ActiLife 7 User's Manual

- Document Number: SFT12DOC13
- Revision: I
- Effective Date: 01/30/2026

Change Page

About the Change Page

The following table describes the changes that have been made to this document since its original baseline. Documents affected by the changes made need to be listed and updated to keep procedures up to date. This table shall be maintained as long as this document is active.

Revision	Description of Changes/Documents Affected	Effective Date
A	Initial release – internally reviewed	4/3/12
B	Updated WASO definition	5/16/12
C (internal release)	Added Risk Management documentation	4/16/13
D	Added LEAP information & general update.	10/01/24
E	Added LEAP raw data for the PPG green sensor, command line for HR/HRV algorithm, and updated branding	10/09/24
F	Added support for Temperature and Step Count for LEAP devices	12/10/24
G	Added support for IMU in LEAP device	4/15/25
H	Added details related to Extracting Step Count from Leap device in AL Using English(world) as regional Settings for non-US users in AL	7/24/25
I	Added support for CPIW Accelerometer Data & LEAP PPG Red/IR 50 Hz	01/30/26

Signature Page

Printed Name of Document Creator or Editor: _____

Printed Name of Reviewing Manager: _____ ☐Approved

Signature: _____ Date and Time: _____

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Signature: _____ Effective Date: _____

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Getting Started

Downloading and Installing

Download ActiLife 7 from https://actilife.theactigraph.com/support/getactilifebykey/ to a known location. Double-click the icon to start the installer. After running the ActiLife installer, follow the installation instructions in the on-screen prompts.

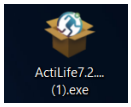

FIGURE 1A – ACTILIFE SETUP ICON

After installing ActiLife, an icon similar to the one shown here will appear on your desktop. Double-click the icon to start ActiLife 7.

FIGURE 1B – PROGRAM DESKTOP SHORTCUT

IMPORTANT: Please be sure to remove any Ametris devices that you have connected to your computer during installation. Failure to do so could result in a faulty installation of your ActiLife software.

NOTE: Older versions of ActiLife (5 and 6) will be removed whenever ActiLife 7 is installed

Licensing

ActiLife software is a licensed program and requires users to obtain a product key before the software can be activated. If you have not purchased an ActiLife license, you may do so by requesting a quote at https://theactigraph.com/academic-research#actilife. If you have misplaced your product key, contact Ametris support at support@Ametris.com in order to proceed. Once ActiLife 7 has been purchased or upgraded from a previous version, users are entitled to free updates for 12 months. After that period, an optional maintenance plan may be purchased. **It is highly recommended that users purchase the maintenance plan in order to guarantee access to the newest updates, features, and bug fixes.**

Activation over the Internet

The first time the program is launched, users will be presented with a screen similar to that shown in Figure 2. If you have already received a product key for your ActiLife Full or ActiLife Lite software, type that product key

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in the box provided. If the license formatting is correct, a green check mark will appear to the right of the license box. Click "Activate". ActiLife will connect to Ametris's license server to confirm that the product key is correct and that it has indeed been purchased or upgraded. After activation, a screen similar to the one shown in Figure 3 will be displayed. This screen summarizes the product type and the number of activations used and available, as well as the name and contact information of the person to whom the license is registered. **Name, Email, and Organization fields must be populated in order to continue.** This activation process is required for each computer on which ActiLife is running.

FIGURE 2 – ACTILIFE ACTIVATION SCREEN

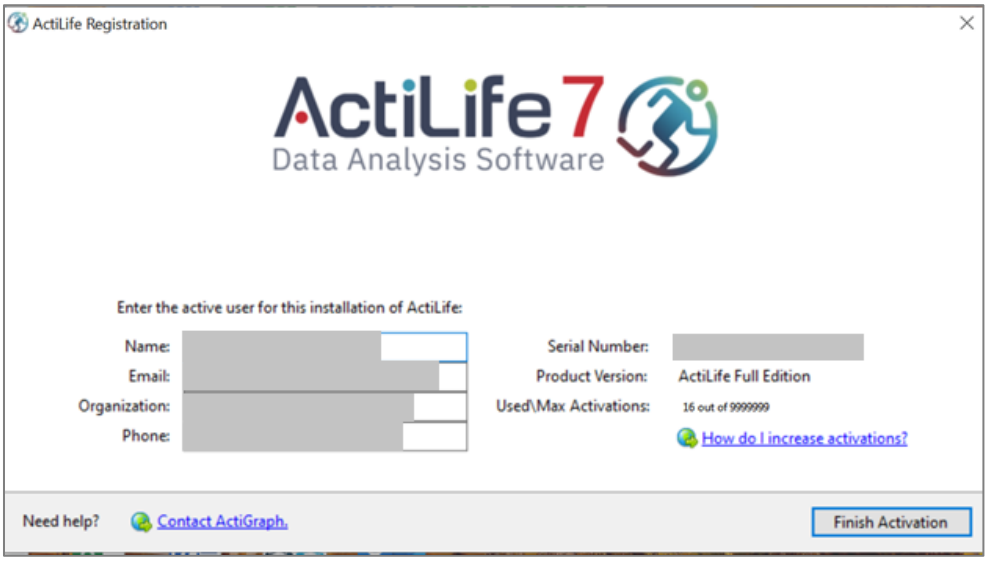

FIGURE 3 – ACTILIFE REGISTRATION CONFIRMATION

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Activation without an Internet Connection

For users without an internet connection, ActiLife can be activated by contacting our technical support staff either via email (support@Ametris.com) or by phone (1-877-497-6996). Similar to the Internet activation, enter the ActiLife product key in the first box that appears after launching the program. After clicking "Continue," a screen similar to Figure 4 will appear. Provide the 24-character product key to Ametris customer service representative. After validating the product key, the representative will provide a confirmation code. Type or copy/paste the confirmation code into the box provided. Click 'Next' to activate ActiLife.

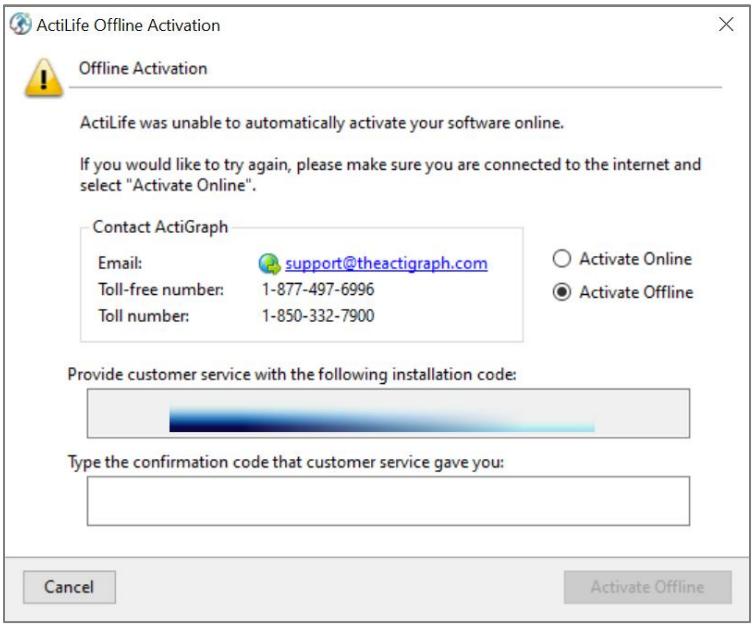

FIGURE 4 – NON-INTERNET ACTIVATION

ActiLife New Feature Overview

Each release (update) of ActiLife provides users with a new feature overview. This screen (or similar) will appear immediately after loading ActiLife 7 for the first time. Note that this screen will change with each release to quickly illustrate the new features.

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FIGURE 5 – ACTILIFE WELCOME SCREEN

To view this welcome screen again at any time, select the 'Help' tab in the menu bar and then select 'ActiLife Tour' as shown in Figure 6.

