VICON Capture.U

BEYOND MOTION

VICON CAPTURE.U USER GUIDE

WHAT'S INSIDE?

About Vicon Capture.U 3

Understand Vicon IMU sensor status 4

Use the Vicon Capture.U app 5

- What's new in the Capture.U app 1.2? 6
- Requirements for the Capture.U app 12
- Download and install the Capture.U app 15
- Attach Vicon IMU sensors to a subject 16
- Start Capture.U and choose a capture mode 18
- Calibrate IMUs 49
- Reset sensors 50
- Get help on the Capture.U app 53
- Addressed issues for the Capture.U app 54
- Known issues for the Capture.U app 54

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Use Vicon Capture.U Desktop 58
What's new in Capture.U Desktop 1.2? 60
Requirements for Capture.U Desktop 72
Download and install Capture.U Desktop 72
Connect sensors to Capture.U Desktop 73
Download a trial from the sensors 76
Edit a downloaded trial 94
Manage connected sensors 95
Erase data from sensors 97
Update sensor firmware 99
Get help on Capture.U 102
Known issues for Capture.U Desktop 103

About Vicon Capture.U

Working seamlessly with Vicon Blue Trident sensors, Vicon Capture.U is a visual application for capturing raw inertial and analytic data, which is not limited by laboratory settings. It offers real-time data overlaid on video, enabling you to analyze movement both on the field and in the lab.

With capture modes for collecting and analyzing raw data, Capture.U enables you to view graphical and statistics information in real time. You can also save video or export data as CSV, X1D or PDF files, for further analysis.

For a brief introduction to Capture.U, see the PDF *Vicon Capture.U Quick Start Guide*.

This guide provides information on using both the Capture.U app, for iOS devices; and Capture.U Desktop, for use on Windows PCs and Macs.

- Use the Vicon Capture.U app, page 5
- Use Vicon Capture.U Desktop, page 58

You can also watch Vicon Capture.U videos[1], covering all aspects of using Capture.U, on YouTube.

1 https://youtu.be/kRuio13OqQk

Understand Vicon IMU sensor status

The LEDs on each Vicon IMU display information about the sensor's status.

Vicon IMU status	LED display
Charging	Both LEDs slow blink (50% duty)
Charged	Both LEDs on steady
Battery indication	Both LEDs blink 1–4 times, pause; pattern repeats 3 times. For example, full battery – LEDs blink 4 times, pause; pattern repeats 3 times.
Sampling	Single or both LEDs brief blink (<10% duty); single or both depending on left or right
Bootloader waiting*	Single LED on steady
Bootloader connected*	Both LEDs on steady
Bootloader exiting*	Both LEDs twinkle
Error during a session • Error overrun • Error storage • Error sync timeout • Error sync	Rapid blinking LEDs

* To enter bootloader mode, hold down the USB adapter button for at least 10 seconds, then release the button. To exit bootloader mode, wait 60 seconds.

Use the Vicon Capture.U app

For information on installing and using the Capture.U app, see these topics:

- What's new in the Capture.U app 1.2?, page 6
- Requirements for the Capture.U app, page 12
- Download and install the Capture.U app, page 15
- Attach Vicon IMU sensors to a subject, page 16
- Start Capture.U and choose a capture mode, page 18
- Calibrate IMUs, page 49
- Reset sensors, page 50
- Get help on the Capture.U app, page 53
- Addressed issues for the Capture.U app, page 54
- Known issues for the Capture.U app, page 54

What's new in the Capture.U app 1.2?

> ⚠ To use the Capture.U app 1.2, you must upgrade the sensor firmware to 9.0.4 or later. To do this, you must use Capture.U Desktop 1.1.1 or later.

The latest version of the Capture.U app provides these new features:

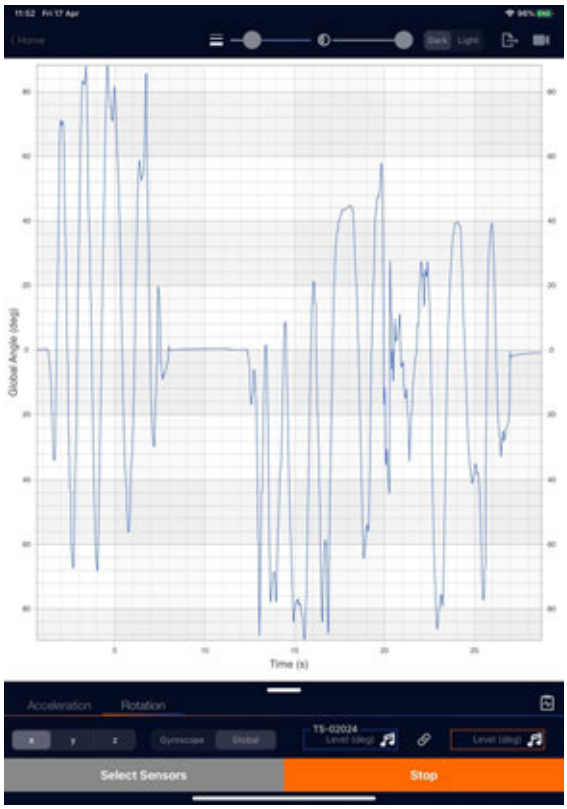
- Global angles in all capture modes, page 7
- Remember previously selected sensors, page 9
- Ability to clear selected sensors, page 9
- Remember previously selected settings, page 10
- Auto-increment trial names, page 10
- Increase graph overlay thickness, page 10
- Ability to search the sensors list, page 11

For information on previous versions of the Capture.U app, see the PDFs *Vicon Capture.U 1.1 User Guide* and *Vicon Capture.U 1.0 User Guide* .

Global angles in all capture modes

You can now capture global angles in all capture modes.

Use the Vicon Capture.U app



- In To Sensor mode, you can capture all 15 axes (High G, Low G Accelerometer, Gyroscope, Magnetometer, and Global Angles).
  You can export the captured data, including global angles, with Capture.U Desktop.
- In To Device mode, you can you can stream, capture and export Low G Accelerometer, Gyroscope, Magnetometer, and Global Angles. You can also export the data as a CSV file via the app.
- In Real-time Insight and AR Visualization modes, if Global Angles are displayed, you can capture, stream and display them in real time. You can also export the data as a CSV file.

In Real-time Insight and AR Visualization modes, global angles are visualized as Euler angles.

From all capture modes, global angles are exported as quaternion components (Qx, Qy, Qz, Qr).

For more information, see the relevant capture mode, page 19.

Remember previously selected sensors

In all capture modes, within a session, the Capture.U app now remembers the sensors that you selected in the previous trial. This enables you to avoid having to re-select the sensors for every trial. Note that if you create a new session, the sensors are not remembered from the previous session.

In To Sensor and To Device modes, when you select the Home tab or close the app, if there is a current session, the selected sensors are remembered.

In Real-Time Insight and AR Visualization modes, the selected sensors are remembered when the capture is stopped, so you don't need to re-select them for the next capture. If you select the Home tab and return to Real-Time Insight or AR Visualization mode, the selected sensors are not remembered.

Ability to clear selected sensors

Related to the ability to remember previously selected sensors for a specific session (see above), if you decide to change the sensor selection for the next trial, you can avoid having to manually deselect the selected sensors by using the new **Deselect All** option at the top right corner of the Sensor selection screen to clear selected sensors.

Remember previously selected settings

In To Sensor and To Device modes, Capture.U now remembers the previously selected settings so that you don't have to manually select the desired axes or video settings (if capture video was selected) for every new trial within a session. Only the settings captured within a session are remembered: when you start a new session, the settings are not remembered.

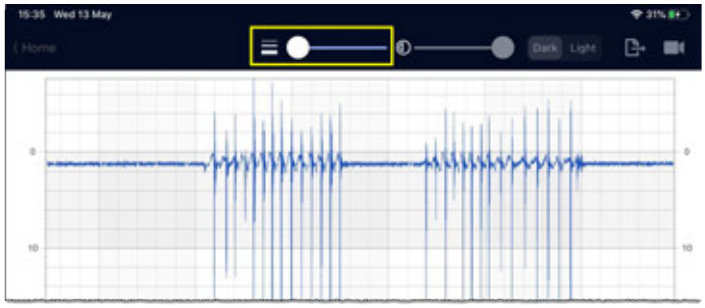
Auto-increment trial names

When you're setting up the To Sensor and To Device capture modes, trial names are now auto-incremented (eg, after the initial trial, which is automatically given the same name as the session, *MyTrial* becomes *MyTrial-1* , *MyTrial-2* , etc), so that you don't have to manually enter a trial name each time, giving you a faster turnaround when starting trials.

For details, see Capture to sensor, page 20 and Capture to device, page 27.

Increase graph overlay thickness

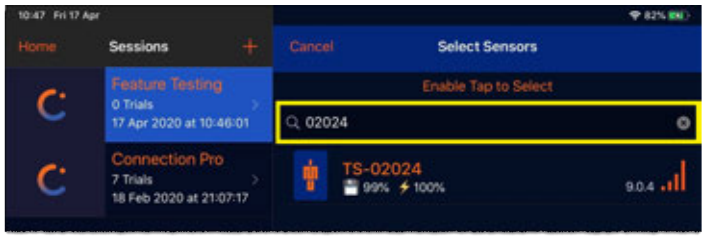
In Real-time Insight and AR Visualization modes, you can now increase the overlay thickness of the lines displayed on the data graph, so that when you're outside in a sunny environment, you can view the real-time data stream more easily.



For details, see Step 8, page 33 of *Capture in Real-time Insight mode* or Step 9, page 43 of *Capture in AR Visualization mode*.

Ability to search the sensors list

In all capture modes, you can now enter and search for a sensor number so that you don't have to scroll the sensor list or use tap-to-select to find a sensor.



Requirements for the Capture.U app

The Vicon Capture.U app is available for iOS devices only.

Before you begin, ensure your iOS device meets or exceeds these requirements:

- iOS 11 and later - with BLE 4.2 and later devices (1.1 and 1.2)
  To access AR Visualization capture mode, Vicon recommends an iOS 13 device, BLE 5 and an Apple A12 Bionic or later chip device.
- iOS 13 and BLE 4.2 devices:
  - iPad 5th generation (2017) (A9), iPad Air 2 (A8X), iPad mini 4 (A8),
    9.7-inch: iPad Pro (A9X), iPad 6th generation (2018) (A10),
    10.5-inch: iPad Pro (A10X),
    12.9-inch: iPad Pro 1st generation (A9X) and iPad Pro 2nd generation (A10X)
  - iPhone 6s (A9), iPhone 6s Plus (A9), iPhone 7 (A10), iPhone 7 Plus (A10)

For optimum performance, and to access all available capture modes, this specification is recommended:

- iOS 13, BLE 5.0 and Apple A12 Bionic (or later) chip devices.

This table lists the latest iOS 13 supported devices:

iOS devices (iOS 13)	Bluetooth 4.2 (Bionic chip)	Bluetooth 5 (Bionic chip)	Bluetooth 5 with Apple A12 Bionic chip or later (recommended)
iPhones	iPhone 6s (A9)	iPhone 8 (A11)	iPhone Xs (A12)
	iPhone 6s Plus (A9)	iPhone 8 Plus (A11)	iPhone Xs Max (A12)
	iPhone 7 (A10)	iPhone X (A11)	iPhone XR (A12)
	iPhone 7 Plus (A10)	iPhone Xs (A12)	iPhone 11 (A13)
		iPhone Xs Max (A12)	iPhone 11 Pro (A13)
		iPhone XR (A12)	iPhone SE (A13)
		iPhone 11 (A13)	
		iPhone 11 Pro (A13)	
		iPhone SE (A13)	

Use the Vicon Capture.U app

iOS devices (iOS 13)	Bluetooth 4.2 (Bionic chip)	Bluetooth 5 (Bionic chip)	Bluetooth 5 with Apple A12 Bionic chip or later (recommended)
iPads	12.9-inch iPad Pro 2nd generation (A10X) 12.9-inch iPad Pro 1st generation (A9X) 10.5-inch iPad Pro (A10X) 9.7-inch iPad Pro (A9X) 9.7-inch iPad 6th generation (2018) (A10) iPad 5th generation (2017) (A9) iPad 7th generation (A10) iPad Air 2 (A8X) iPad mini 4 (A8)	12.9-inch iPad Pro 3rd generation (A12X) 11-inch iPad Pro (A12X) iPad Air 3rd generation (A12) iPad mini 5th generation (A12)	12 .9-inch iPad Pro 3rd generation (A12X) 12.9-inch iPad Pro (4th generation) (A12Z) 11-inch iPad Pro (A12X) iPad Air 3rd generation (A12) iPad mini 5th generation (A12)

Download and install the Capture.U app

To install Capture.U:

- Download the Vicon Capture.U app from the App Store to your iOS device.

> Capture.U supports only Vicon Blue Trident sensors. Blue Thunder sensors are not supported.

Attach Vicon IMU sensors to a subject

The method you use to attach the sensors to your subject depends on the type of movement you want to capture.

- To capture the movement of a subject's limbs, you can attach the sensors using the supplied straps.
- To capture the movement of other parts of the anatomy (for example, where movement of the vertebrae is of interest), you can attach sensors directly, using suitable tape.

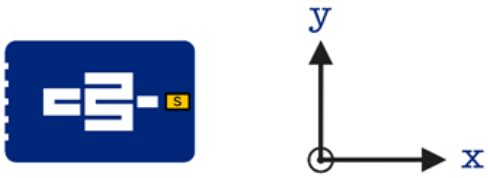
To attach sensors to a subject using the supplied straps:

1. Insert each sensor into its strap with the IMU symbol facing outwards.

2. Attach the straps to the subject, ensuring that:
   a. The strap sits snugly against the limb.
   b. The sensor is oriented with the top (head) pointing in the same direction as the movement of the subject.
   c. The flashing LED is at the top of the strap.
   The following example shows a strap attached so that the sensor sits directly on the medial aspect of the tibia, just above the medial malleolus:

To attach sensors to a subject where straps are not used:

1. Position the sensor on the subject, depending on the required sensor orientation.

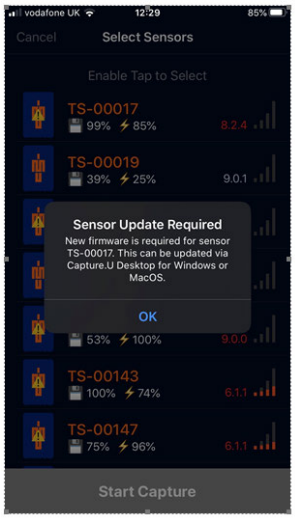


2. Secure the sensors using your preferred type of tape (for example, hypoallergenic, double-sided, micropore surgical tape).

Start Capture.U and choose a capture mode

1. On your iOS device, start Capture.U.

   If you need to upgrade your Blue Trident sensors to Firmware 9, which enables you to use your sensors with both Capture.U and Vicon Nexus, when you start Capture.U the sensors are displayed with a yellow warning symbol, and a message alerts you to their status:



   Click **OK**, and upgrade the sensor firmware with Capture.U Desktop (see Update sensor firmware, page 99).

2. Tap to choose a capture mode.

Your choice of capture mode depends on the number of sensors you want to use, the range you require and the type of output you want:

- For unlimited range and up to 20 sensors, with reference video data directly from the device, choose **To Sensor**. After you have captured the data, download it to your computer with Capture.U Desktop for further analysis.
- For data that is saved directly to your device (where the capture range is constrained by the Bluetooth® range of the device), choose **To Device** or **Real-Time Insight** mode.
- For access to Apple's ARKit video-based visualization (the iOS device must be compatible with Apple ARKit 3), choose **AR Visualization** mode.

> In all capture modes, there may be a lag in data frames (a small offset) between sensors when starting capture, but the data will be synced.

The capture modes are explained in more detail in the following sections:

- Capture to sensor, page 20
- Capture to device, page 27
- Capture in Real-Time Insight mode, page 30
- Capture in AR Visualization mode, page 38
- Run Activity Widget demo, page 48

Capture to sensor

Choose the **To Sensor** mode when you want a high sensor count and unlimited range. After capturing the required movement, you can download your data with Vicon Capture.U Desktop.

An example of this type of usage might be to monitor the track performance of multiple athletes who are running a marathon. After capturing data from all the athletes, you can download the data from the sensors to your computer with Capture.U Desktop (see Use Vicon Capture.U Desktop, page 58).

Watch the Vicon video, Capture to Sensor[2] on YouTube.

