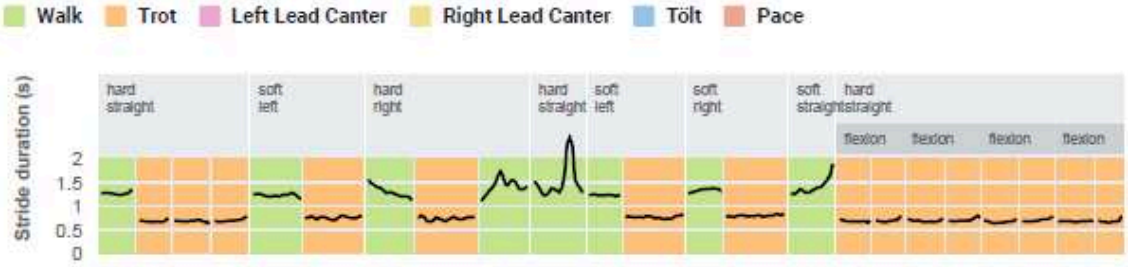




**Figure 83: Example first page of a general report**

# A CSV export - stride-by-stride results

All parameters and information below are available for each detected stride. In the CSV file, one row represents one stride. There are four types of parameters that are exported:

1. **General information**, described in Table 1,
2. **Leg parameters - temporal**, described in Table 2,
3. **Leg parameters - spatial**, described in Table 3, and
4. **Upper-body parameters**, described in Table 4.

**Table 1: CSV results for each stride - general information**

| CSV column name | Description |
|---|---|
| **segment** | Non-merged segment numeration as it appears in the application |
| **gait** | Gait type: Walk, trot, canter-left, canter-right, tölt, pace |
| **direction** | Direction of motion: straight, left, right |
| **surface** | Surface type: hard, soft |
| **horse_name** | Horse name as entered in the application |
| **measurement** | File name containing the date and time of the measurement, which can serve as unique identifier |
| **exam_type** | Exam type selected in the application: in hand, ridden, driven, research |
| **flexion_test** | If a flexion test (FT) was started during the measurement, all strides of the segment labeled with a FT are labeled with the FT denomination (limb, location). See Figure 42 on page 34 for the list of available FT denominations. |
| **exam_purpose** | Exam purpose as selected in the app: research, lameness evaluation, prepurchase exam, sport horse monitoring |
| **diagnostic_analgesia** | If a measurement was started with a diagnostic analgesia (DA), all strides of that measurement are labeled with the DA denomination (limb, location). See Figure 35 on page 30 for the list of available DA denominations. |
| **inconclusive** | Gives a warning if the segment of data contains potentially inconclusive results (e.g. if the calibration was not properly conducted) |

**Table 2: CSV results for each stride - leg parameters (temporal)**

| CSV column name | Description |
|---|---|
| **stride_dur** | Stride duration in seconds. |
| **stride_speed** | Speed of the stride, in meters per second. This result is available only if the measurement includes a sensor with GNSS. |
| **stride_length** | Length of the stride, in meters. This result is available only if the measurement includes a sensor with GNSS. |
| **duty_factor** | Percentage of stance duration over stride duration, calculated as the average stance duration for all limbs, divided by the average stride duration. |
| **duty_factor_LF/RF/LH/RH** | Percentage of stance duration over stride duration, for individual limbs. |
| **stance_dur_LF/RF/LH/RH** | Stance phase duration in seconds, for individual limbs. |
| **swing_dur_LF/RF/LH/RH** | Swing phase duration in seconds, for individual limbs. |
| **swing_intensity_LF/RF/LH/RH** | Sum of the absolute values of angular velocity in the sagittal plane divided by the duration of the swing phase, for individual limbs. |
| **suspension_L/R_sec** | Left/Right suspension durations in seconds. |
| **suspension_L/R_perc** | Left/Right Suspensions expressed as a percentage of the stride duration. |
| **suspension_sec** | Suspension duration at canter, in seconds. |
| **suspension_perc** | Suspension at canter, expressed as a percentage of the stride duration. |
| **dap_L/R_sec** | Diagonal Advanced Placement (DAP), in seconds. Also called diagonal dissociation. Calculated for walk, trot, canter, and tölt |
| **dap_L/R_perc** | DAP expressed as percentage of the stride. |
| **lap_L/R_sec** | Lateral Advanced Placement (LAP), in seconds. Also called lateral dissociation. Calculated for walk, tölt and pace. |
| **lap_L/R_perc** | LAP expressed as percentage of the stride. |