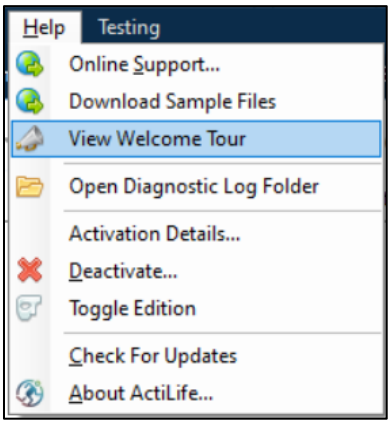

FIGURE 6 – RUN TOUR FROM HELP MENU

ActiLife Default Units Selection

On first load, ActiLife gives users the option to choose which default units of measurement, time display format, and download directory they wish to use (see Figure 7). These settings can be changed at any time from the Options menu.

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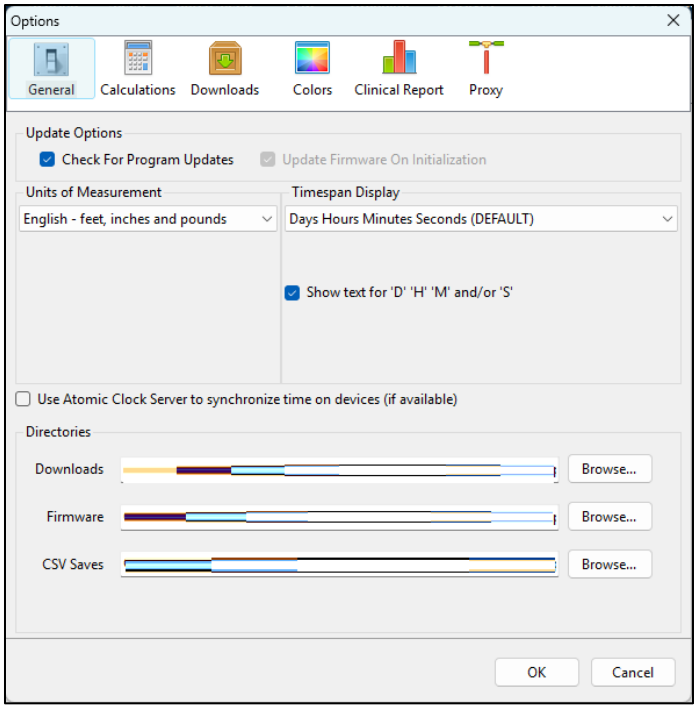

FIGURE 7 - DEFAULT UNITS SETTINGS ON FIRST LOAD

ActiLife Data Formats

ActiLife stores and uses data from native *.agd files which are produced during the download or export process for all devices. ActiLife can import data from any legacy file formats by selecting "File->Import/Export/Convert" and selecting the appropriate action from the menu (see the ActiLife Main Menu discussion section in this manual). Multiple files can be imported simultaneously.

ActiLife Main Menu

File Menu

The file menu in ActiLife contains options related to file manipulation, AGD file analysis, and template loading and editing.

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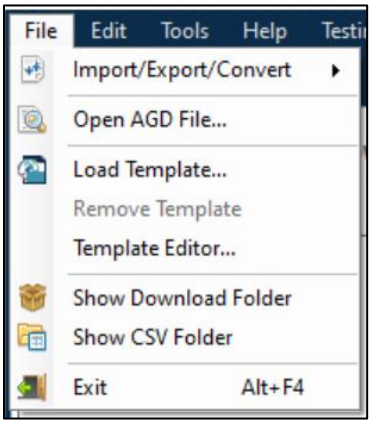

FIGURE 8 – ACTILIFE FILE MENU

Import/Export

As discussed previously, users can import and export file formats to various formats to meet nearly any need. For details about the various file formats, see details in Appendix A – File Types in ActiLife. The table below explains the Import/Export options that are shown in Figure 9.

Epoch to Epoch	• Imported files in this category contain epoch level data (e.g., 1s, 5s, 10s, 30s, 60s epochs). • Exported files also contain epoch level data in the new file format. • CSV->AGD conversion will convert both regular CSV files and Data Table CSV files. • Use these options to simply switch file types (file extensions).
Raw to Epoch	• Imported files in this category contain raw, 30Hz data or contain binary compressed data (*.gt3x format). Note, 12Hz import files are not allowed. See Uncompressing *.gt3x Files for details. • Imported files in this category contain raw AGSD and AGDCbinary file formats with sample rates 32Hz, 64Hz, 128 Hz and 256 Hz. • *.DAT files are file types used in ActiLife version 7. • Exported files in this category contain epoch level data (e.g., 1s, 5s, 10s, 30s, 60s epochs). • Exported files are first filtered then accumulated • Supported export file formats include .CSV, .AGD, .DAT
Raw to Raw	• Used to export binary*.gt3x files directly to *.csv format • Used to export binary*.agsd and *.agdc files directly to *.csv format • Used to export agsd and agdc files to resample 30 Hz raw data in CSV format. • Both import and export file formats contain raw data at whatever frequency was used to produce the *.gt3x file or the *.agsd file
Reintegrate	• This feature is used to reintegrate epoch level post-filtered/post-accumulated *.agd files into larger epoch "buckets." • E.g., reintegrating a 10s epoch file into a 60s epoch file. • Files cannot be reintegrated into smaller epoch lengths (e.g., 15s -> 10s)
Misc	• **Heart Rate R-R.** Exports HR data from .agd files containing HR information. • **Proximity Tagging.** Exports proximity tagging file in .csv format from selected .agd file(s). • **IMU.** Exports GT9X Link IMU data in .csv format from selected .gt3x file(s).

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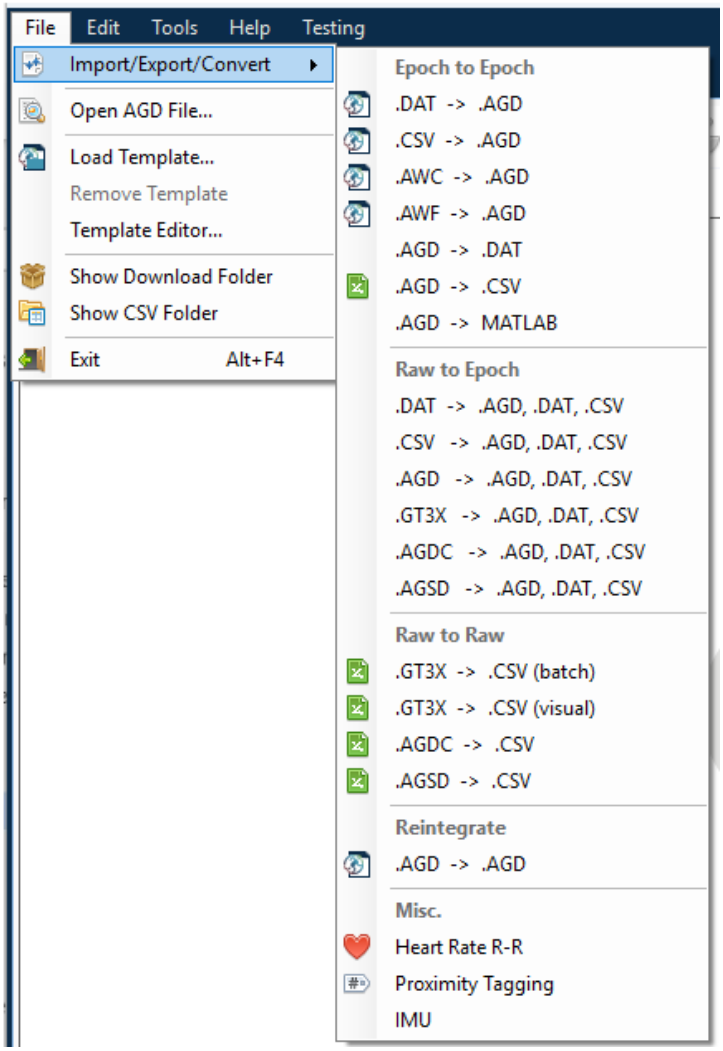

FIGURE 9 – ACTILIFE IMPORT/EXPORT MENU OPTION

Converting to a Data Table vs. standard .CSV

A data table *.csv file contains separate columns with corresponding headers for each data type collected by the device and also includes the Vector Magnitude sum of each axis if data is collected for all three axes. A standard *.csv file produced during conversion simply exports the data into *.csv format. Column headers are not included unless that option is by checking "Add Column Headers to CSV" in the options menu.

AGD to CSV conversion

This allows users to convert the epoch AGD file to CSV format for easier analysis. The user can select the required fields in the OUTPUT CSV file from the source AGD.