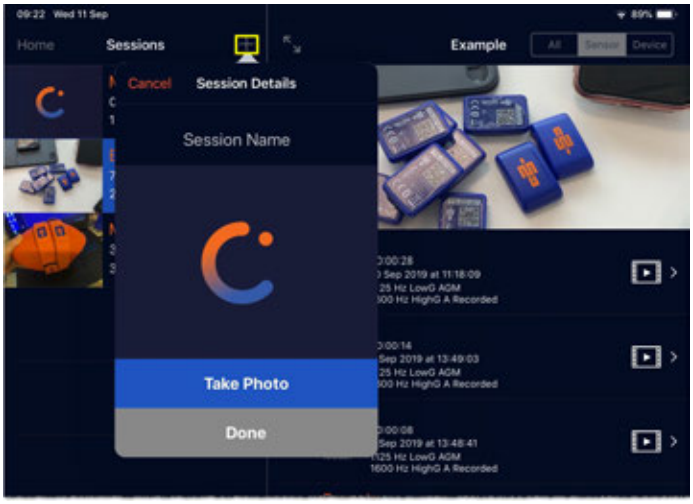
Summary of **To sensor** mode:

No. of sensors:	Up to 20
Data type:	IMU data
Video:	Reference video
Axes:	15 High G and Low G accelerometer Gyroscope and Magnetometer (option to capture all axes) Global Angles
Output:	Data (.csv, with Desktop) Video (.mp4) and notes (.txt)
Range:	Unlimited
Capture rate:	High G accelerometer (default): 1600 Hz Low G accelerometer and Gyroscope: 1125 Hz Low G Magnetometer: 112 Hz Global Angles (with Low G accelerometer, Gyroscope, Magnetometer): 225 Hz (A, G) and 70 Hz (M)

2 https://youtu.be/yR6tCPH_iJU

To capture to sensors:

1. Open the Capture.U app.
2. In the Capture section tap **To Sensor**.
3. Either create a new session or select an existing one:
   - To create a new session:
     i. At the top of the screen, tap the plus sign + to the right of **Sessions**.

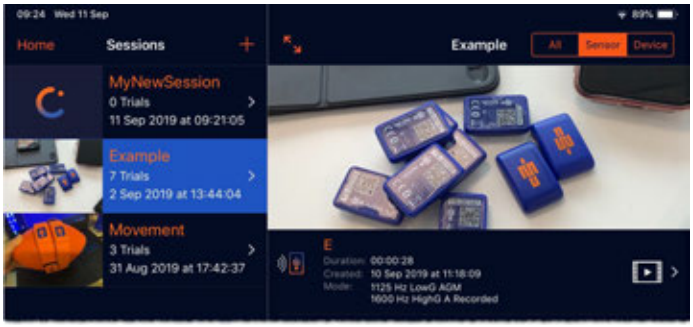


     ii. In the **Session Name** field, enter a name for your new session.

     iii. If you want to add an image as an identifier for the session, tap **Take Photo** and add the required image.

     iv. Tap **Done**.
     Your new session is displayed in the list of sessions on the left.
     (To make any changes, slide the session towards the left and tap **Edit**.)

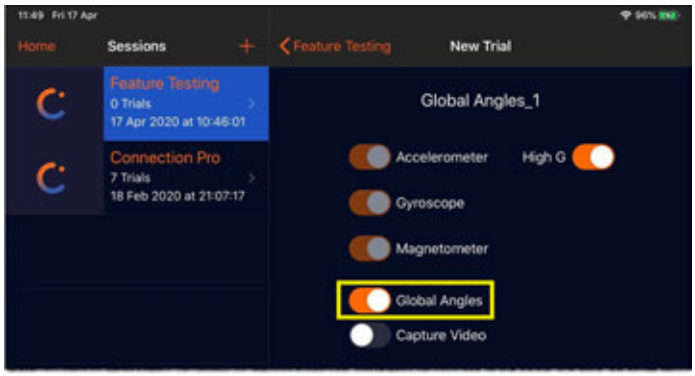
   - To select an existing session:
     - Tap an existing session in the list on the left.



4. At the bottom right, tap **New Trial**, then if required, enter a name for your trial. By default, the trial name is the same as the session name unless you rename the trial. Subsequent trial names are followed by a hyphen and a digit (for example, *MyTrial-1*) and are automatically incremented (for example, *MyTrial-2*).

   > Do not use an underscore as part of the name (eg, *_2*), as it is an invalid character in a trial name.

5. From the options below, select the data to stream (**Accelerometer (High G** or **Low G)**, **Gyroscope**, **Magnetometer, Global Angles**), and whether you want to capture a video. Note that if you select Global Angles, then Low G Accelerometer, Gyroscope, and Magnetometer are also captured and the capture rate is reduced to 225 Hz (A, G) and 70 Hz (M).



> If you plan to capture global angles, before you start capture, you must calibrate the IMU sensors. For instructions on how to do this, see Calibrate IMUs, page 49.

If you turn on **Capture Video**, you can choose to record **High** (1920 x 1080), **Medium** (480 x 360, the default), or **Low** quality (192 x 144) video.

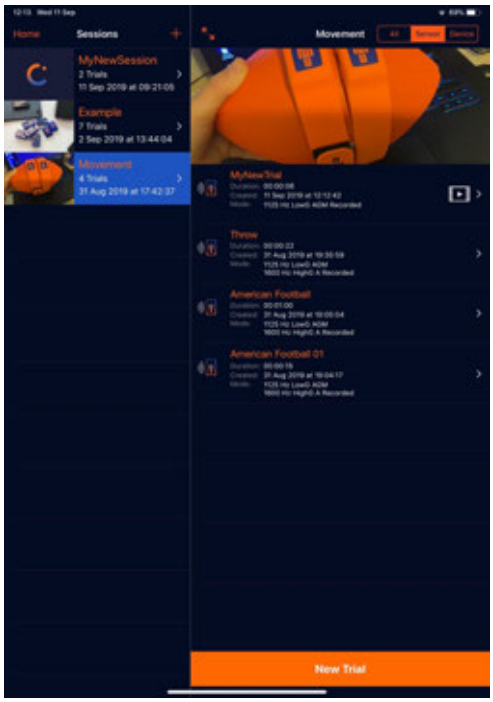
6. When you have made your selections, check below on the screen, to make sure the data mode is correct (in this case, it is **Data captured to sensor**), and tap **Start Capture** at the bottom right of the screen.

7. Select the sensors, by doing one of the following:
   - Tap to select the required sensors from the list on the right.
     or
   - Tap **Enable Tap to Select** and then tap the required sensor(s) twice.
     or
   - At the top of the list on the right, in the Search field, enter the number of the required sensor.

> If one or more of the required sensors is displayed in orange and is labeled **Reset required**, see Reset sensors, page 50.

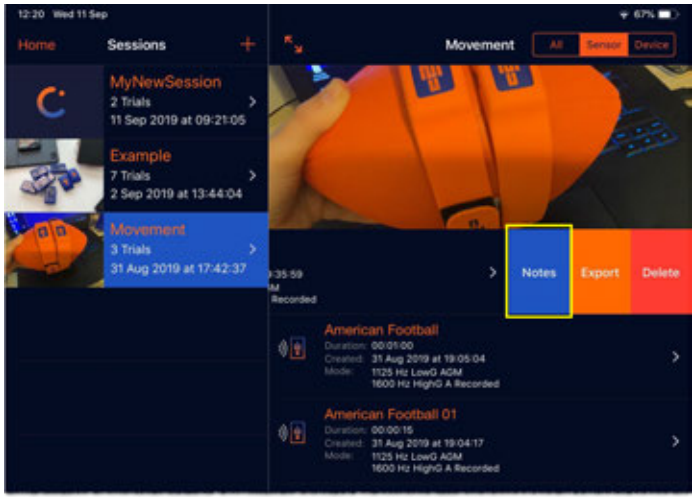
8. At the bottom right, tap **Start Capture**.
   If you chose to record a video, it is displayed at the bottom left of the screen.
   If Video is not selected, you can capture two trials simultaneously.
   To add notes during capture, tap **Notes** (top right).

9. When you have captured the required data, tap **Stop Capture**.
   Your new trial is displayed in the list of trials on the right of the screen, with the most recent trial at the top.



If you recorded a video, you can play it back on your iOS device without exiting Capture.U by tapping the video icon on the right.

To add notes after you have finished capturing, slide the trial towards the left and then tap **Notes**.



10. To export any video and/or notes that you created, slide the trial towards the left, and then tap **Export.**

> As long as the sensors remain within Bluetooth range, you can add notes after you finish capturing a trial. These notes are saved to the sensor and, together with any notes made during capture, are available for review and export in Capture.U Desktop. For details, see Export notes from To Sensor mode, page 69.

If you recorded a video, you are asked if you want to include it in the export. Tap **Yes**, then select the required export option.
A .zip file with the name of your trial, which contains any notes (.txt) and video (.mp4) is exported.

> Use Quicktime or another suitable video player, eg VLC Media Player, to view the downloaded video file.

11. Download your trial data (.csv) with Capture.U Desktop (see Use Vicon Capture.U Desktop, page 58).

Capture to device

Choose the **To Device** mode when you need a higher sensor count than **Real-Time Insight** mode (which is restricted to two sensors). Data is captured within the Bluetooth range of the device only. In this mode, you can also use reference video.

Note that as data is streamed over Bluetooth, external factors can cause dropped samples. If this is an issue, you can either interpolate between samples or use **To Sensor** mode instead, to avoid dropped samples altogether.

Watch the Vicon video, Capture to Device[3] on YouTube.

Summary of **To device** mode:

No. of sensors:	Up to 14 (depending on device, eg, BLE 4.2 iOS devices are limited to 7 sensors)
Data type:	IMU data
Video:	Reference video
Axes:	3 or 12 High G Accelerometer or Low G Accelerometer, Gyroscope, Magnetometer and Global Angles
Output:	Data (.csv), video (.mp4) and notes (.txt)
Range:	Bluetooth: 20 m+
Capture rate:	High G accelerometer (default): 800 Hz Low G Accelerometer: 800 Hz 2-axes: Low G and Gyroscope: 500 Hz Low G, Gyroscope 250 Hz and Magnetometer: 112 Hz Magnetometer only: 112 Hz Global Angles (with Low G Accelerometer, Gyroscope, Magnetometer): 225 Hz (A, G) and 70 Hz (M)

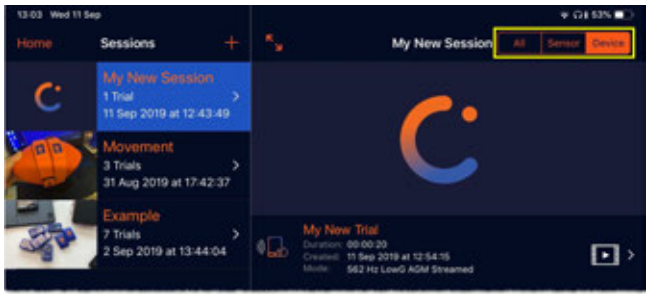
3 https://youtu.be/uFW21vz9CZE

To capture to a device:

1. Open the Capture.U app.
2. In the Capture section tap **To Device**.
3. Add a new **Session** or select an existing one (see *Capture to sensor*, Step 3, page 21).
4. Create a **New Trial** (see *Capture to sensor*, Step 4, page 22, but note that the capture options differ, as shown in the above table).

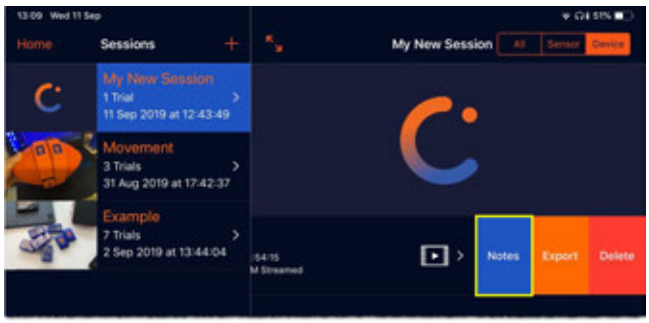
   > If you plan to capture global angles, before you start capture, you must calibrate the IMU sensors. For instructions on how to do this, see Calibrate IMUs, page 49.

5. Tap **Start Capture** at the bottom right of the screen.
   Note that when Global Angles is selected, Low G Accelerometer, Gyroscope, and Magnetometer are also captured and the capture rate is reduced to 225 Hz (A, G) 70 Hz (M) for the Low G sensor.
6. Select the required sensors (see *Capture to sensor*, Step 7, page 24).
7. Tap **Start Capture**.
   To add notes during capture, tap **Notes** (top right).
8. When you have captured the required data, tap **Stop Capture**.
   Your new trial is displayed in the list of trials on the right of the screen (the most recent trial is at the top).
   Notice that in the filter at the top, **Device** is automatically selected, to display trials recorded directly to your iOS device. If required, you can change this to display trials captured to sensors, or all trials.



You can play back a recorded video on your iOS device without exiting Capture.U by tapping the video icon in the list of trials.

To add notes after capturing, slide the trial left and tap **Notes**.



9. To export your data and any video/notes, slide the trial left and tap **Export**.
   If you recorded a video, you are asked if you want to include it in the export.
   Tap **Yes**, then tap the required export option.
   A .zip file containing your data (.csv), notes (.txt) and video (.mp4) is exported.
   If you chose to capture Global Angles and export a *.csv* file, the CSV will include the Low G data (Low G accelerometer, gyroscope and magnetometer) and the global angles. The global angles are exported as quaternion components (Qx, Qy, Qz, Qr).

   Use Quicktime or another suitable video player, eg VLC Media Player, to view the downloaded video file.

Capture in Real-Time Insight mode

Choose **Real-Time Insight** mode to capture movement for real-time data streaming from two sensors with video overlay. You can also define your own benchmarks (that is, you can set a threshold for alerts). For example, you can choose to be notified by a sound when a specified level is reached, so that you can easily recognize when an athlete hits a ball hard enough.

An example of using Real-Time Insight mode might be a coach and an athlete who want to review performance data together over multiple trials on an iOS device, then have the coach send the athlete a report of what was reviewed.

Note that as data is streamed over Bluetooth, external factors can cause dropped samples. If this is an issue, you can either interpolate between samples or use To Sensor mode instead, to avoid dropped samples altogether.

Watch the Vicon video, Using Real-Time Insight[4] on YouTube.

Summary of **Real-Time Insight** mode:

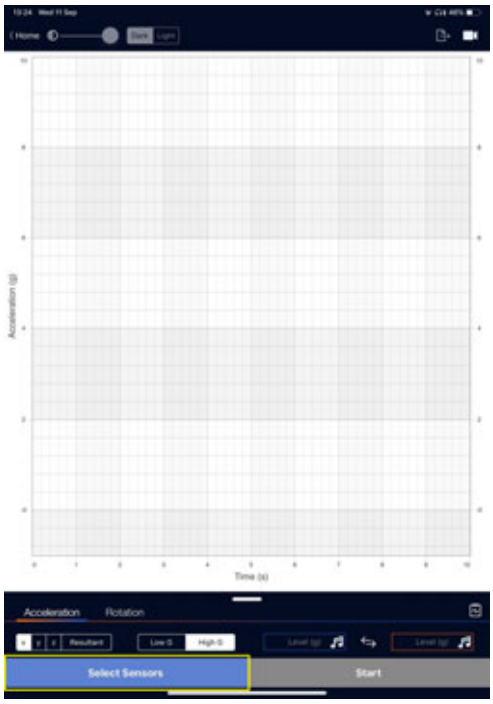
No. of sensors:	2
Data type:	IMU data
Video:	Video data real-time overlay
Axes:	3 High G Accelerometer (default) or Low G Accelerometer or Gyroscope (in either case, both exported) or Global Angles (with Low G Accelerometer, Gyroscope and Magnetometer)
Output:	Data (.csv), video (.mp4) and report (.pdf)
Range:	Bluetooth: 20 m+
Capture rate:	High G Accelerometer (default): 800 Hz Low G Accelerometer and Gyroscope: 500 Hz Global Angles with Low G Accelerometer, Gyroscope and Magnetometer: 225 Hz (A, G) and 70 Hz (M)

4 https://youtu.be/zPk-WlS5OmY

Use the Vicon Capture.U app

To use Real-Time Insight mode:

1. Open the Capture.U app.
2. In the Capture section tap **Real-Time Insight**.
3. At the bottom left of the screen, tap **Select Sensors**.



4. Select up to two sensors (for details, see *Capture to sensor*, Step 7, page 24), and then tap **Set**.

5. Select either **Acceleration** (**x**, **y**, **z**, or **Resultant** and **Low G** or **High G**) or **Rotation** (**x**, **y**, or **z**).
Note that **Resultant** is the peak resultant acceleration, which is calculated by $\sqrt{x^2 + y^2 + z^2}$
With the **High G** accelerometer selected, the resultant acceleration can reach up to 346 G.
With the the **Low G** accelerometer selected, the resultant acceleration can reach up to 26 G.