**Table 3: CSV results for each stride - leg parameters (spatial)**

| CSV column name | Description |
|---|---|
| **rom_sagittal_LF/RF/LH/RH** | Angular range of motion (ROM) in the sagittal plane of each limb, in degrees. |
| **rom_coronal_LF/RF/LH/RH** | Angular range of motion (ROM) in the coronal plane of each limb, in degrees. |
| **protraction_LF/RF/LH/RH** | Maximum value in the sagittal plane, in degrees. |
| **retraction_LF/RF/LH/RH** | Minimum value in the sagittal plane, in degrees. |
| **abduction_LF/RF/LH/RH** | Maximum value in the coronal plane, in degrees. |
| **adduction_LF/RF/LH/RH** | Minimum value in the coronal plane, in degrees. |

**Table 4: CSV results for each stride - upper-body parameters**

| CSV column name | Description |
|---|---|
| **min_diff_head/wth/sac** | Difference in vertical minima reached during the left and right steps for the head/withers/sacrum sensor, in millimeters. 0 indicates perfect symmetry. Calculated for walk and trot. |
| **max_diff_head/wth/sac** | Difference in vertical maxima reached during the left and right steps for the head/withers/sacrum sensor, in millimeters. 0 indicates perfect symmetry. Calculated for walk and trot. |
| **si_up_head/wth/sac** | Symmetry index for the upward vertical movement of the head/withers /sacrum sensor. Value between -1 and 1, where 0 indicates perfect vertical upward movement symmetry. Calculated for walk and trot. |
| **hiphike_swing** | Difference in vertical upwards displacement of the left and right tuber coxae during the hind limbs swing phase, in millimeters. Calculated at trot if tuber coxae sensors are available. |
| **hiphike_stance** | Difference in vertical upwards displacement of the left and right tuber coxae during the hind limbs stance phase, in millimeters. Calculated at trot if tuber coxae sensors are available. |

# B CSV export - raw data

When exporting the data in CSV format, the raw signals from each sensor are made available in a file named "measurementDate-HorseName-data.csv", see Table 5 below. The **measurementDate** follows the ISO 8601 filename notation format, YYYYMMDDThhmmss. The user can also provide a file name when saving the file.

**Table 5: Exported CSV data - raw signals**

| CSV column name | Description | Unit |
|---|---|---|
| **timestamp** | Timestamp for the sampled data point | s |
| **node-id** | Sensor node identifier | |
| **lostSamples** | Number of samples lost between two data points | |
| **ax/ay/az** | Low-g acceleration on the x/y/z axis | $m/s^2$ |
| **cx/cy/cz** | Magnetometer on the x/y/z axis | $\mu$ T |
| **gx/gy/gz** | Angular rotation around the x/y/z axis | °/s |
| **rssi** | Received Signal Strength Indicator | dBm |
| **quat1/2/3/4** | $1^{st}$ to $4^{th}$ quaternion | |
| **ax/ay/az-hg** | High-g acceleration on the x/y/z axis | $m/s^2$ |
| **pressure** | Pressure | hPa |
| **temp** | Temperature | °C |
| **rtc** | Real time clock, epoch/unix timestamps | s |
| **cpuTemp** | Temperature of the CPU | °C |
| **bat** | Battery output | V |
| **extIn** | External input voltage | V |

If a GNSS node is available, the GNSS data is exported in a separate file named "measurementDate-HorseName-data-gps.csv", see Table 6 below. The **measurementDate** follows the ISO 8601 filename notation format, YYYYMMDDThhmmss. The user can also provide a file name when saving the file.

**Table 6: Exported CSV data - GNSS**

| CSV column name | Description | Unit |
|---|---|---|
| **timestamp** | Timestamp for the sampled data point | s |
| **node-id** | Sensor node identifier | |
| **navValid** | Validity of the navigational data | 0:invalid, 1:valid |
| **velValid** | Validity of the velocity data | 0:invalid, 1:valid |
| **year** | Year | yyyy |
| **month** | Month | mm |
| **day** | Day | dd |
| **hour** | UTC time | hh |
| **minute** | UTC time | mm |
| **second** | UTC time | ss |
| **latitude** | Distance north or south of the Equator | ° |
| **longitude** | Distance east or west of the prime meridian | ° |
| **altitudeEllipsoid** | Altitude above the ellipsoid | m |
| **altitudeMSL** | Altitude above the mean sea level | m |
| **speedOverGround** | Speed at the sensor level | m/s |
| **courseOverGround** | Direction of progress | ° |
| **numberSvsInFix** | Number of satellites used to calculate position | |
| **hdop** | Horizontal Dilution of Precision | |
| **ehpe** | Estimated Horizontal Position Error | m |
| **evpe** | Estimated Vertical Position Error | m |
| **ete** | Estimated Time Enroute | s |
| **ehve** | Estimated Horizontal Velocity Error | m/s |