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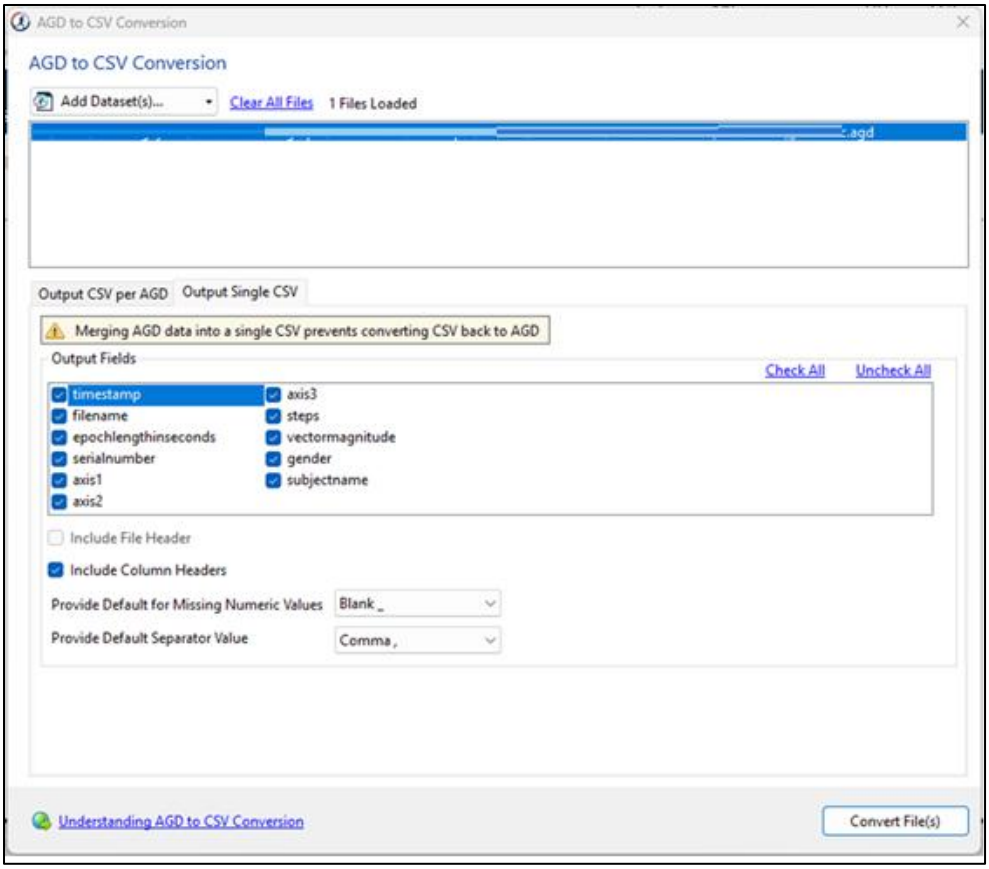

FIGURE 10A – AGD TO CSV CONVERSION

MATLAB Export Option

Users can export native *.AGD files to *.MAT format for easy importing into MathWorks Matlab® mathematical software platform.

Re-integrating

The "Re-Integrate AGD File" option allows users to integrate AGD files to larger epoch periods (e.g., 1 second epoch data collection reintegrated to 60 second epoch periods for Sleep Analysis or Data Scoring). After selecting the file to be reintegrated, selected the desired epoch length as shown and click "OK." The new file will be saved in the same directory as the existing file with an appended file name indicating the new epoch length.

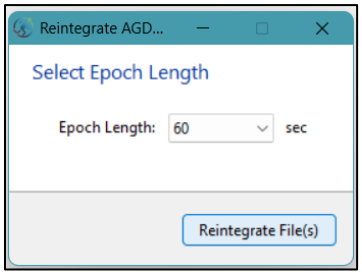

FIGURE 10B – RE-INTEGRATION OPTION

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Open AGD File

The AGD File Viewer can be accessed from the File menu, by clicking “finished downloading” from the Devices grid after a download, or by double-clicking on an *.agd file from within Windows Explorer.

Using the AGD viewer, users can instantly view the data they’ve just downloaded. With ActiLife 7 and later, the AGD viewer provides a graphical summary view of both activity or daily activity counts which allow users to make quick observations about the subject’s compliance level (see Figure 11).

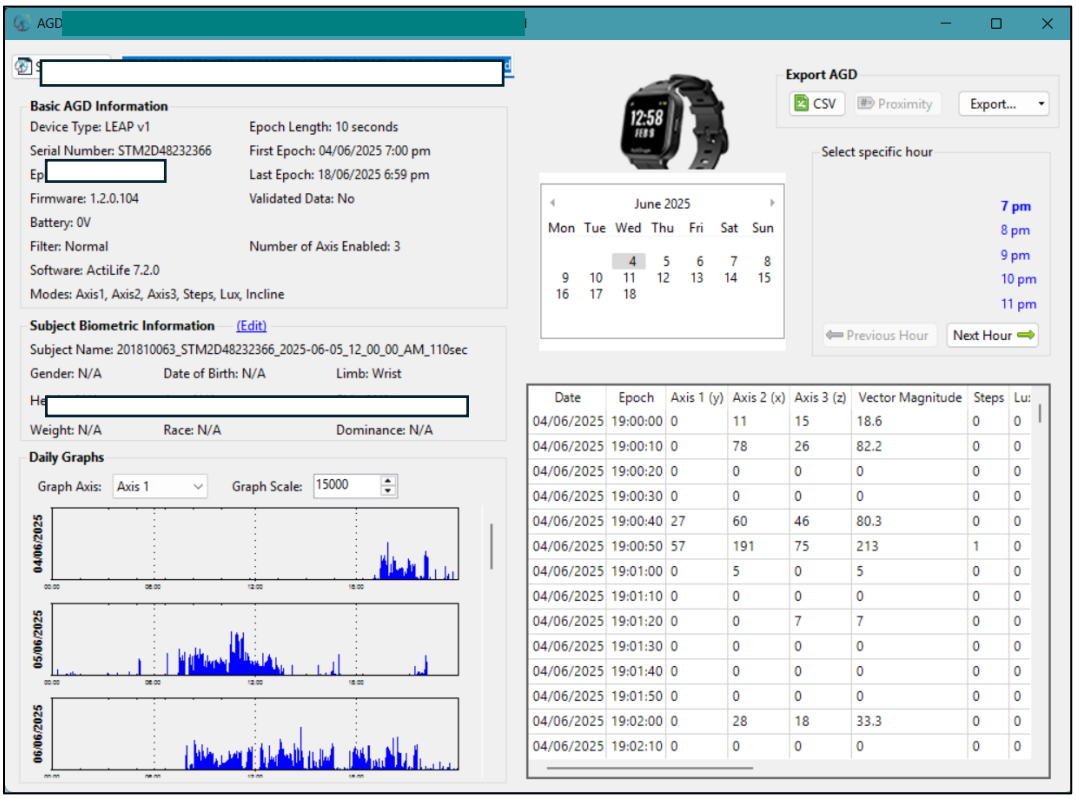

FIGURE 11 - AGD FILE VIEWER (SHOWING CUT POINTS OR DAILY COUNTS)

Click “Edit” near the “Subject Biometric Information” section to edit the stored biometric variables associated with the *.agd file. Click “Save” to instantly update the file with these changes.

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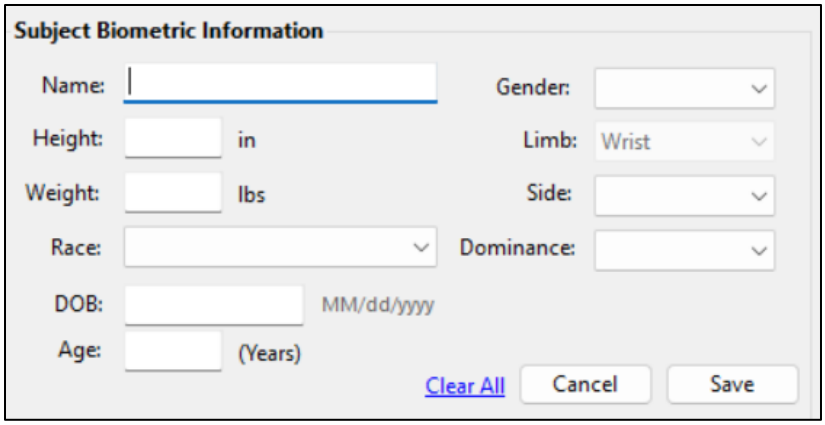

FIGURE 12 - EDIT SUBJECT BIOMETRICS FROM AGD VIEWER

The AGD viewer will display hour-long previews of the data in a grid format. The hourly view can be changed by clicking the desired date/hour or by clicking "Next Hour->" to proceed sequentially through the hourly view. Data can be copied from the grid by selecting the data and pressing "CTRL+C." Data can then be pasted by pressing "CTRL+V" in MS Excel® or any text editor.