   To enable **Global Angles**, select **Rotation** and ensure **Global** is selected.

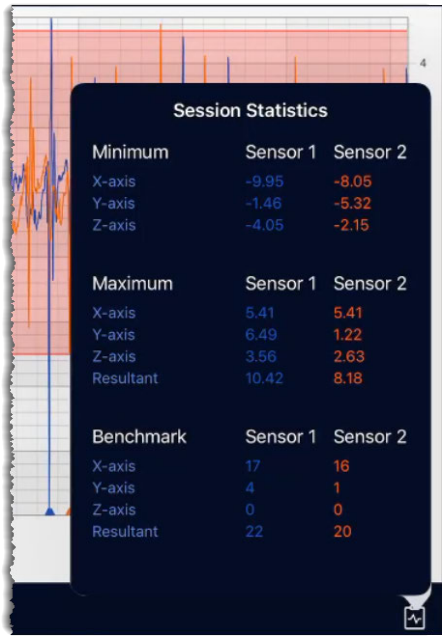
   Global angles are streamed in real time on the graph. They are visualized as Euler angles (XYZ rotation order) and exported as quaternion components (Qx, Qy, Qz, Qr).
Note that when Global Angles is selected, Low G Accelerometer, Gyroscope,

and Magnetometer are also captured and the capture rate is reduced to 225 Hz (A, G) 70 Hz (M) for the Low G sensor.

> If you plan to capture global angles, before you start capture, you must calibrate the IMU sensors. For instructions on how to do this, see Calibrate IMUs, page 49.

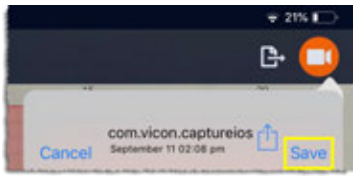
6. At the bottom right of the screen, tap **Start**.
7. To play a sound when a specified level is reached, in the **Benchmarks** area, enter the required values in the benchmark fields.
   The values are indicated by a shaded area on the graph.
8. To view and optionally record real-time video (recorded at 1920 x 1080), tap the Video icon at the top right of the screen.
   The graph is overlaid on the video. To make the graph easier to see, the controls at the top of the screen enable you to change the thickness of the lines (slide right to increase line thickness), the opacity of the graph, and select a dark or light version.

9. To see statistics for the capture in real time, tap the Statistics icon , towards the bottom right of the screen.
   The minimum and maximum values detected by the sensors are displayed, in addition to how many times the benchmark values have been reached.



10. When you have captured the required movement, tap **Stop**.

11. From the export icons, select the required export type (file or video):
    - To save a video to your device, tap the Video icon (top right) and then tap **Save**.



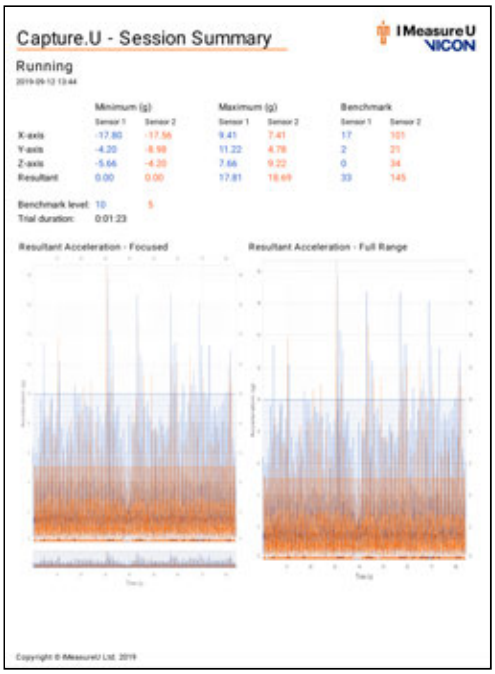
Depending on the length of your video, this may take some time. Don't tap Save again, but wait until the video is saved.

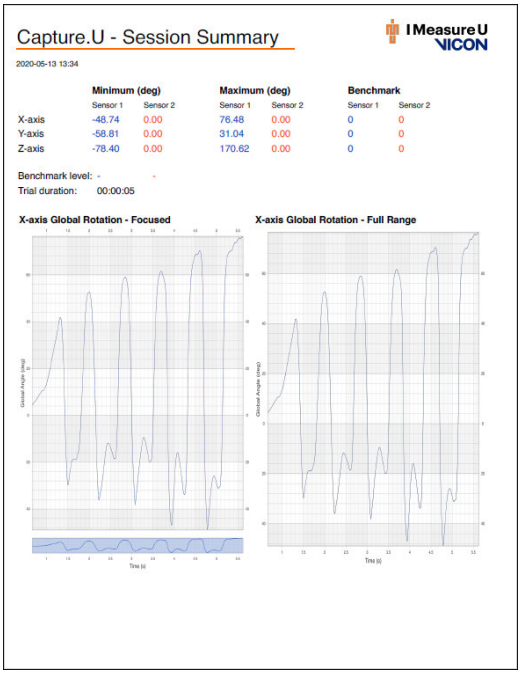
> Find saved videos on the **Photos** tab in the Photos app .

    - To export either a report (.pdf) or data (.csv), or to browse previously recorded videos, tap the File icon (top right).

        - If you choose **Export to PDF**, you can add a title in the PDF preview that is displayed.
        The preview shows the information that will be displayed in the exported PDF, with statistics information at the top of the page, a Focused view of the graph (showing the region of interest) and Full Range view (showing the whole range). This lets you check that the graph is as required before you export it. If it isn't, tap **Cancel**, change the **Acceleration** and/or **Rotation** to show a graph of the required view (X, Y, Z, or Resultant) and tap **Export to PDF** again.

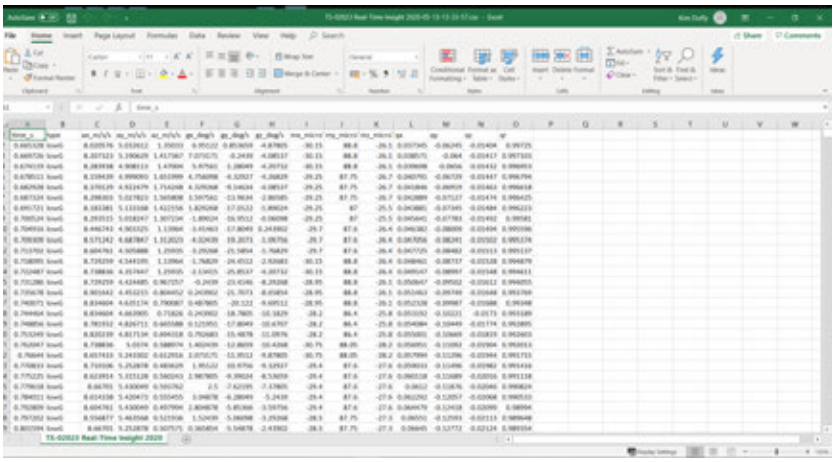
When you're happy with the preview, tap **Export** at the top to export the PDF.





- If you choose **Export to CSV**, the data values exported can be X, Y and Z, but not Resultant.

  If you export **Global Angles** , the data is exported as quarternion components (Qx, Qy, Qz, Qr).



> If either Low G or Gyroscope is selected, both Low G and Gyroscope are exported.

- If you choose **Browse Video**, previously captured Real-Time Insight videos are listed. Tap to select a video, then play a minimized preview by tapping the Play icon at the bottom, or tap **Use** at the top right to play in full-screen mode.

Capture in AR Visualization mode

Choose **AR Visualization** mode to explore how using the ARKit with Capture.U can enhance your in-field capture experience while you're capturing IMU and reference video data.

Note that as data is streamed over Bluetooth, external factors can cause dropped samples. If this is an issue, you can either interpolate between samples or use **To Sensor** mode instead, to avoid dropped samples altogether.

Important
To access the AR Visualization capture mode, your iOS device must:

- Be compatible with the Apple ARKit 3
- Use iOS 13, with the Apple A12 Bionic chip (or later)

If you select this capture mode on an iOS device that doesn't meet these requirements, a message warns you that your device is incompatible, and you are unable to proceed in this mode.

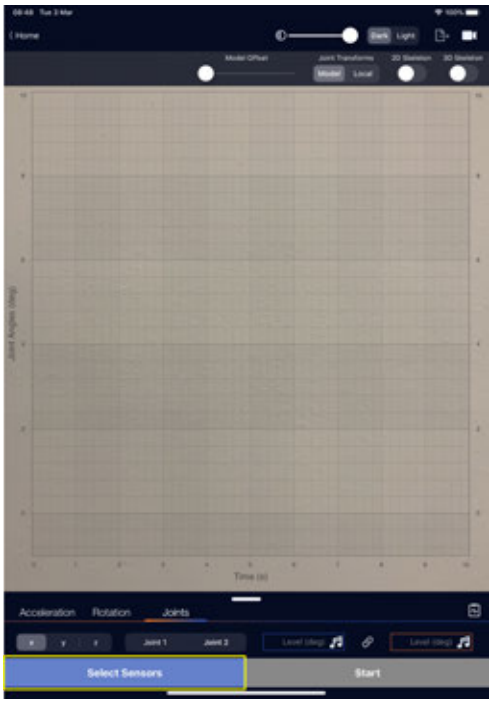
Summary of **AR Visualization** mode:

No. of sensors:	2
Data type:	IMU data
Video:	Video data real-time overlay
Output variables:	4 Joint Angles (default) High G Accelerometer or Low G Accelerometer or Gyroscope (in either case, both exported) or Global Angles (with Low G Accelerometer, Gyroscope and Magnetometer)
Output:	Data (.csv), video (.mp4) and report (.pdf)
Range:	Bluetooth: 20 m+
Capture rate:	Joint Angles: 60 Hz High G Accelerometer (default): 800 Hz Low G Accelerometer and Gyroscope: 500 Hz Global Angles with Low G Accelerometer, Gyroscope and Magnetometer: 225 Hz (A, G) and 70 Hz (M)

Use the Vicon Capture.U app

To use AR Visualization mode:

1. Open the Capture.U app.
2. In the Visualizations section tap **AR Visualization**.
3. At the bottom left of the screen, tap **Select Sensors**.



4. Select up to two sensors (for details, see *Capture to sensor*, Step 7, page 24), and then tap **Set**.

5. Select one of these options:

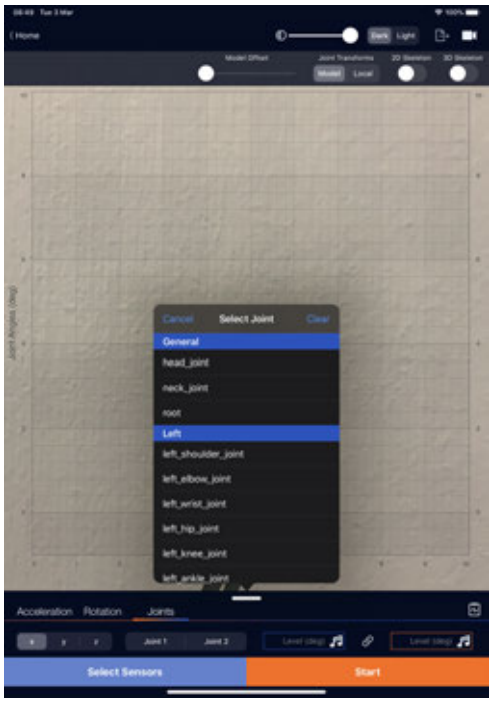
   - **Acceleration** (x, y, z, or **Resultant** and **Low G** or **High G**)
     Note that **Resultant** is the peak resultant acceleration, which is calculated by $\sqrt{x^2 + y^2 + z^2}$
     With the **High G** accelerometer selected, the resultant acceleration can reach up to 346 G.
     With the the **Low G** accelerometer selected, the resultant acceleration can reach up to 26 G.

   - **Rotation** (x, y, or z)
     To enable **Global Angles**, select **Rotation** and ensure **Global** is selected.

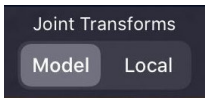
Global angles are streamed in real time on the graph. They are visualized as Euler angles (XYZ rotation order) and exported as quaternion components (Qx, Qy, Qz, Qr).
Note that when Global Angles is selected, Low G Accelerometer, Gyroscope, and Magnetometer are also captured and the capture rate is reduced to 225 Hz (A, G) 70 Hz (M) for the Low G sensor.

> If you plan to capture global angles, before you start capture, you must calibrate the IMU sensors. For instructions on how to do this, see Calibrate IMUs, page 49.

- **Joints**, which lets you select two joint angles that are derived from the Apple ARKit 3 (tap **Joint 1**, select the required joint, then tap **Joint 2** to select it).

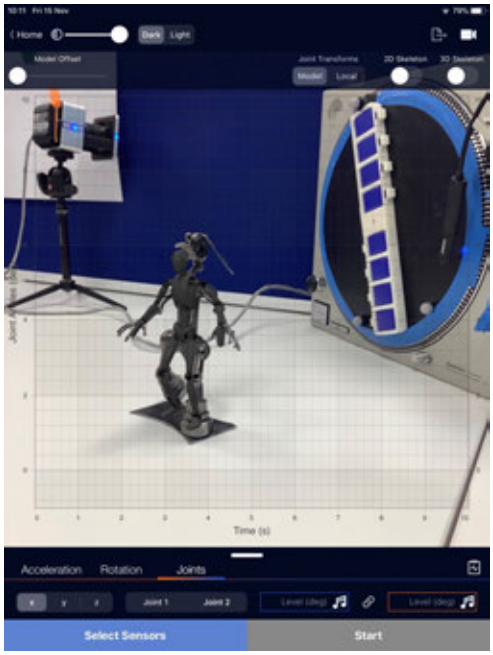


6. At the top right of the screen, you can select whether the joint transforms are model transforms (relative to the root joint) or local transforms (relative to the parent). The default setting is **Model**.



7. At the bottom right of the screen, tap **Start**.
8. To play a sound when a specified level is reached, in the **Benchmarks** area, enter the required values in the benchmark fields.
   The values are indicated by a shaded area on the graph.
9. To record real-time video (recorded at 1920 x 1080), tap the Video icon at the top right of the screen.
   The graph is overlaid on the video. To make the graph easier to see, the controls at the top of the screen enable you to change the thickness of the lines (slide right to increase line thickness), the opacity of the graph, and select a dark or light version.

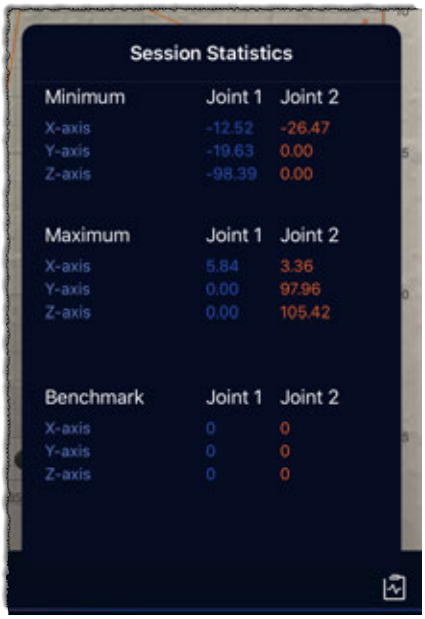
When a subject is visible, the AR figure automatically overlays its image.



10. To offset the skeleton from the tracked subject, use the **Model Offset** slider at the top left of the screen to apply the required offset.

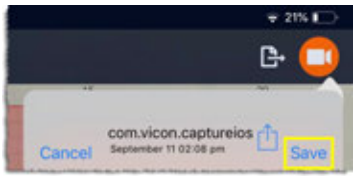
11. To enable or disable 2D and 3D skeleton visualization, select the required **2D Skeleton** and **3D Skeleton** option(s) below the Video icon.
You can select 2D, 3D, or both.

12. To see statistics for the capture in real time, tap the Statistics icon , towards the bottom right of the screen.
The minimum and maximum values detected by the sensors are displayed, in addition to how many times the benchmark values have been reached.



13. When you have captured the required movement, tap **Stop**.

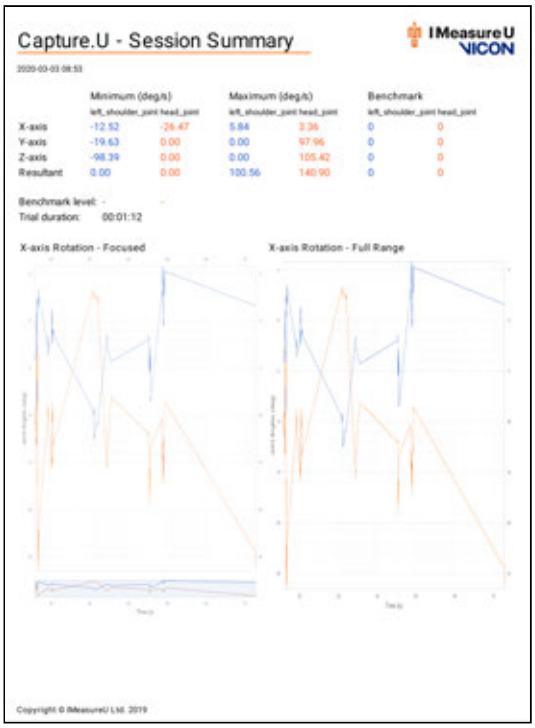
14. From the export icons, select the required export type (file or video):
    - To save a video to your device, tap the Video icon (top right) and then tap **Save**.



Depending on the length of your video, this may take some time. Don't tap Save again, but wait until the video is saved.

> Find saved videos on the **Photos** tab in the Photos app.

- If you choose **Export to PDF**, you can add a title in the PDF preview that is displayed.
  The preview shows the information that will be displayed in the exported PDF, with statistics information at the top of the page, a Focused view of the graph (showing the region of interest) and Full Range view (showing the whole range). This lets you check that the graph is as required before you export it. If it isn't, tap **Cancel**, change the **Joints**, **Acceleration** and/or **Rotation** to show a graph of the required view (X, Y, Z, or Resultant) and tap **Export to PDF** again. When you're happy with the preview, tap **Export** at the top to export the PDF.

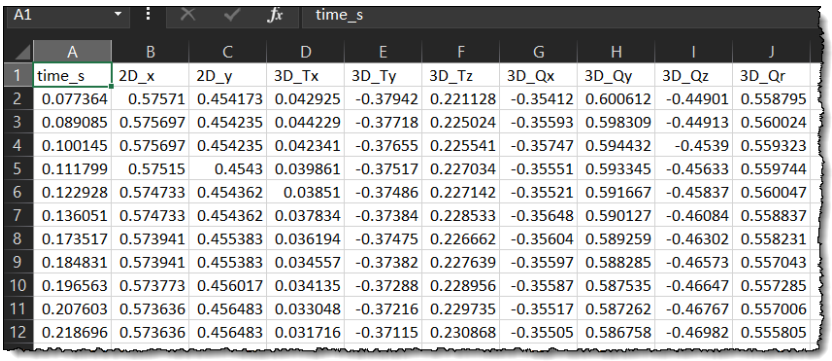


- If you choose **Export to CSV**, the data values exported can be X, Y and Z, but not Resultant.

> If you chose to display High G acceleration, High-G and joint data is exported.
> If you chose to display Joints, Low-G accelerometer and gyroscope data is exported with the joint data.

If you export Global Angles, the data exported is in the format: 2D joints (x and y, which are positions in screen space where the joint was tracked via image processing), 3D joint translations (Tx, Ty, Tz,

relative to the root joint if model transforms are selected, or relative to the parent joint if local transforms are selected) and in quaternion format: Qx, Qy, Qz, Qr, with Qr being the real component representing the rotation.



	A	B	C	D	E	F	G	H	I	J
1	time_s	2D_x	2D_y	3D_Tx	3D_Ty	3D_Tz	3D_Qx	3D_Qy	3D_Qz	3D_Qr
2	0.077364	0.57571	0.454173	0.042925	-0.37942	0.221128	-0.35412	0.600612	-0.44901	0.558795
3	0.089085	0.575697	0.454235	0.044229	-0.37718	0.225024	-0.35593	0.598309	-0.44913	0.560024
4	0.100145	0.575697	0.454235	0.042341	-0.37655	0.225541	-0.35747	0.594432	-0.4539	0.559323
5	0.111799	0.57515	0.4543	0.039861	-0.37517	0.227034	-0.35551	0.593345	-0.45633	0.559744
6	0.122928	0.574733	0.454362	0.03851	-0.37486	0.227142	-0.35521	0.591667	-0.45837	0.560047
7	0.136051	0.574733	0.454362	0.037834	-0.37384	0.228533	-0.35648	0.590127	-0.46084	0.558837
8	0.173517	0.573941	0.455383	0.036194	-0.37475	0.226662	-0.35604	0.589259	-0.46302	0.558231
9	0.184831	0.573941	0.455383	0.034557	-0.37382	0.227639	-0.35597	0.588285	-0.46573	0.557043
10	0.196563	0.573773	0.456017	0.034135	-0.37288	0.228956	-0.35587	0.587535	-0.46647	0.557285
11	0.207603	0.573636	0.456483	0.033048	-0.37216	0.229735	-0.35517	0.587262	-0.46767	0.557006
12	0.218696	0.573636	0.456483	0.031716	-0.37115	0.230868	-0.35505	0.586758	-0.46982	0.555805

To export either a report (.pdf) or data (.csv), or to browse previously recorded videos, tap the File icon (top right).

- If you choose **Browse Video**, previously captured videos are listed. Tap to select a video, then play a minimized preview by tapping the Play icon at the bottom, or tap **Use** at the top right to play in full-screen mode.

Run Activity Widget demo

The Activity Widgets provide pre-defined workflows that have output metrics.

Activity Widgets might be particularly useful in situations where a quick assessment with minimal/no user setup is required, for example, in undergraduate research projects, grass-roots sports, etc.

For a quick demonstration, you can view an animated GIF example. To do this:

1. From the **Activity Widgets**, select **Swimming**.
2. Hold the iOS device in landscape orientation.
3. Tap the screen to run the example through each workflow screen.
4. When you have tapped through all the screens, you are returned to the home screen.
   This provides an overview of the workflow for the activity widgets.

> To exit the Swimming GIF example at any time, tap **Home**.
> You are returned to the Capture.U app home screen.

Further, fully interactive Activity Widgets are planned.

Calibrate IMUs

In all capture modes, if you plan to capture global angles, to ensure that the IMU sensor data is stable and to minimize drift, at the start of a day's capturing, you must calibrate the IMU sensors.

To calibrate the sensors:

1. Start streaming global angles.
2. Wave the sensor in a figure-of-eight for at least 10 seconds.
3. Put the sensor on a flat surface.
4. Wait until the data has stabilized.
   In Real-Time Insight and AR Visualization modes, you can observe that **X** angle is 0 and the **Y** angle is 0 (the figure-of-eight provides enough information for the sensor to self-calibrate). However, the **Z** angle may have a non-zero value, depending on how it is rotated to the magnetic north.
5. Rotate the sensor on the flat surface until **Z** is also 0.
6. You can now capture data in the required capture mode, page 19.

Reset sensors

When you select a capture mode and tap **Select Sensors**, if one or more of the sensors needs a reset, it is displayed in orange and is labeled **Reset required**.

This may happen, for example, if you close the app before stopping a capture.

You can reset sensors using the **Reset sensors** option.

To reset sensors:

1. Tap the Settings icon (the cog symbol, bottom right).

2. Tap **Reset sensors**.

3. Select the sensor by doing one of the following:
   - Select **Tap to Select** and then tap the sensor twice.
     or
   - In the list in the app, tap the sensor name.
     or
   - At the top of the sensor list, in the Search field, enter the number of the sensor.

   The sensor is selected.

4. Tap **Reset Selected**.

The reset sensor(s) are now available and the app returns to the **Settings** window.

5. To close the **Settings** window, tap the **Back** button or tap a blank area of the Capture.U screen.

Get help on the Capture.U app

1. Tap the Settings icon (the cog symbol, bottom right).

2. Tap **Help**.
3. Tap one of the options:
   - **Customer Support** Opens the Vicon Support webpage[5].
   - **Privacy Policy** Displays the Vicon Capture.U legal policy[6].
   - **Terms of Use** Displays the Vicon Capture.U terms of use[7].
4. To close the **Settings** window, tap the **Back** button or tap a blank area of the Capture.U screen.

5 https://www.vicon.com/support
6 http://legal.vicon.com/app_privacy_policy.html
7 http://legal.vicon.com/ios_terms_of_use.html

Addressed issues for the Capture.U app

The following issues were addressed in the current version of the Capture.U app:

- In **AR Visualization** mode, exported CSV file names are correct in folders and sub-folders, whether exporting Acceleration, Rotation, or Joints.
- In **Real-Time Insight** mode and you toggle the keyboard on and off during live capture, parts of the user interface are no longer cut off.
- When creating a new trial on the iPad or iPad Pro, you can now select the X button to clear a trial name.
- The displayed rate for Magnetometer (when only Magnetometer is selected) has been updated to illustrate the true capture rate of 112 Hz.

Known issues for the Capture.U app

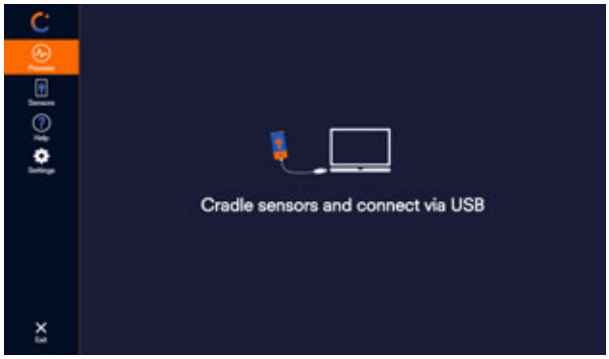
Issue	Workaround
When using **Real-Time Insight** mode, if you have not enabled video, the controls at the top of the screen that enable you to change the opacity of the graph and to select a dark or light version of the graph are not selectable.	If you need to change the opacity of the graph and/or to select a dark or light version of the graph, ensure video is enabled. To do this, tap the Video icon at the top right of the screen.

Issue	Workaround
The data rates displayed by the Capture.U app for the magnetometer do not always reflect its true values. In **To Sensor** mode and **To Device** mode, if you select **Magnetometer** only, the rate is accurately represented in the displayed information (**112 Hz LowG M Recorded** and **112 Hz LowG M Streamed at 112 Hz** respectively). However, if other Low G inputs are also selected, the displayed value reflects the rate of the other inputs, and the magnetometer rate is not shown.	Be aware that the rate reported in the Capture.U app for Magnetometer is only accurate if **Magnetometer** only is selected, that is: • During standard capture, the magnetometer rate is 112 Hz. • If **Global Angles** are also selected, the rate is 70 Hz. If other Low G inputs are also selected, the displayed value reflects the rate of the other inputs.
When displaying or exporting global angle data, Nexus attempts to remove discontinuities, caused by restricting the helical angle to rotations of less than 180 degrees, by adding or removing multiples of 360 degrees of rotation to the helical angle vector. However, when the IMU approaches its original orientation after a full 360 degree rotation, the overall rotation in the underlying data is small and the axis of rotation at this time will generally not be parallel to the overall rotation vector of the gross movement. This may lead to apparent large excursions in the helical angle and a difference in the values displayed in graphs or exported from Nexus when compared with the unadjusted values exported from CaptureU.	None. However, note that although the component values differ, they still describe equivalent rotations.
In **Real-Time Insight** and **AR Visualization** modes, saving a video takes longer than expected and a gray box may be displayed.	Depending on the length of your video, saving may take some time. Don't tap Save again, but wait until the video is saved. If after waiting, the app seems unresponsive and/or a gray box is displayed, the app may have terminated. Restart the device and flush the Bluetooth.

Issue	Workaround
When capturing global angles in **Real-Time Insight** and **AR Visualization** modes, data may appear to drift.	Each day, or session, before you start capture, perform the following calibration: 1. Start streaming global angles. 2. Wave the sensor in a figure-of-eight motion for at least 10 seconds. 3. Put the sensor on a flat surface. Observe that **X** angle is 0 and the **Y** angle is 0 (the figure-of-eight provides enough information for the sensor to self-calibrate). However, the **Z** angle may have a non-zero value, depending on how it is rotated to the magnetic north. 4. Rotate the sensor on the flat surface until **Z** is also 0.
In **AR Visualization** mode, the shoulder joints do not appear to be where you would expect them (ie, corresponding to the ball and socket joint at the top of the arm). Instead, they appear to refer to the neck-end of the clavicle (or in close proximity).	None.
If you repeatedly enter and exit AR Visualization mode by tapping **Home** or exiting the app, the Capture.U app unexpectedly stops.	Restart the device and flush the Bluetooth.
The ARKit 3 joint data and the Vicon IMU data is not time-synced.	To synchronize the data post-capture, ensure the subject performs a foot-stamp (or any other movement that shows a clear, recognizable signal in both streams) during capture.

Issue	Workaround
When Capture.U is used on an iPhone, it remains in portrait orientation, even when the phone is rotated.	None: this is intended behavior. When Capture.U is used on iPhones, for optimal use of the screen proportions, it is displayed in portrait mode only.
On iPhones, graphs are always exported in portrait orientation (side-by-side).	None: this is intended behavior. As iPhones are locked to portrait orientation (see above), graphs are always exported in portrait orientation (side-by-side).
In **Real-Time Insight** mode, when you set benchmarks, you can't close the Benchmark keyboard.	To close the Benchmark keyboard, tap the Real-Time Insight graph.
If trial and/or session names are followed by a double space, a period is automatically added. The period is an illegal character, so if you try to use a trial or session name that is followed by a period, the Capture.U app does not save it.	Do not append a double space to trial or session names.
Downloaded High G accelerometer data may exhibit "latching". This is where, when the data becomes close to zero, its value is automatically rounded to zero.	None

Use Vicon Capture.U Desktop



Vicon Capture.U Desktop lets you download data that you collected with Vicon Blue Trident IMU sensors and access a walk-through and documentation.

From Capture.U Desktop, you can export data as CSV (both raw data export and Aligned CSV, for synchronized sensor data, enabling you to directly compare IMU axes), or X1D (for import to Nexus) for further analysis.

Watch the Vicon video, Using Capture.U Desktop[8] on YouTube.

When using Capture.U Desktop, note that:

- Capture.U Desktop is a fixed size window so can't be minimized or maximized.
- To close Capture.U Desktop, click the **Exit** button (bottom left of the window).
- Capture.U Desktop 1.1.1 is supported by Firmware 9.x, and the Capture.U 1.2 app and Nexus 2.10 are supported by Firmware 9.0.4 and later.

8 https://youtu.be/_RC28CXasrk

Use Vicon Capture.U Desktop

For more information about Capture.U Desktop, see:

- What's new in Capture.U Desktop 1.2?, page 60
- Requirements for Capture.U Desktop, page 72
- Download and install Capture.U Desktop, page 72
- Connect sensors to Capture.U Desktop, page 73
- Download a trial from the sensors, page 76
- Edit a downloaded trial, page 94
- Manage connected sensors, page 95
- Erase data from sensors, page 97
- Update sensor firmware, page 99
- Get help on Capture.U, page 102
- Known issues for Capture.U Desktop, page 103

What's new in Capture.U Desktop 1.2?

The latest version of Capture.U Desktop provides these new features:

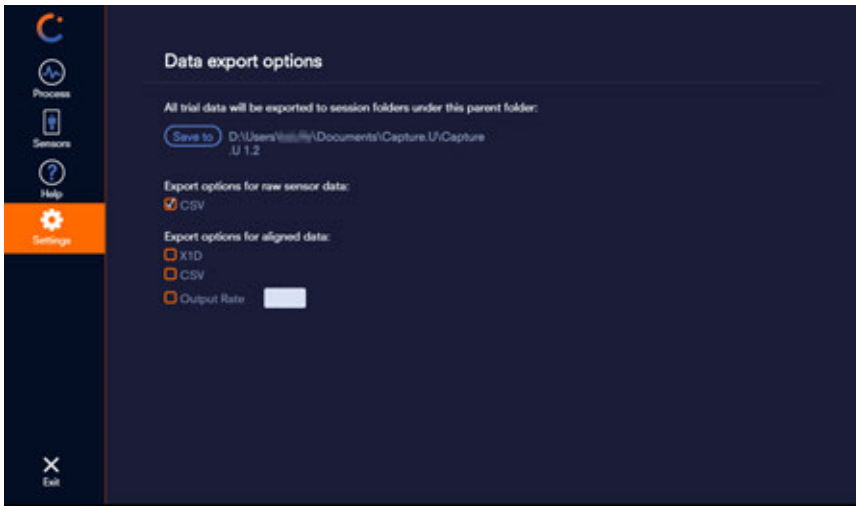
- One-click download, page 61
- Export onboard global angles, page 63
- Export aligned data at a specified rate, page 64
- Graph legend automatically displayed, page 67
- Erase data for all connected sensors, page 68
- Export notes from To Sensor mode, page 69

For information on previous versions of Capture.U Desktop, see the PDFs *Vicon Capture.U 1.1 User Guide* and *Vicon Capture.U 1.0 User Guide* .