Data can be exported to any format directly from the AGD file viewer by clicking on "Export Data..." above the data graph. This is equivalent to selecting "Export" from the File menu.

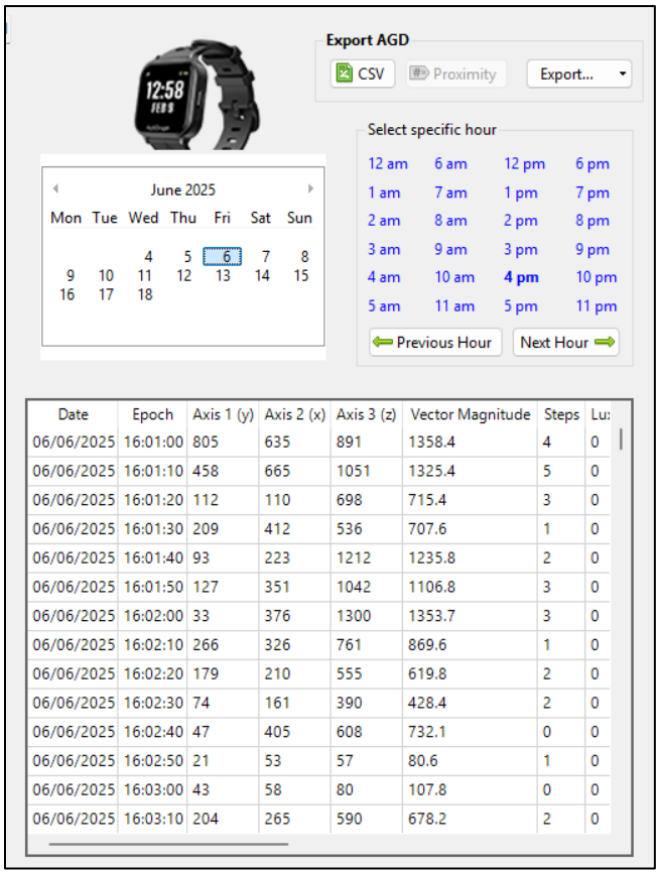

FIGURE 13 – AGD FILE VIEWER

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Load Template

The 'Load Template' option allows users to browse and locate an ActiLife template file (*.agt) which forces ActiLife to pre-defined initialization and/or download parameters to ensure consistency among all sites. For details on using the template editor, see Building and Using a Template. Once a template is loaded, details about the template including the template name and 'last modified' date will appear in the upper right-hand corner of the ActiLife tool as shown in Figure 14.

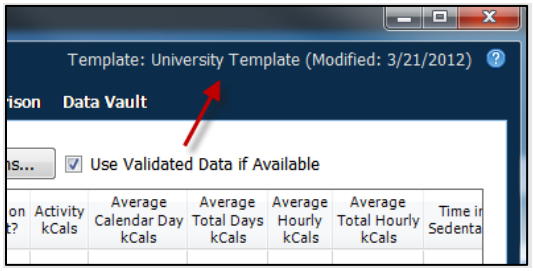

FIGURE 14 – TEMPLATE-IN-USE INFORMATION

Remove Template

The 'Remove Template' option simply disables any active template that ActiLife is using. The current template information as shown in Figure 14 will disappear after using this option. For more information about the template feature, see Building and Using a Template.

Template Editor

The template editor loads the template editor form which can be used to create new or modify existing templates for use with all versions of ActiLife. For more information, see Building and Using a Template.

Show Download Folder

The Show Download Folder simply opens ActiLife's default download folder. This option is useful for locating files downloaded from devices in the Devices tab.

Show CSV Folder

The Show CSV Folder opens the default CSV conversion/download folder

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Note. The template editor is not available in ActiLife LITE.

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Edit Menu

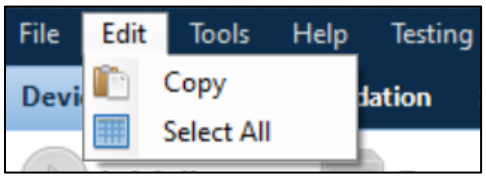

FIGURE 15 – EDIT MENU

The "Copy" and "Select All" options in the Edit menu allow users to select and copy elements in the selected grid so that they may be pasted into a text or spreadsheet editor. These apply to any tab within ActiLife.

Tools Menu

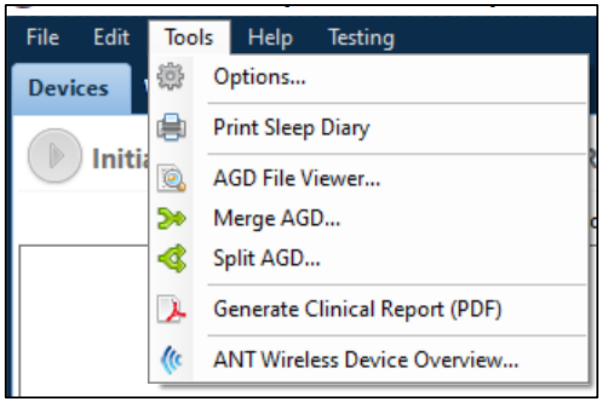

FIGURE 16 - TOOLS MENU

The Tools menu contains options for printing a sleep diary, creating a clinical report splitting and merging multiple AGD files together and an ANT Wireless device overview.

Options

General Options

Update Options

Checking "Check for Program Updates" enables ActiLife's auto-update feature and allows ActiLife to check for program updates via the Internet when the program starts up. If an Internet connection is unavailable, ActiLife automatically skips this step.

Important: It is strongly recommended that this option remains checked. Doing so ensures that the user has the latest version of ActiLife. Older versions of ActiLife may have bugs or issues which could affect data collection and/or device interaction. Ametris makes every effort to ensure that data collection and download are unaffected during program updates

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Firmware Updates

Each time a device is initialized, ActiLife checks the firmware version on the device. If it is not the latest version available from Ametris, it is automatically loaded onto the device prior to re-initialization. Because all data on a device is deleted prior to flashing firmware, firmware updates are only performed just prior to re-initialization during which time the device is fully erased. The "Update Firmware on Initialization" option allows the user to disable this feature. However, in order to guarantee that all devices remain up to date, this feature is permanently checked and enabled and cannot be unchecked. In order to disable this feature, contact Ametris support at support@Ametris.com.

It should be noted that ActiLife automatically downloads the latest version of firmware (for all Ametris devices) each time the program loads. In this way, ActiLife makes every effort to keep users updated with the latest firmware for their devices. The latest firmware files can be found in the *C:\Users\<user name>\Documents\ActiGraph\ActiLife\FirmwareFiles* directory.

ActiLife ships with the latest versions of firmware available in an effort to ensure that our offline customers remain updated.

Units of Measurement

Use these options to select the desired units of measurement throughout the ActiLife software (in all grids and in all exports). If "English" is selected, users have the option to display subject height information in inches or Ft/Inches.

Timespan Display

The Timespan Display settings set the default view for the 'Current Data Recorded' display in the Devices grid. Selecting the default (Days Hours Minutes Seconds) breaks the display of time parameters in ActiLife's grids into four parts (days, hours, minutes, and seconds). Checking "Show text for 'D' 'H' 'M' and/or 'S'" annotates the time with letters corresponding to hours, minutes or seconds (e.g., 820m versus 820 – useful for copy/pasting into a text or spreadsheet editor that may not use the h/m/s notation).