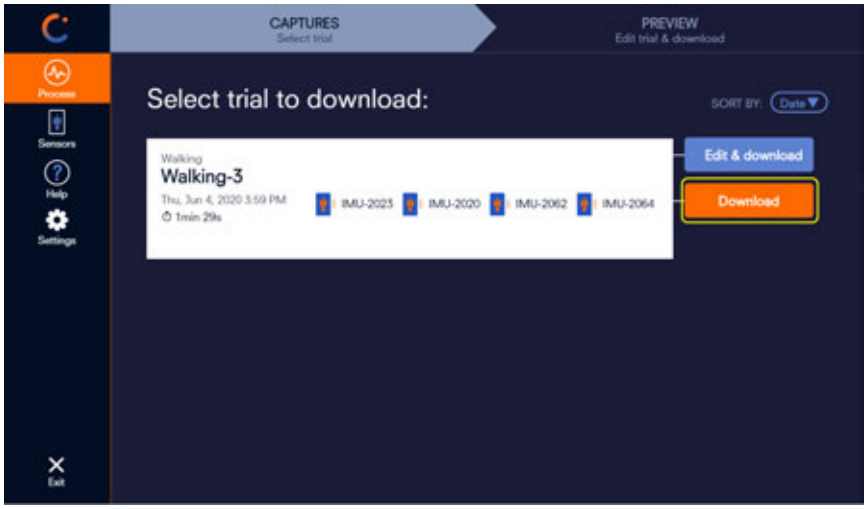
One-click download

When capturing in To Sensor mode, you can now download your data with a single click to a location and format you have previously chosen.

1. Specify the required download settings on the new **Settings** tab, including the **Save To** location and the file format options for data export.



2. Click **Process**, and on the **Captures** tab, select the one-click **Download** option for each required To Sensor session.



When using one-click download, you can't trim the data. If you need to trim the data, use the **Edit & download** option instead.
When you select **Edit & download**, information from the **Settings** is populated into the **Preview** tab.

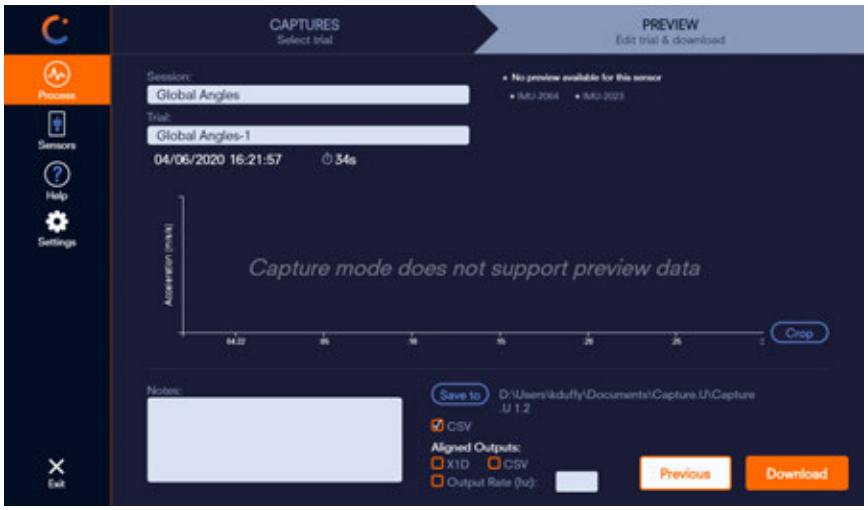
For more information, see Download with a single click, page 92.

Export onboard global angles

Capture.U Desktop now enables you to export global angles that you captured in To Sensor mode with the Capture.U app. Global angles are automatically included in the normal data export process (see Download a trial from the sensors, page 76).

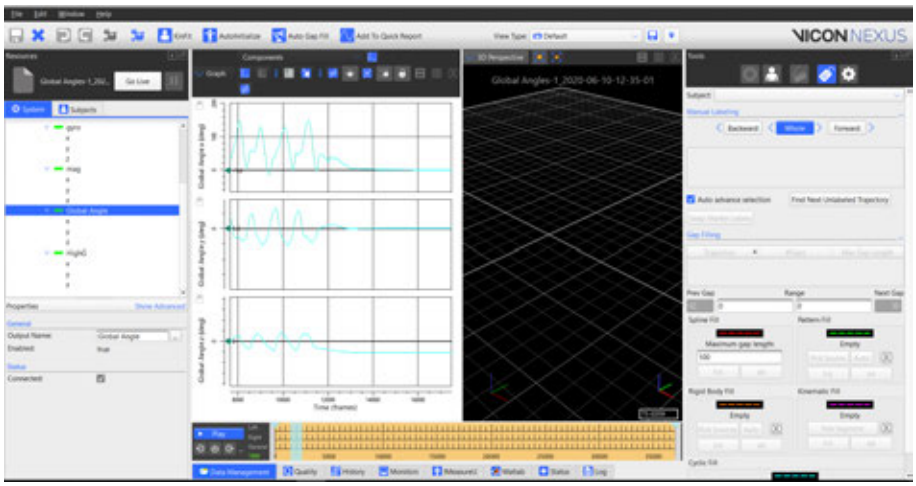
When exporting global angles, bear in mind these points:

- You can download global angles using either of the options on the **Process** tab: **Edit & download** or one-click **Download**. For details, see Download a trial from the sensors, page 76.
- No preview data of trials containing global angles is available, even if you use the **Edit & download** option.



You can export global angles data in all the usual data export formats:

- **CSV** (raw data) The global angles are available in the exported *_lowg.csv* files. They are exported as helical angles (x_deg, y_deg, z_deg) and in a quaternion matrix (qx, qy, qz, qr).
- **Aligned Outputs** (at either a specified output rate or the default rate):
  - **CSV** (aligned) The global angles are exported as helical angles, which are represented as x_deg, y_deg, z_deg, and in a quaternion matrix, represented as qx, qy, qz, qr.
  - **X1D** (for import into Nexus) When imported into Nexus, global angles can be visualized in the Graph pane and in the 3D Perspective view.



Export aligned data at a specified rate

You can now choose the rate at which your aligned CSV data is exported. For example, if you specify 1000 Hz, all data exported is aligned to 1000 Hz.

You can do this in either of these ways:

- Set the default output rate for subsequent downloads, page 65.

or

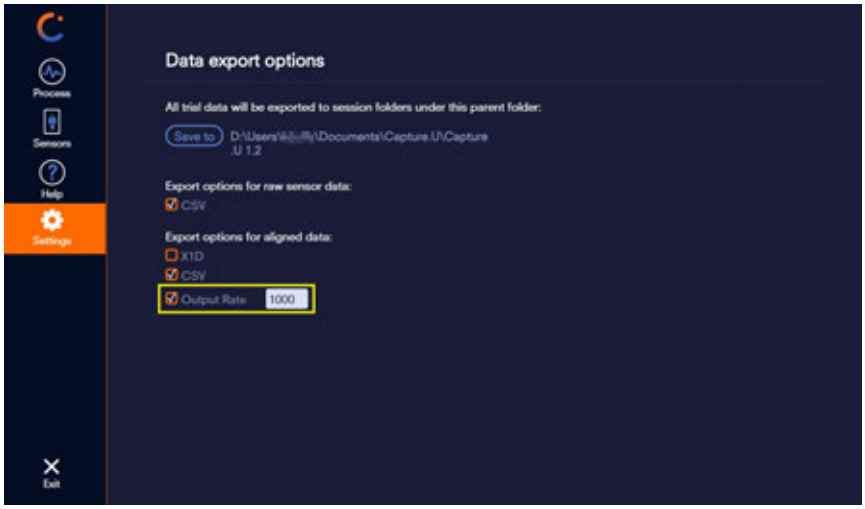
- Set the output rate for a single download, page 66.

The Output Rate applies to both aligned CSV and X1D files to align all data to this rate.

If you don't set the Output Rate, the data is aligned to the highest capture rate (ie, high-G acceleration), so all data aligns to 1600 Hz.

Set the default output rate for subsequent downloads

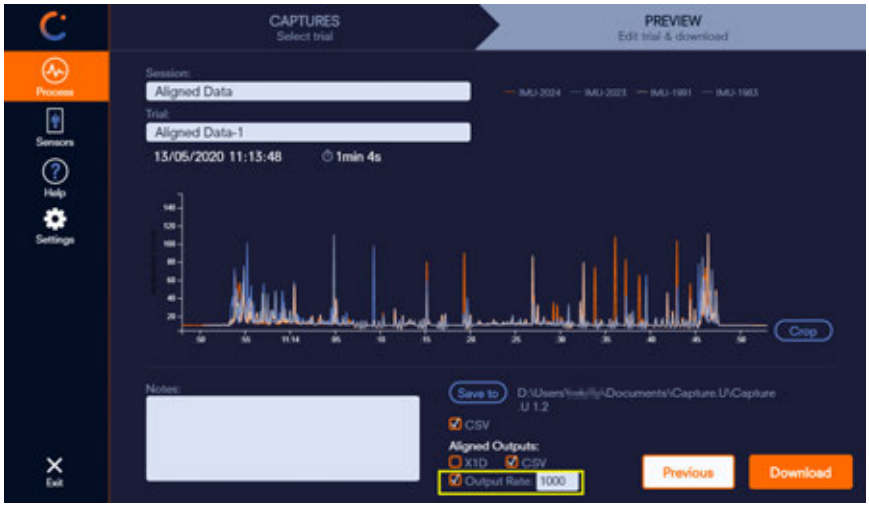
1. On the **Settings** tab, select the required export options (for example, the location, raw data (CSV), and aligned data (X1D and CSV)).
2. Select **Output Rate** and in the text box, enter a value between 25 and 3200 Hz.



The specified output rate is applied to all trials subsequently downloaded, unless you change the settings, either on the **Settings** tab again or via **Edit & download** (see Set the output rate for a single download, page 66).

Set the output rate for a single download

1. On the **Process** tab, select the **Edit & download** option for the required trial. The **Preview** tab is displayed, showing the currently specified options for **Aligned Outputs**:
   - If you haven't set the default output rate (see Set the default output rate for subsequent downloads, page 65), the Aligned Output options are not selected and the Output Rate is blank.
   - If you have set the default output rate, the values you selected populate the Aligned Outputs options and you can choose to either leave them as they are or change them.
2. Set the required export options (for example, specify the required **Save to** location, raw data (**CSV**), and aligned data (**X1D** and **CSV**)).
3. Select **Output Rate** and in the text box, enter a value between 25 and 3200 Hz.



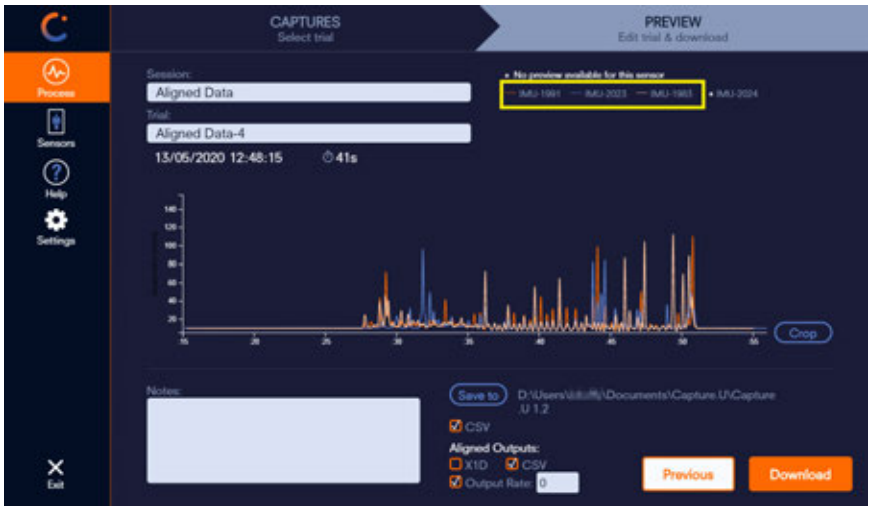
4. Click **Download** to apply the specified output rate to the selected trial.

Graph legend automatically displayed

Capture.U now automatically displays a graph legend at the top right of the **Preview** tab, to enable you to easily identify which curve is related to each sensor.

The legend displays an entry for each of the sensors associated with the trial and indicates which color on the graph belongs to which sensor.

An asterisk (*) is displayed when no preview is available for the sensor(s). This may be because global angles were captured or because data has been deleted from that particular sensor, for example.

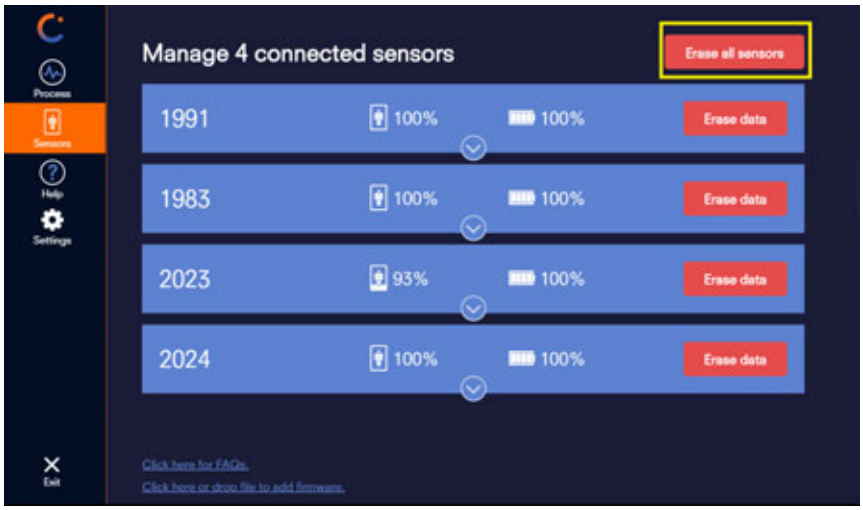


Erase data for all connected sensors

You can now erase sensor data for all connected sensors, instead of having to select each sensor individually.

To erase data for all connected sensors:

- On the **Sensors** tab, click **Erase all sensors**.



> If the firmware for any of the selected sensors needs updating, you are alerted that the data cannot be not erased from those sensors until the firmware is updated.

Export notes from To Sensor mode

In Capture.U Desktop, you can now review, edit and export as a *.txt* file any notes that you made during or after capturing data in the To Sensor mode of the Capture.U app.

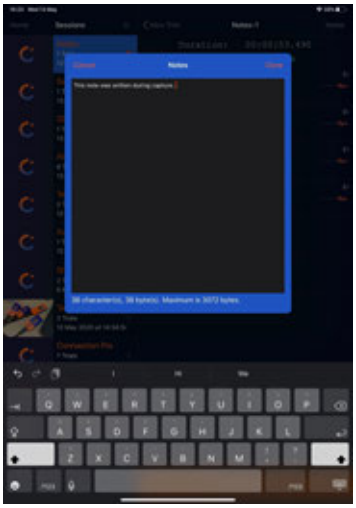
Notes that are written to the sensor populate the **Notes** field on the **Preview** tab. Any notes that you add post-capture in the Capture.U app are synced to the sensor, as long as the sensor is within range. You can also export these post-capture notes from Capture.U Desktop.

Note that:

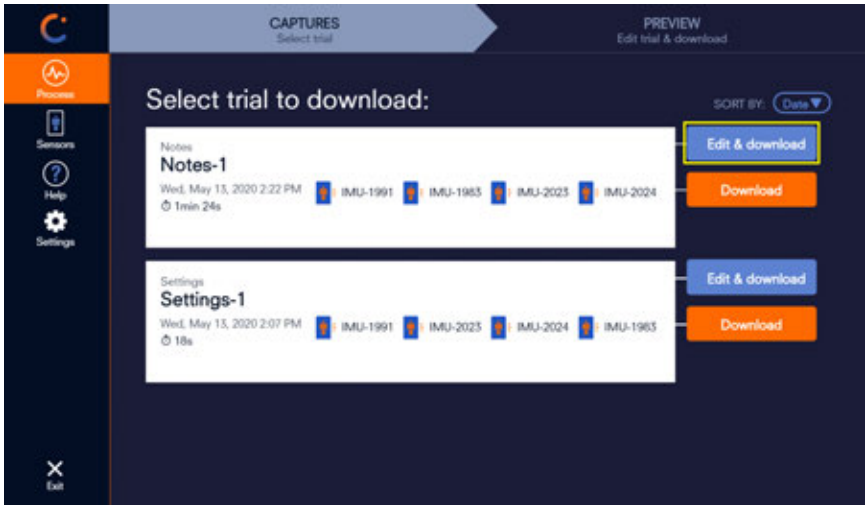
- Changes made to the notes in Capture.U Desktop are not synced to the sensor, so they are not retained after you exit the Capture.U app.
- You can continue to export notes directly from the Capture.U app, as previously.

To export notes from the Capture.U app:

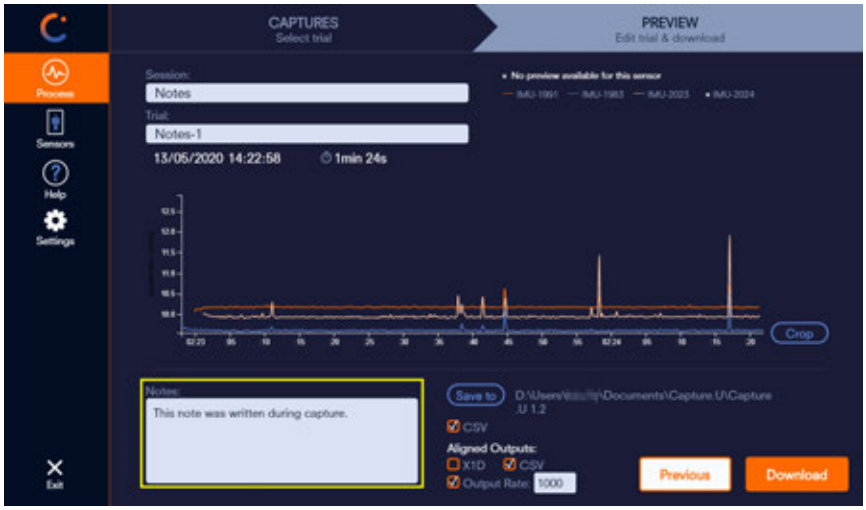
1. In the Capture.U app, create your note(s) during or after capture (remember that you can only add notes after capture if the sensors are still within Bluetooth range).



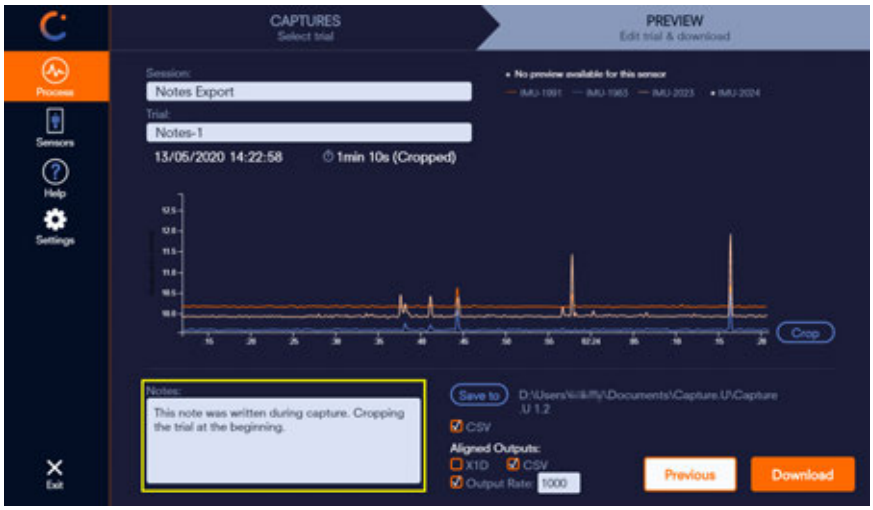
2. In Capture.U Desktop, on the **Captures** tab, to the right of the trial that you want to download:
   - To download your notes without making any further changes, click **Download**.
     or
   - To edit the notes or make other changes to the data, click **Edit & download**.



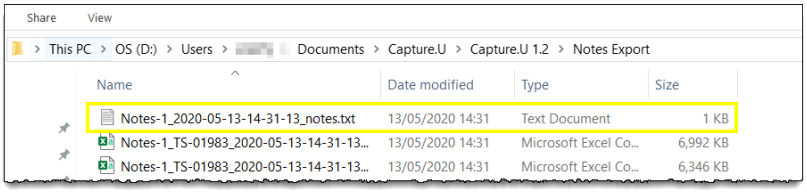
On the **Preview** tab, the notes you made in the Capture.U app are displayed in the **Notes** field.



3. Make any required changes, such as cropping the trial and editing the notes.



4. When you click **Download**, a *.txt* file containing the notes is exported to the **Save to** location.



Requirements for Capture.U Desktop

The following requirements are the minimum that are recommended and fully supported:

Capture.U Desktop for Windows

- Windows 10 (64 bit)

Capture.U Desktop for OSX

- macOS Sierra (10.12)

Download and install Capture.U Desktop

To install Capture.U Desktop on your computer:

1. Check that your computer software meets the recommended specification (see Requirements for Capture.U Desktop, page 72).
2. Download Capture.U Desktop from: https://www.vicon.com/software/capture-u/
3. Unzip and double-click the .exe file to install.

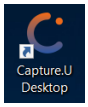
Connect sensors to Capture.U Desktop

To connect sensors:

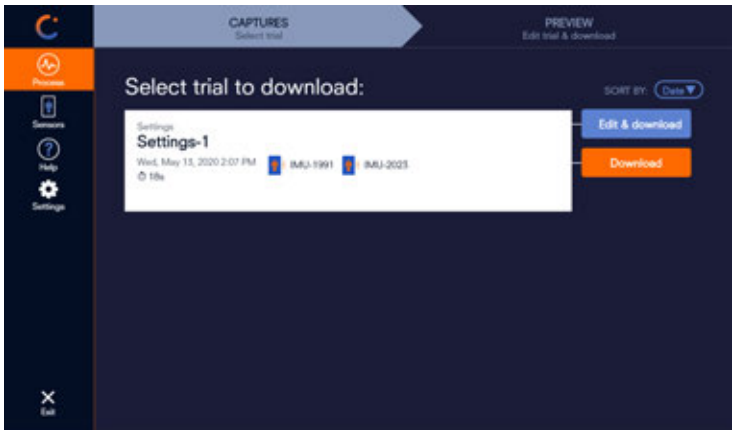
1. Insert each Blue Trident sensor into its USB adapter.
2. With the supplied micro-USB cables, connect the adapter(s) to the computer.

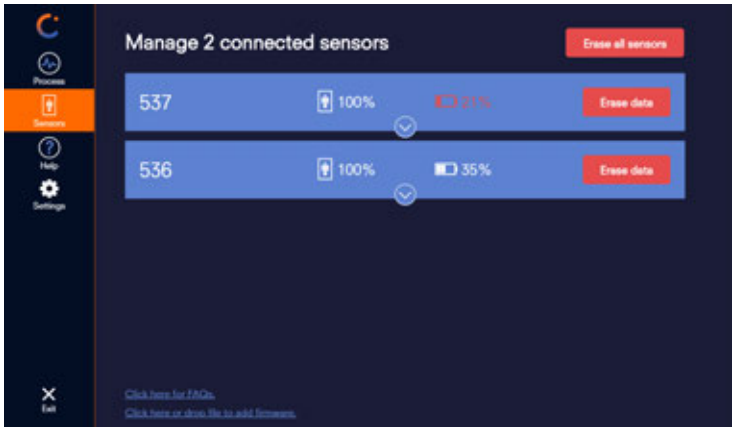
If you can't connect all the sensors that were used for capturing data because you used more sensors that you have USB ports, connect the sensors to the available ports. You will be able to connect the remaining sensors later. For more information, see Download a trial when some sensors are not connected, page 86.

3. On your computer, start Capture.U Desktop.



4. To confirm that one or more sensor(s) is connected to Capture.U Desktop, click either **Process** or **Sensors**.
   All connected sensors are displayed.





Capture.U icons on the Captures tab

The following icons are displayed on the **Captures** tab to indicate the status of the sensors:

Icon	Meaning
	Blue Trident sensor is connected to Capture.U Desktop.
	Blue Trident sensor is not connected to Capture.U Desktop.
	Blue Trident sensor was selected for the trial, but no data has been recorded or data has been erased.
	Blue Trident sensor data has been downloaded for the trial.

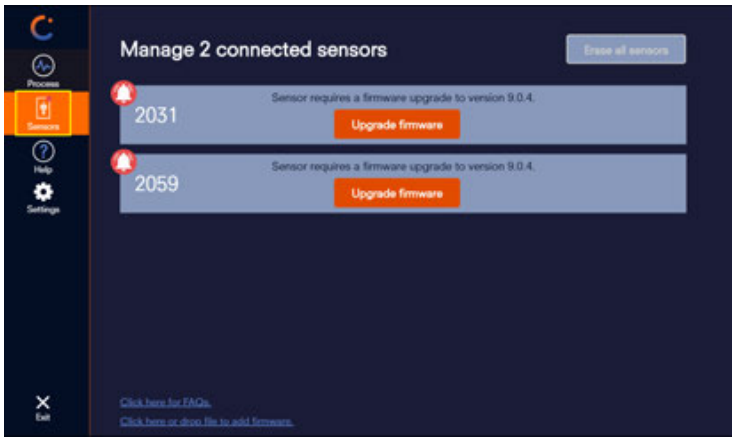
Download a trial from the sensors

The following steps describe how to download a trial from the sensors where all the sensors used for the capture are connected, no data is missing, and you have not yet set up one-click downloading. For information on other scenarios, see also:

- Download a trial when some sensors are not connected, page 86
- Download a trial when sensor data has been erased, page 90
- Download with a single click, page 92

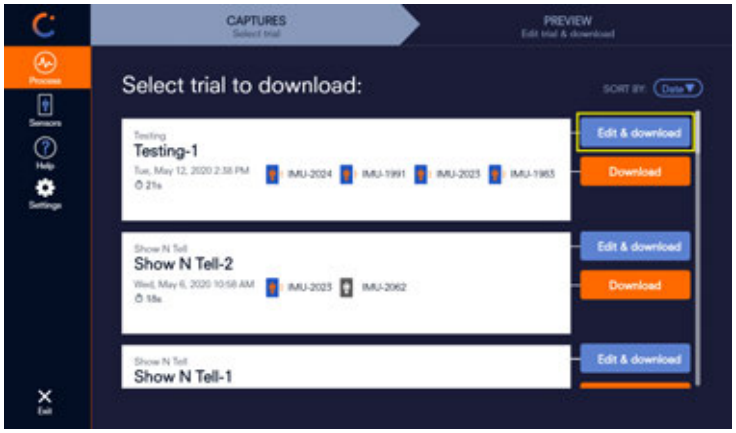
To download a trial from the sensors:

1. Ensure your Blue Trident sensors are connected to your computer (see Connect sensors to Capture.U Desktop, page 73).
   If a red circle is displayed in the top right of the **Sensors** symbol, the Blue Trident sensors need a firmware update.



   Before attempting to continue, update the firmware (see Update sensor firmware, page 99).
   Note that you can't download trials that were captured with the **To Sensor** capture mode until the sensor firmware has been updated.

2. Click **Process** and on the **Captures** tab, under **Select trial to download**, click **Edit & download** to the right of the required trial.

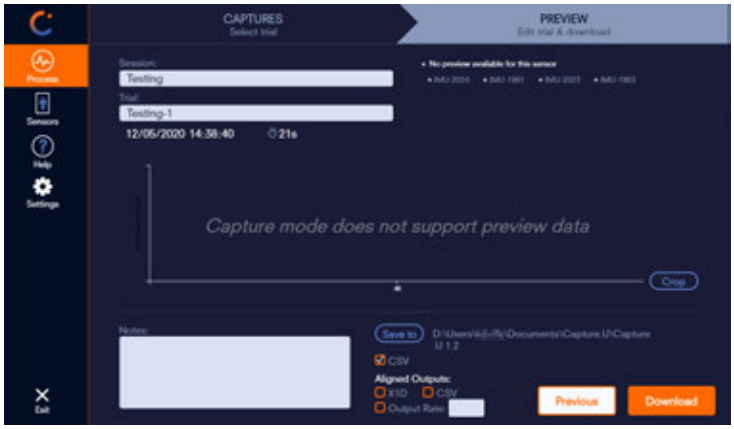


Depending on whether the selected trial contains global angles, the **Process** tab changes to one of the following views:

- If the selected trial contains no global angles, the **Process** tab changes from the **Captures** tab to the **Preview** tab, showing preview data.

> Preview shows the Resultant acceleration, not the captured onboard data.

- If the selected trial contains global angles, the **Process** tab changes from the **Captures** tab to the **Preview** tab, but no preview is displayed.



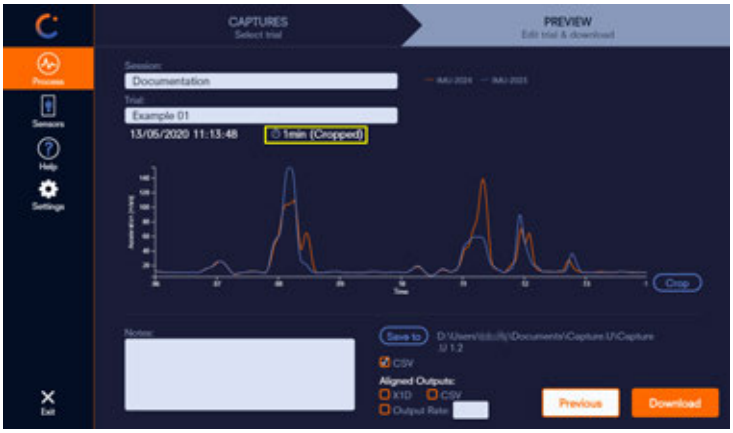
3. If required, before downloading the trial, you can edit the capture to rename it, crop it, add notes, and/or change the Save location:
   - To rename the trial, click in the **Session** and/or **Trial** fields.

- To crop the trial, so that you download only the region of interest:
  i. Click the **Crop** button at the bottom right of the graph.

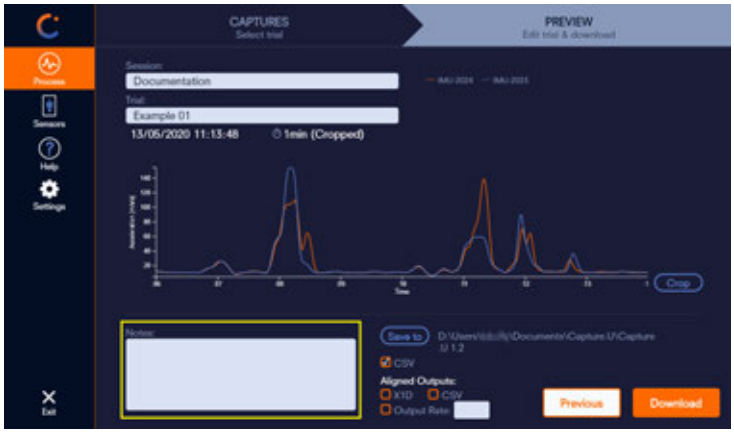
  ii. Select the required part of the trial by clicking on the graph then dragging over the region of interest.
  The selected region is indicated by a rectangle. If you need to adjust the size of the selected region, drag the sides of the rectangle.
  In the following example, the selected region excludes the start and end of the trial.

iii. Click **Apply** to crop the trial.

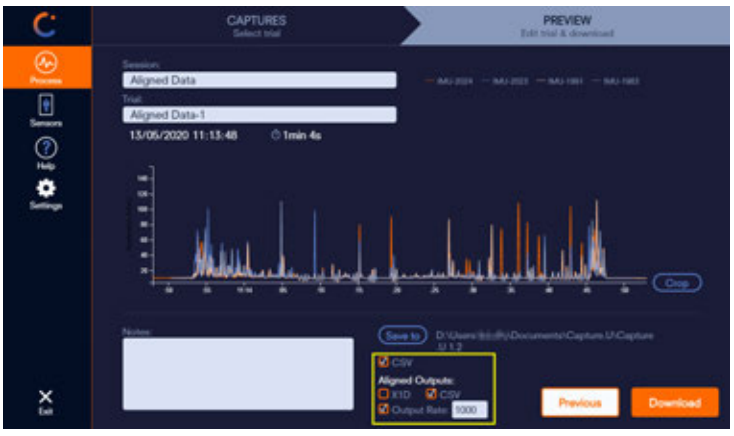
The time of the trial changes to the cropped time.