Directories

Use this option to set the default directories for data downloads, firmware storage, and CSV file creation

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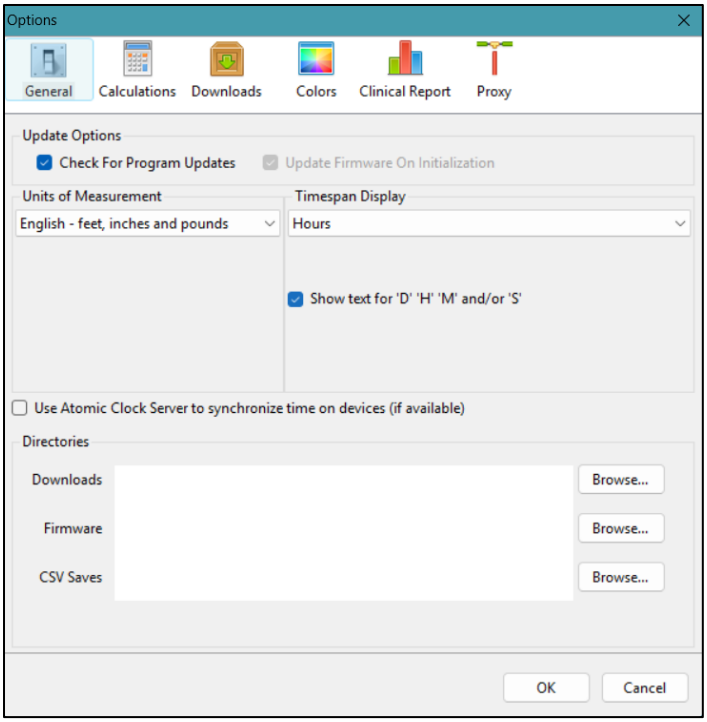

FIGURE 17A - GENERAL OPTIONS

Downloading

Download Naming Convention

These options set the default naming convention for downloaded files. During the download process, users have the option to change this option.

Create File Options

Create DAT and CSV with AGD Download

Use these options to create a *.dat or *.csv file at the time of download. **Important**: These options only work whenever an AGD file is created. Hence, when downloading a wGT3X-BT device, *.dat and *.csv files will not be created when these options are checked ***unless*** the "Create AGD File" is checked during the download process (see Downloading wGT3X-BT Devices) for details on creating an AGD file on download).

Add Column Headers to CSV

Checking this option will add column header labels to the columns in CSV (like "Axis 1," "Axis 2,", "Axis 3," "Steps," etc.) files when those files are created via export.

Compress GT3X Files

This option will apply maximum file compression to *.gt3x files when they are downloaded from wGT3X-BT devices. This compression can greatly reduce the file size of the *.gt3x zip files, but can double the post-processing time (i.e., the time it takes to create an *.agd file from a *.gt3x file). For details on post-processing, see Uncompressing *.gt3x Files.

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Create sub-folders when exporting "Raw to Epoch"

Check this option to create sub-folders for *.agd, *.dat, and/or *.csv files created when exporting from “Raw to Epoch” files from the Import/Export menu.

Create AGD during Download

When checked, this option tells ActiLife to automatically create an *.agd file immediately after downloading *.gt3x files. For more information on these file types, see Appendix A – File Types in ActiLife.

Scan of Downloads

When downloading data, this option allows users to be notified of large gaps (null data or 0s) in the data which may indicate either a problem with the device itself or non-compliance with the device end-user. Setting this option to a certain percentage will prompt the user if there are more than that percentage of the data contains 0s. For example, setting up to 10% will cause notifications to appear when 10% or more of the data on the device contains null data (0s). Set this option to 100% to disable notifications.

Calculations

Wear Time Validation

Wear Time Validation options are used to set the default values for the dataset filters in the Wear Time Validation tool. The user also has the option to switch between the Floating Window or Daily Wear Time Validation algorithms.

Note: The daily algorithm has been deprecated and should be avoided.

Sleep Scoring

The Sleep Scoring option allows the user to set the default Sleep Scoring Formula for the Sleep Scoring Tool. See Sleep Scoring Algorithms for more information.

Checking the “Create Clinical Report on Download” will cause ActiLife to automatically create a clinical PDF report immediately after download. See Clinical Report for details.

Colors

The Colors option allows the user to set the default colors for all graphing items in ActiLife. The “Multiple Colors” checkbox in the Progress Bar section will cause ActiLife to use multi-colored progress bars in the Devices tab when interacting with multiple devices.

Clinical Report

Customize the configuration of the Clinical Report and select the algorithm used for each analysis tool. Users can adjust settings to match their study requirements, ensuring that the Clinical Report reflects the desired parameters.

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Print Sleep Diary

Many times, it is useful to provide patients with a sleep log for making subjective logs of time-in-bed (TIB) and time-out-of-bed (TOB) times so that sleep analyses can be properly performed. The "Print Sleep Diary" option in the Tools menu allows users to export a printable sleep diary for patients to use while they are wearing a device. Click the option and select a location to store the log diary (PDF format). A screenshot of the log diary is shown in Figure 17B.

AGD File Viewer

Using the AGD viewer, users can instantly view the data they've just downloaded. With ActiLife 7 and later, the AGD viewer provides a graphical summary view of both activity or daily activity counts which allow users to make quick observations about the subject's compliance level (see Figure 11).

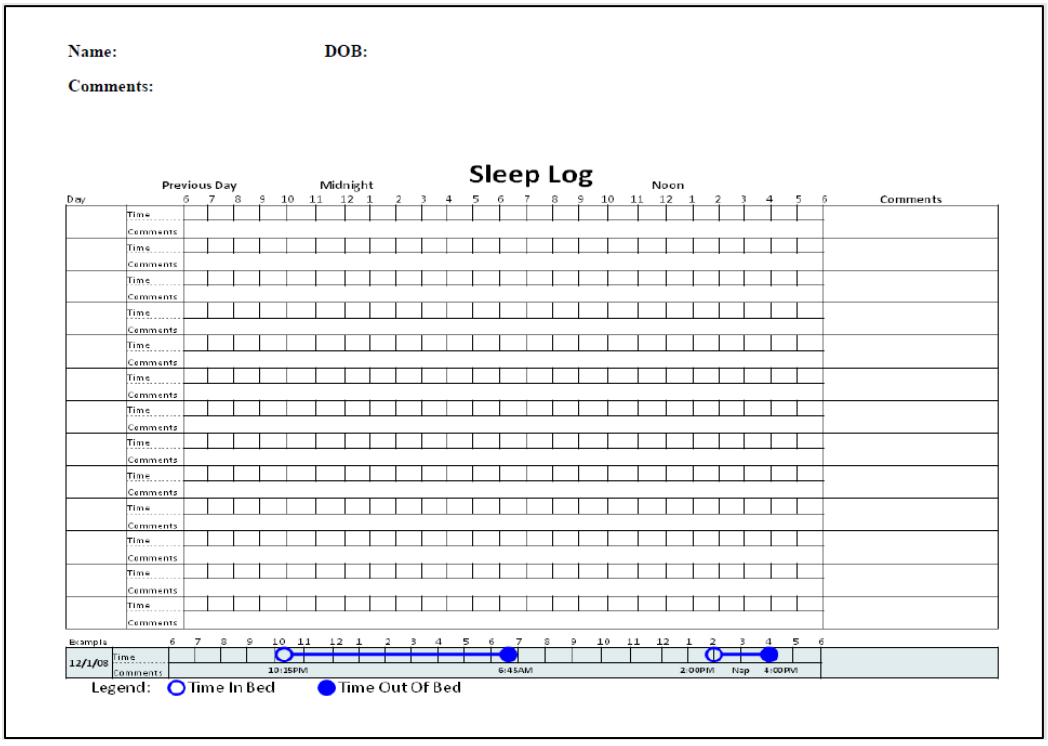

FIGURE 17B - SLEEP LOG (DIARY)

Generate Clinical Report

ActiLife can create a clinical report which contains the following information:

- Subject and Device Information (Name, Weight, Device Serial Number, Start/End Time)
- Wear Time Information
- Energy Expenditure
- Cut Points

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- Sleep Graphs
- Sleep Period Breakdown and Summary

The clinical report can be used to quickly generate a report on an individual in a clinical environment without running through all of the tools in ActiLife.

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Generating a Clinical Report

When downloading data from a device, users can generate a Clinical Report by simply checking the box "Create Clinical Report on Download…" as shown in Figure 18.