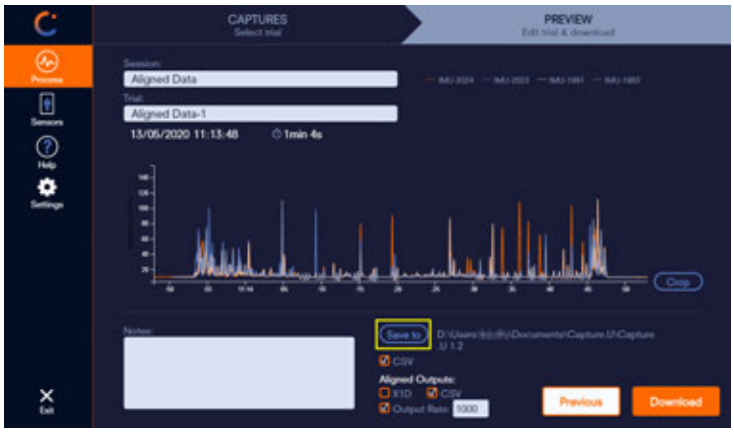
- To add notes, click in the **Notes** field (bottom left).



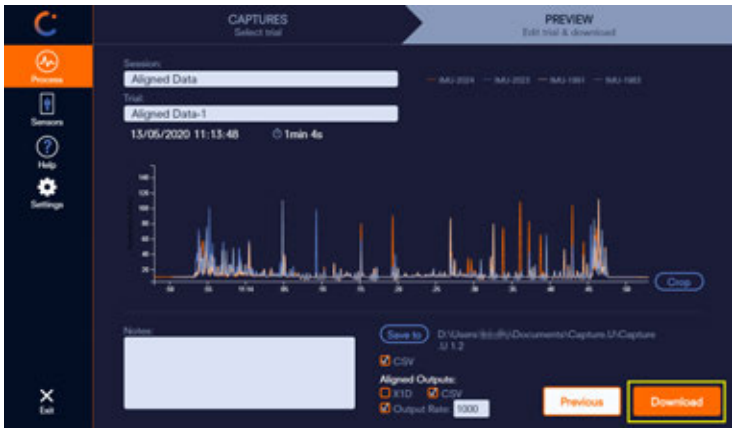
- To choose the file type to download, select from:
  - **CSV** (raw data) The default setting. If your data includes global angles, they are available in the exported *_lowg.csv* files. They are exported as helical angles (x_deg, y_deg, z_deg) and in a quaternion matrix (qx, qy, qz, qr).
  - **Aligned outputs:**
    - **X1D** For importing captured **To Sensor** trials into Vicon Nexus. The X1D file consists of *.imu* and *.system* files, and is imported into Nexus. If your data includes global angles, when they are imported into Nexus, you can display them in the Graph pane.
    - **CSV** Exports synchronized sensor data as a CSV file, so that you can directly compare your IMU axes. For example, the low-G (16-G) accelerometer, which captures at 1125 Hz, is synchronized and aligned to the high-G (200-G) accelerometer, which captures at 1600 Hz. The CSV file has the filename suffix *_aligned*. If your data includes global angles, they are exported as helical angles, which are represented as x_deg, y_deg, z_deg, and in a quaternion matrix, represented as qx, qy, qz, qr.
    - **Output Rate** The rate to which exported CSV data is aligned. Select **Output Rate** and enter a number between 25 and 3200 Hz. If you don't select the Output Rate, the data is aligned to the highest capture rate (ie, high-G acceleration), so all data aligns to 1600 Hz.
      The output rate applies to both the aligned CSV and X1D file to align all data to this rate.



- To change the location for downloaded trials, click **Save to**.
  This displays the File Explorer, enabling you to select the required folder.

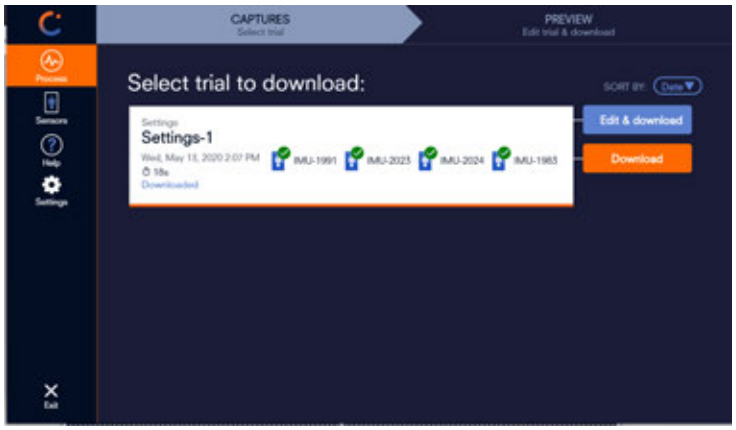


4. When you have finished editing the trial, click **Download** to save the trial data to your computer.

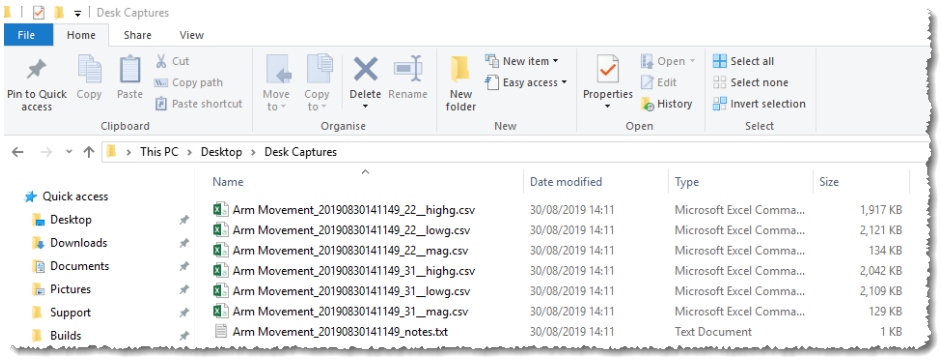


An orange progress bar indicates the download status.

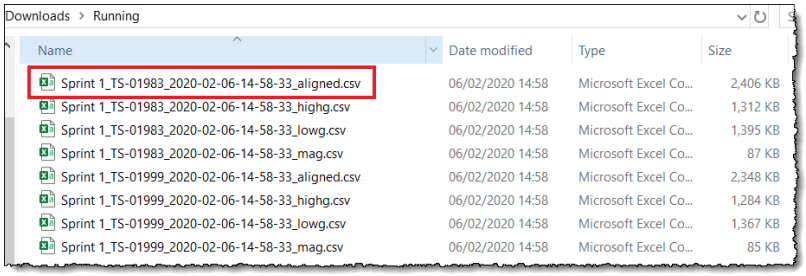
When the trial has finished downloading, the trial is labeled **Downloaded** and green check marks are displayed on each sensor.



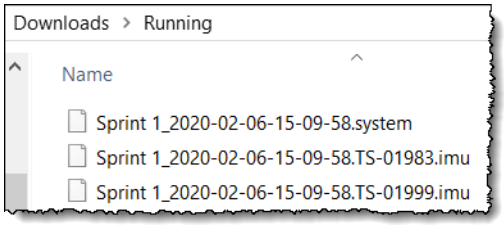
The trial data and any notes you created are saved in the **Save to** folder.



If you chose the Aligned CSV export option, all the synchronized and aligned CSV files include `_aligned` on the CSV export.



If you chose X1D export option, the X1D file is exported as *.imu* and *system* files.



You can then load this file into Nexus.

Download a trial when some sensors are not connected

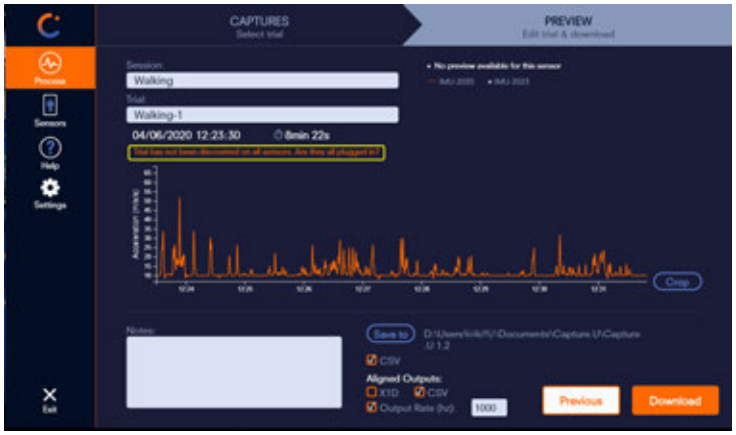
If you can't connect all the sensors that were used for capturing data because you used more sensors that you have USB ports, connect the sensors to the available USB ports. You will be able to connect the remaining sensors later.

To download a trial when some sensors are not connected:

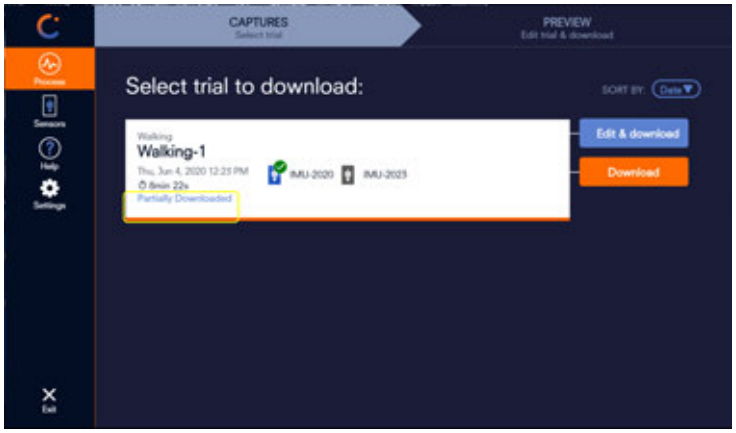
1. Connect sensors to the available USB ports on your computer (see Connect sensors to Capture.U Desktop, page 73).
2. Select **Process** and on the **Captures** tab, notice that connected sensors are displayed in blue and sensors that are not connected are displayed in gray. This example shows a trial that was captured with two sensors, but with only one of the sensors connected.

3. Under **Select trial to download**, click **Edit & download** to the right of the required trial.

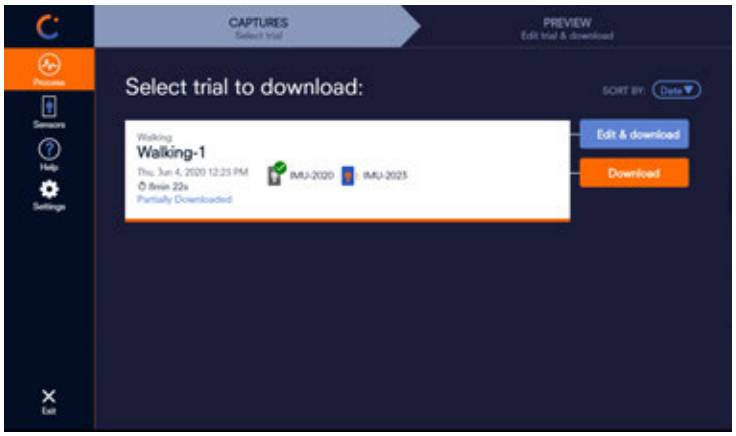
On the **Preview** tab, a message warns you that not all sensors are connected.



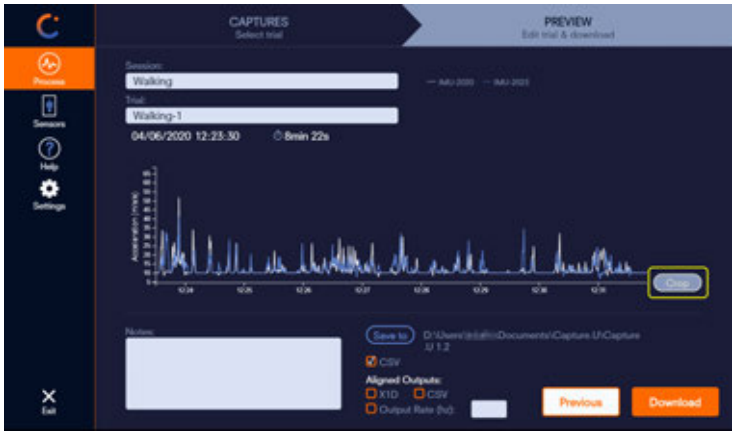
4. Edit the trial if required (see Step 3, page 78 in *Download a trial from the sensors*). To ensure data formatting is consistent, any cropping of the data of the connected sensors is automatically applied when you connect the remaining sensors.
5. When you have finished any editing, click **Download**.
   When the trial has been downloaded, it is labeled **Partially Downloaded**.



6. Connect the remaining sensor(s) to the computer.

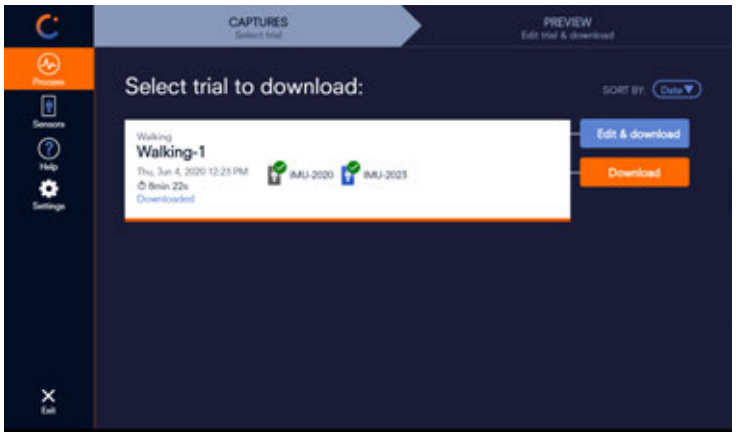


7. Select the trial.
   On the **Preview** tab, notice that the **Crop** button is unavailable, to ensure the data is formatted in the same way as the previously connected sensors.
   If you cropped the trial when you connected the first set of sensors, the trial is automatically cropped in the same way as the previously connected sensors.



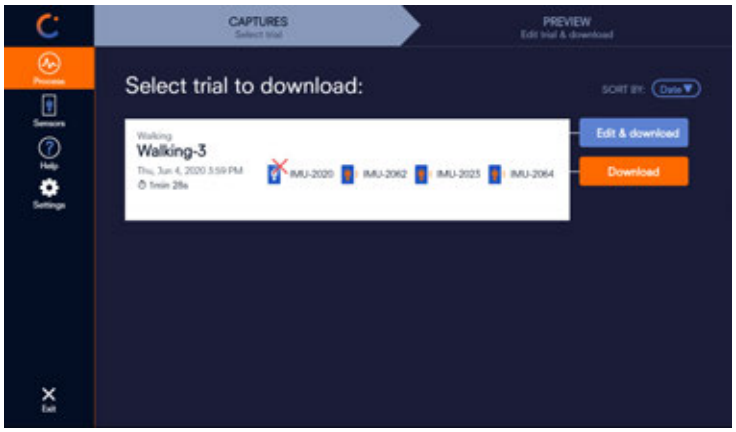
8. Click **Download**.

When data from all the sensors has been downloaded for the associated trial, green check marks are displayed for each sensor.

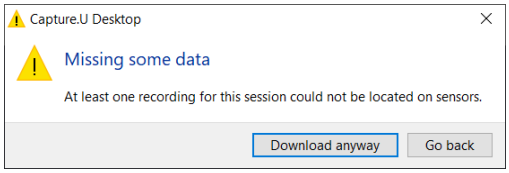


Download a trial when sensor data has been erased

1. If you deleted data from one or more sensors that were used in a trial before downloading the data, when you connect the relevant sensor(s), any sensor with deleted data is displayed with a red cross on the **Captures** tab:

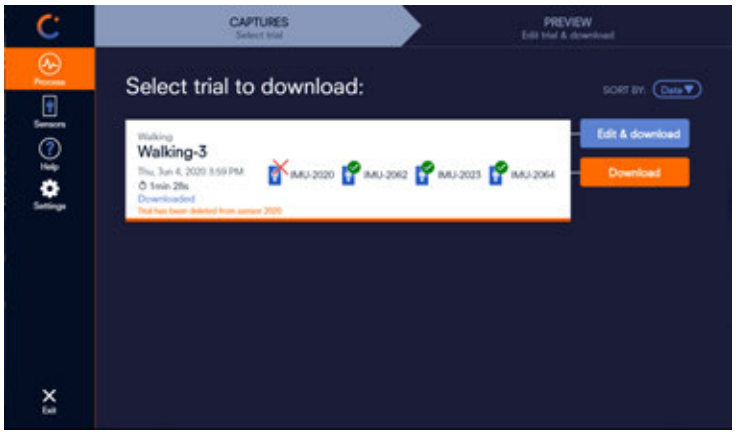


   You can still download data from the other sensors, but when you select the trial, a message warns you that some data is missing.