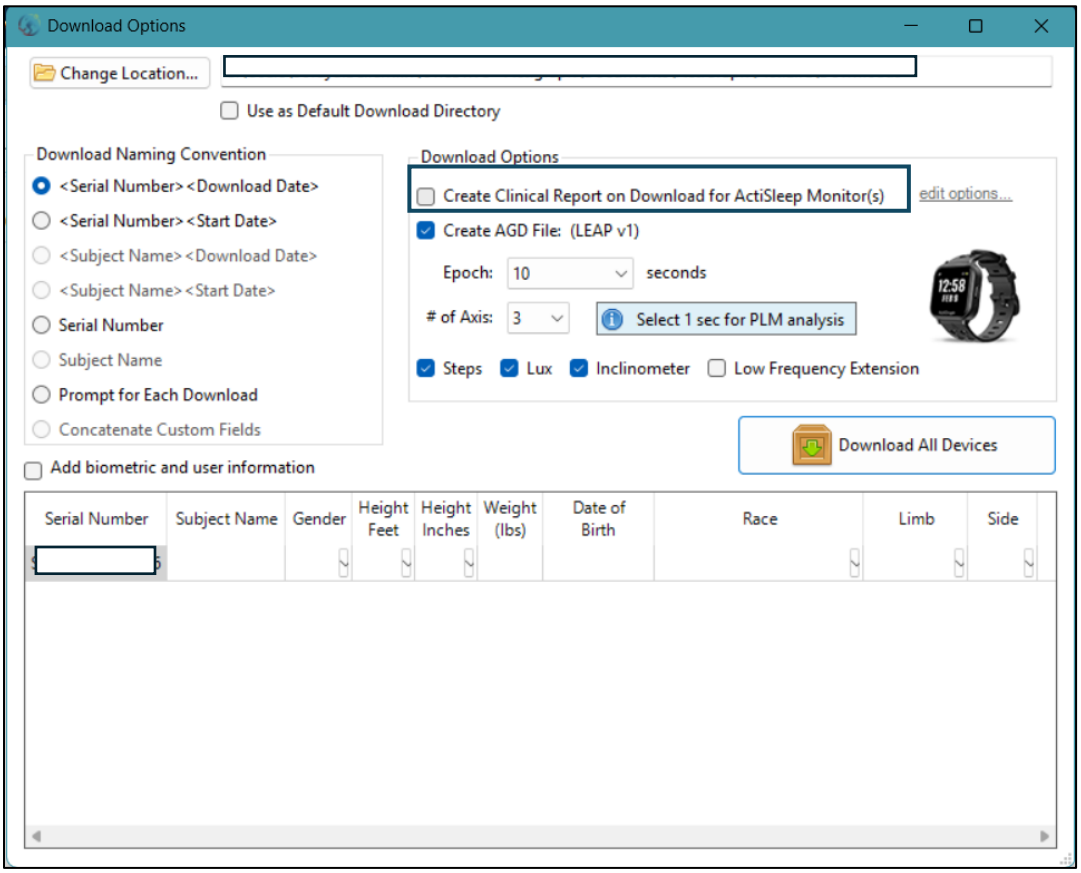

FIGURE 18 - CLINICAL REPORT ON DOWNLOAD

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The report can also be generated after a data download through the tools menu. Select the *.agd file that was generated from the device and click “Open”.

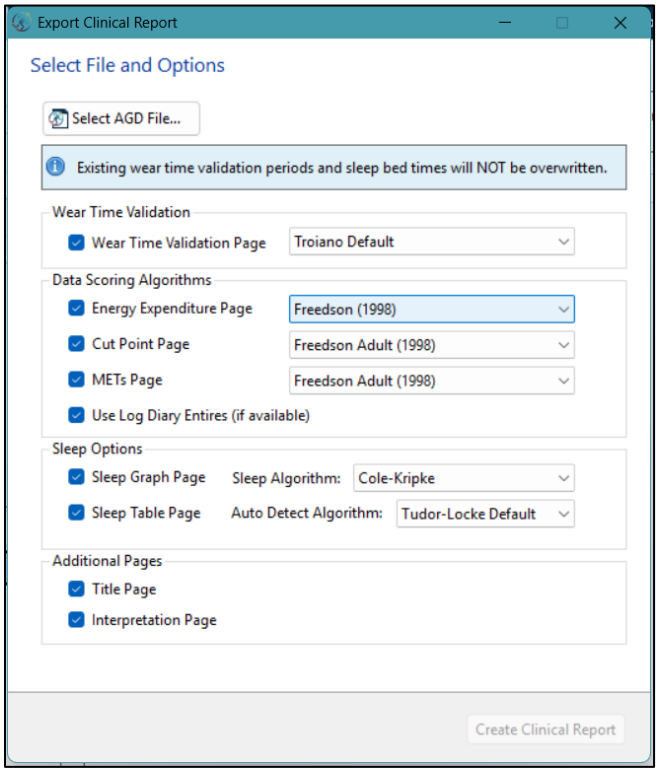

FIGURE 19 - CLINICAL REPORT GENERATOR

Clinical Report Default Values

The Clinical Report generator uses the default values stored in the Wear Time Validation tool to calculate wear and non-wear time. Similarly, the tool also uses the default algorithms selected in Data Scoring (on last program close) to calculate Energy Expenditure. To change the algorithms, open ActiLife, navigate to the Data Scoring tab, switch to a new energy expenditure algorithm and close the program. If sleep times have already been entered via the Sleep Analysis tool, the Clinical Report tool will use those times to calculate the sleep score and graph information in the report. If not, the Auto Score feature will be utilized.

Merge AGD

This option allows the user to Merge any 2 compatible AGD files having the same epoch length.

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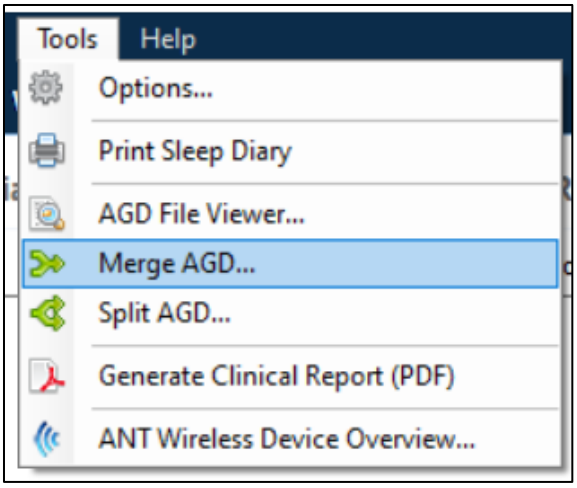

FIGURE 20A - MERGE AGD TOOL

Select any **2 AGD Datasets having the same epoch length**. After the second file is chosen, you will get an option as displayed below.

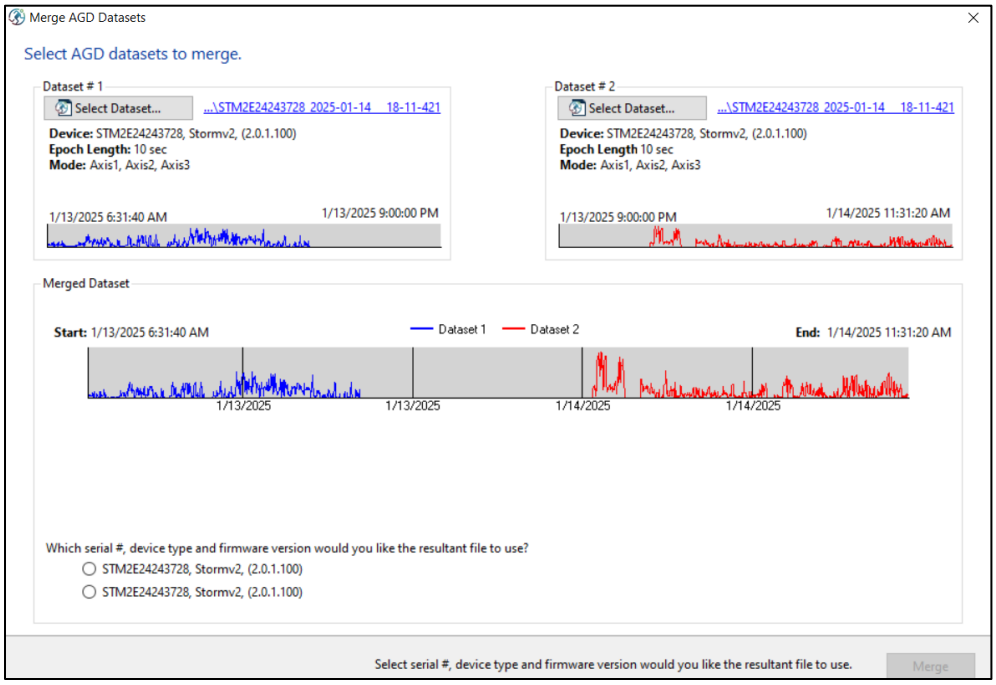

FIGURE 20B - MERGE AGD TOOL SELECT DATASET

Choose the device serial number and click the MERGE button. This should save the combined file in the same PATH as the source file.

If any 2 incompatible epoch length files are chosen, the user will see error as below.

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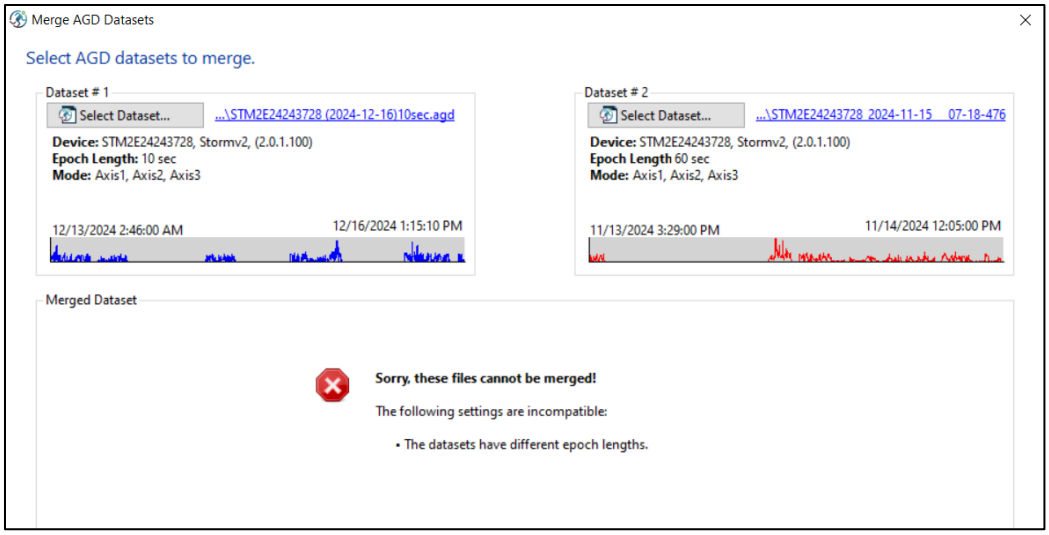

FIGURE 20C - MERGE AGD TOOL INCOMPATIBLE EPOCH LENGTH

Split AGD

This option allows the user to split any large AGD file into multiple AGD files.

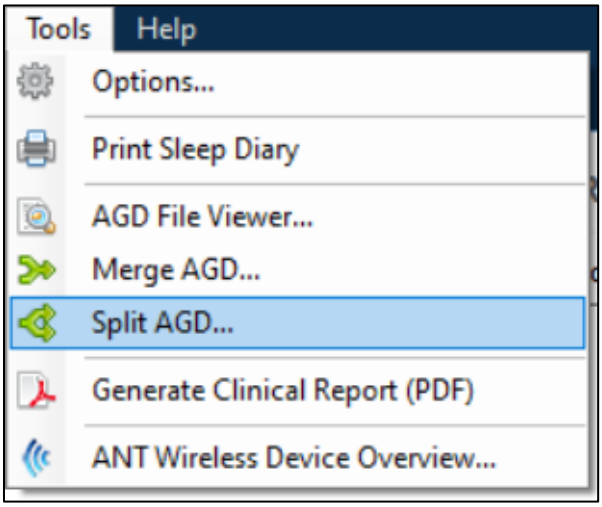

FIGURE 21A - SPLIT AGD TOOL

Choose any AGD file and you will see option as provided below

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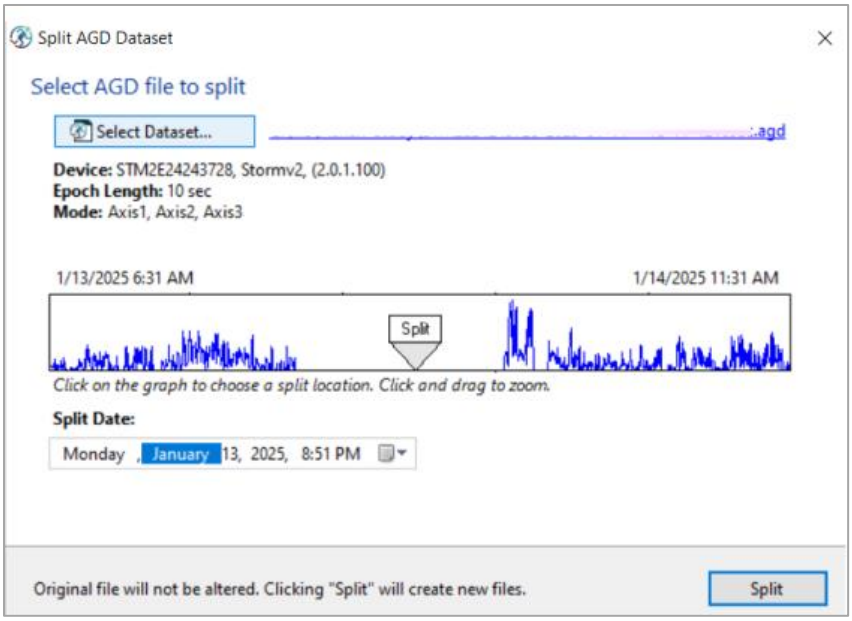

FIGURE 21B - SPLIT AGD TOOL SELECT DATASET

The user can split files either by

- Clicking on any timeline in the window where the SPLIT icon is present, and it will update the SPLIT DATE accordingly
- OR vice versa.

Once successfully split, the split files will be saved in the same folder as the source file. The files with be suffixed with _A and _B after the source file name.

Help Menu

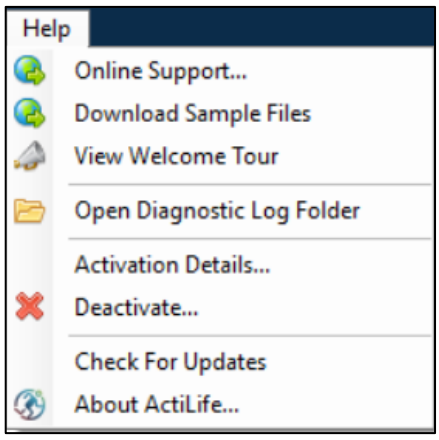

FIGURE 21C - HELP MENU

Online Support

Click this option to access our online support system

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View Welcome Tour

This option launches the ActiLife introduction dialog that outlines what's new in the current release.

Activation Details

Click this option to view the ActiLife product key, the edition type, and the maintenance expiration date.

Deactivate

ActiLife licenses are node locked to the machine on which the software is installed. Users are allotted a specific number of activations on various machines. In order to prevent losing an activation, ActiLife should be deactivated before it is uninstalled and removed from its host computer. To deactivate ActiLife and reclaim the activation, select the Deactivate option and click "Deactivate ActiLife."

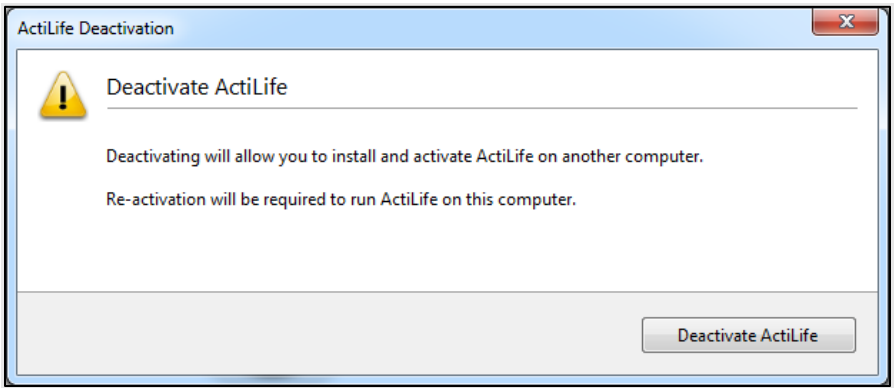

FIGURE 20D - DEACTIVATE DIALOG

Check for Updates

Clicking this option will force ActiLife to check for any maintenance updates. This action is done automatically each time ActiLife is loaded but may be manually done via this method.