2. To continue, select **Download anyway**.
3. Edit the trial if required (see Step 3, page 78 in *Download a trial from the sensors*) and then click **Download**.

When the trial has been downloaded for all sensors, on the **Captures** tab, you are warned that the trial has not been discovered on all the required sensors.

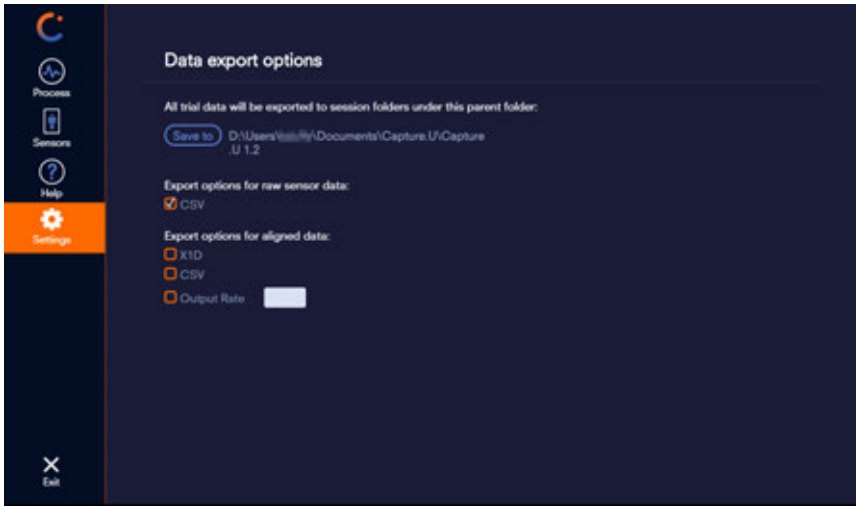


Download with a single click

When you have captured trials in To Sensor mode, you can download your data with a single click to a location and format you have previously chosen. You first set the required download options in the **Settings** tab, and then go to the **Process** tab and click the **Download** option for the required trial(s).

To specify the options for one-click download:

- On the **Settings** tab, set the data export options, which will be used for one-click download. These include the **Save To** location and the file format options for data export (e.g. X1D and CSV).



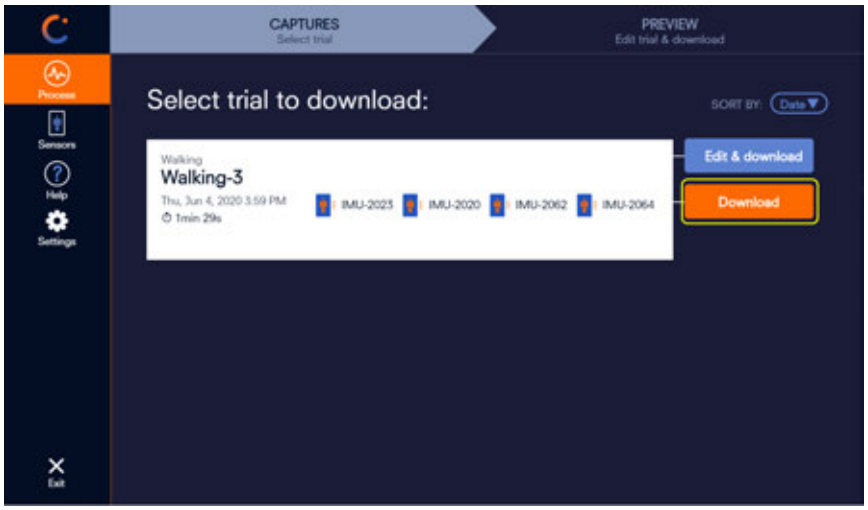
To change the file type to download, select from:

- **CSV** The default setting
- **Aligned outputs:**
    - **X1D** For importing captured **To Sensor** trials into Vicon Nexus. The X1D file consists of *.imu* and *.system* files, and is imported into Nexus.
    - **CSV** Exports synchronized sensor data as a CSV file, so that you can directly compare your IMU axes. For example, the low-G (16-G) accelerometer, which captures at 1125 Hz, is synchronized and aligned to the high-G (200-G) accelerometer, which captures at 1600 Hz. The CSV file has the filename suffix *_aligned*.
    - **Output Rate** The rate to which exported CSV data is aligned. Select **Output Rate** and enter a number between 25 and 3200 Hz. If you don't select the Output Rate, the data is aligned to the highest

capture rate (ie, high-G acceleration), so all data aligns to 1600 Hz. The output rate applies to both the aligned CSV and X1D file to align all data to this rate.

To select one-click download for data export:

- On the **Process** tab, select the **Download** option for each capture To Sensor session.



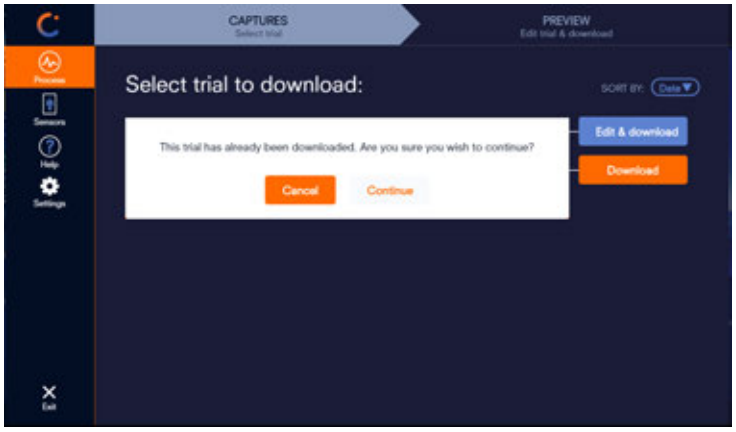
The aligned data is generated in a CSV file with the filename suffix *_aligned*. If you selected X1D, an X1D file is generated (consisting of *.imu* and *.system* files, which are imported into Nexus).
Subsequent exports from this session are exported using the options you chose on the **Settings** tab.

> When you use one-click download, you can't trim the data. If you need to trim the data, use the **Edit & download** option.
> When you select **Edit & download**, the settings information is populated into the Preview pane.

Edit a downloaded trial

To change a trial that you have downloaded (for example, if you want to crop the trial), provided that you haven't deleted the data from the sensor, you can re-download the trial and make the required changes.

1. With the relevant sensor connected, select **Process** and on the **Captures** tab, select the required trial.
   A message notifies you that this session has already been downloaded and asks if you want to continue.



2. Click **Continue**.
   You can then edit the trial as required and download in the same way as the original download (see Download a trial from the sensors, page 76).

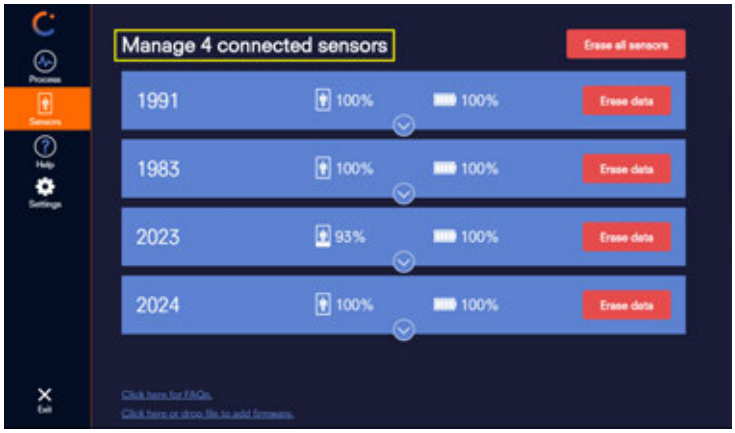
> If you haven't changed the session/trial name and Save location, the trial export files are only differentiated by their download time.

Manage connected sensors

To manage connected sensors, in the main Capture.U Desktop window, click **Sensors**.

From here you can update the firmware (see Update sensor firmware, page 99), delete data from the sensors (see Erase data from sensors, page 97), and display detailed information about each one.

At the top left of the window, the number of connected sensors is displayed.



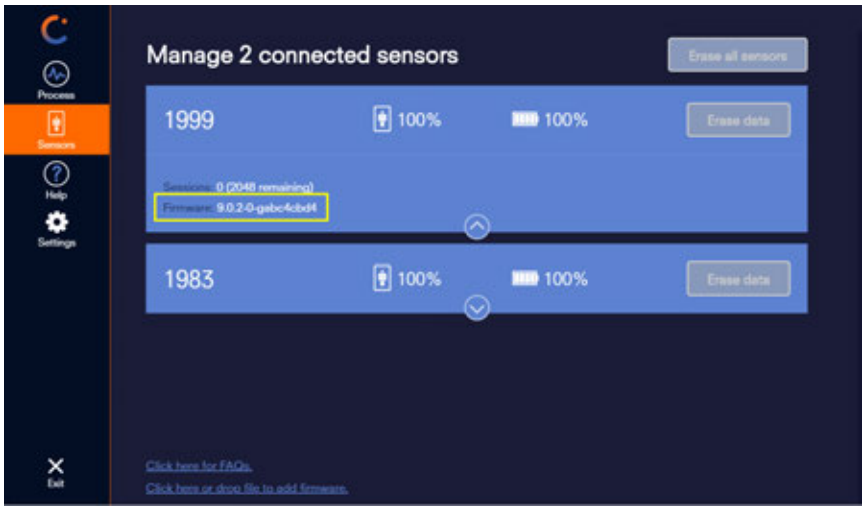
For each connected sensor, the following information is displayed (left to right):

- Sensor ID number
- Percentage of storage available for the sensor
- Battery percentage. Connected sensors are charged if they are not already fully charged.

For further information, click the downward arrow.

The following details are displayed:

- **Sessions**: Number of recorded trials on the sensor
- **Firmware version**



Erase data from sensors

To remove unwanted data from your sensors, you can delete it in one of these ways:

- Erase data from a single sensor, page 97
- Erase data from all connected sensors, page 98

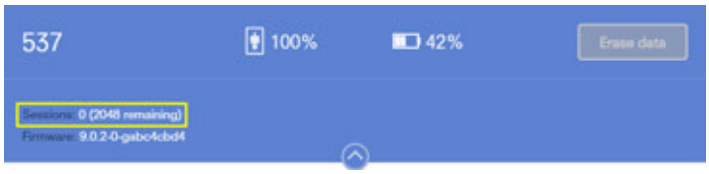
Erase data from a single sensor

To erase data from one or more sensors, you can delete the data using the relevant Erase button on the **Sensors** tab.

To erase data from a sensor:

1. Ensure the sensor(s) from which you want to erase data is connected.
2. Click **Sensors** and then for the required sensor, click **Erase data**.
   A message notifies you that all data will be erased from the sensor and you're given the opportunity to confirm or cancel.

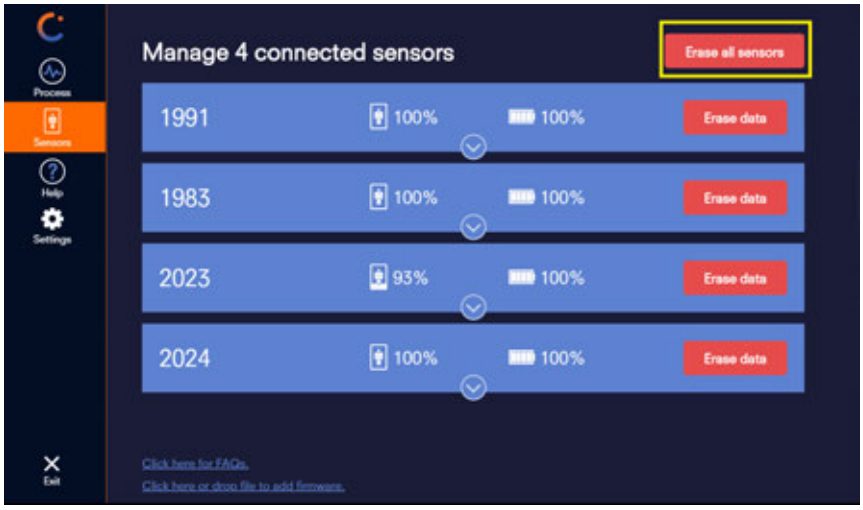
3. To delete the data from the sensor, click **Erase**.
   When the data has been erased from the sensor, the **Erase** button is disabled and if you click the down arrow, you can see that the **Sessions** information now shows a zero.



Erase data from all connected sensors

To erase sensor data from all connected sensors:

- On the **Sensors** tab, click **Erase all sensors**.



Update sensor firmware

Capture.U Desktop enables you to upgrade your Blue Trident sensors to the latest firmware.

To update sensor firmware:

1. If your sensors aren't plugged in, connect them to the computer (see Connect sensors, page 73) and launch Capture.U Desktop.
   On both the **Process** tab and the **Sensors** tab, the connected sensors display a red circle to let you know that firmware needs to be upgraded.
2. Click **Sensors** on the left.
   Capture.U Desktop informs you of the availability of a firmware upgrade.

3. Click **Upgrade firmware**.
   The status changes to **Firmware upgrade in progress**.

4. When the firmware has finished updating, you can expand the displayed information to view the updated firmware number on the **Sensors** tab.

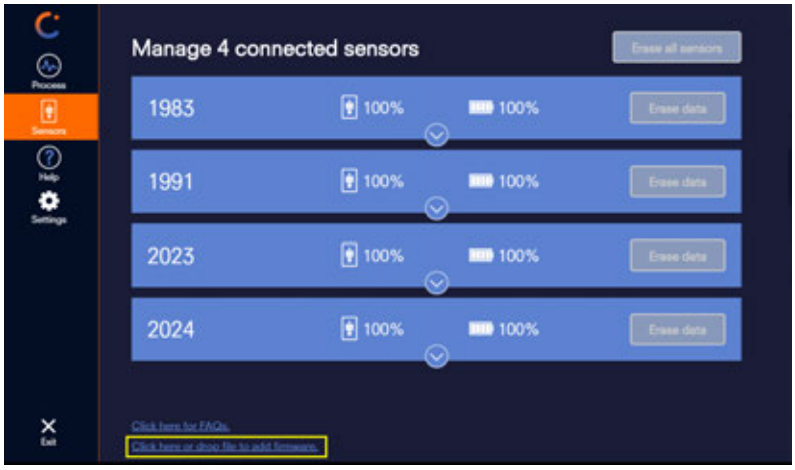
5. If other sensors need to have their firmware upgraded, repeat the above steps for each one.

> If one or more sensors fails to upgrade, try disconnecting the sensor(s) from the computer and entering bootloader mode. To do this, hold down the USB adapter button on the sensor for at least 10 seconds. Release the button and wait 60 seconds for the sensor to exit bootloader mode, then reconnect and relaunch Capture.U Desktop. Retry upgrading the firmware as described above.

6. You can now download trials that were captured using the **To Sensor** capture mode (see Download a trial from the sensors, page 76 and Capture to sensor, page 20).

Load updated firmware (9.x) to upgrade Blue Trident sensors

If new Blue Trident sensor firmware becomes available (that is, firmware later than 9.0.4), add this file to Capture.U Desktop either by clicking or dropping the firmware file onto the **Sensors** tab.



To revert back to 9.0.4 firmware, remove the added firmware file by deleting the firmware file located in:

C:\Users\Username*AppData\Roaming\Capture.UDesktop\firmware*

Get help on Capture.U

To get help on using Capture.U:

1. Start Capture.U Desktop and click **Help**.

2. Choose from the following options:
   - **Guides*** Visit the Vicon IMU documentation web page[9].
   - **FAQs*** Visit the Vicon FAQs web page[10].
   - **Support*** Visit the Vicon Support web page[11].
   - **Start walkthrough**. Launch a quick tour of Capture.U Desktop.
     To use this option, ensure that you have first captured data using the **To Sensor** capture mode in the Capture.U app and connected the sensor(s) to the computer.
     To end the walkthrough at any stage, click **Help** and then click **End walkthrough**.
   - **Version check**. Click the version number (bottom right) to display more detailed version information about Capture.U Desktop.

* Internet access required

9 https://docs.vicon.com/display/IMU/IMU+documentation
10 https://www.vicon.com/faqs/
11 https://www.vicon.com/support/

Known issues for Capture.U Desktop

Issue	Workaround
Downloaded High G accelerometer data may exhibit "latching". This is where, when the data becomes close to zero, its value is automatically rounded to zero.	None