About ActiLife

The About ActiLife option displays information about the ActiLife program including the software version number (also available in the main dialog frame), copyright information, and a link to Ametris's corporate website.

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Device Initialization and Download

Once ActiLife is properly installed and licensed, users will be presented with the “Devices” screen similar to the one shown in Figure 21E. ActiLife is capable of initializing or downloading multiple devices simultaneously. Devices can be connected either before or after ActiLife is launched.

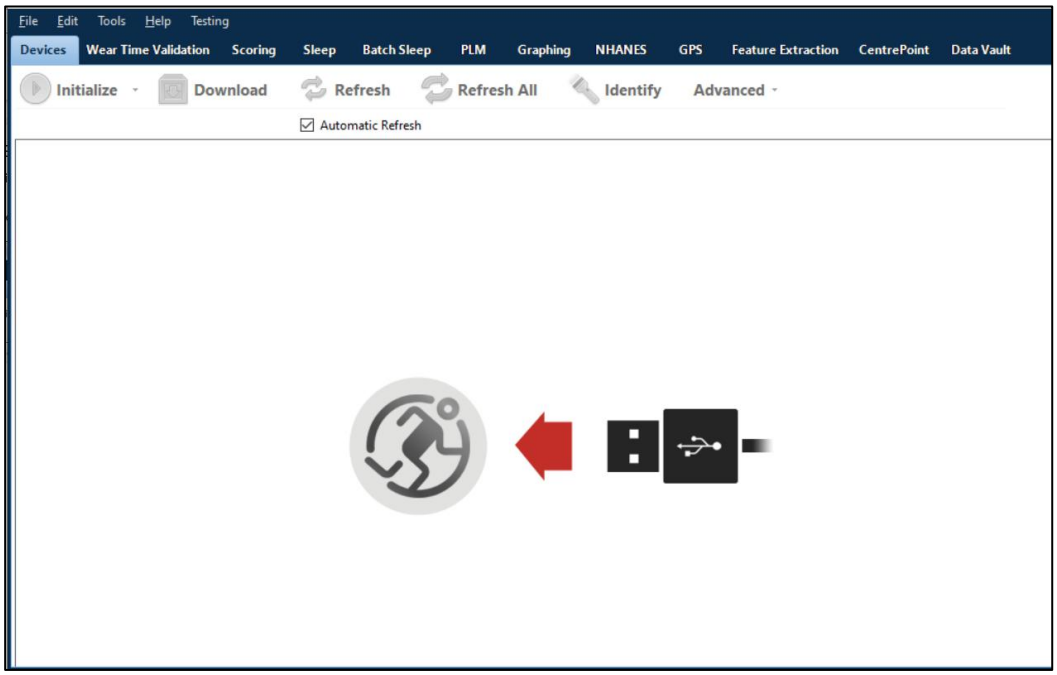

FIGURE 21E – OPENING SCREEN

As shown in Figure 22, device status information will appear in the “Devices” tab as devices are connected to the computer. Device status information is provided in the Devices grid.

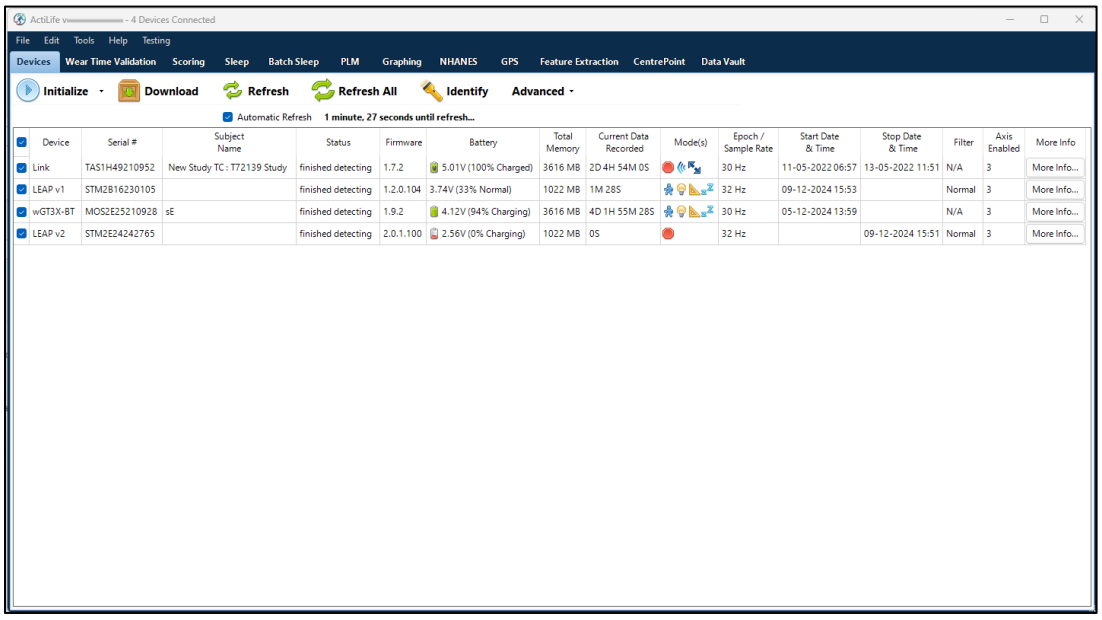

FIGURE 22 - ACTILIFE DEVICES TOOL

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Devices

Device

The “Device” column describes the type of Ametris device(s) connected to the PC. Mixing devices is allowed.

Serial

The “Serial #” column displays the serial number of the device connected.

Status

The “Status” column displays the current status of the attached device. The status could be “Ready,” “Idle,” “Initializing,” “Finished Initializing,” “Updating,” “Downloading,” “Finished Downloading,” or “Finished Creating Clinical Report.”

Progress

The “Progress” column contains the progress bar indicating the progress toward completion of the status indicated in the “Status” column.

Firmware

The “Firmware” column displays the current firmware version on the device. Firmware is automatically updated during initialization. See Update Options for more details.

Battery Voltage

This column displays the device’s battery voltage and charge percentage. For more information, see device owner’s manual.

Total Memory

The Total Memory column displays the total memory available on the device. MB = Megabyte (or 1048576 bytes).

Current Data Recorded

This column displays the current number of days, hours, minutes, and seconds of recorded data on the device. To adjust how this appears, see Timespan Display.

Epoch/Sample Rate

For non-GT3X+ devices, this column represents the accumulation epoch length. For GT3X+ devices and non-GT3X+ devices in raw data collection mode, this column represents the sample/store rate.

Subject Name

This column displays the subject name currently stored on the device.

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Start Date & Time

This column displays the start date and time programmed on the device.

Stop Date & Time

This column displays the stop date and time programmed on the device. This option can be set during initialization and is used to align the file lengths for multiple devices during large longitudinal studies.

Filter

The "Filter" column displays the on-board accelerometer filter setting for initialized devices (Normal or Low-Frequency-Extension). See Setting Device Parameters for details. This column is not applicable for GT3X+ devices as no on-board filtering is performed.

Axis Enabled

The "Axis Enabled" column indicates which axes are being sampled and stored. 1 –vertical axis only (Axis 1); 2 – vertical and horizontal (Axes 1 and 2); 3 – vertical, horizontal, and lateral (Axes 1, 2, and 3).

Modes

The "Modes" column displays icons representing the data channels that the device is set to log (if initialized). The icons and their meanings are interpreted in Table 1.

Mode/Channel Icon	Interpretation
	Flash LED Mode Enabled (LED flashes periodically to indicate device is active). See Recharging and LED Decoding for more details.
	Step counting enabled. It indicates that the device is recording step counts per epoch. See Steps for more details.
	Inclinometer enabled. Indicates that the device is recording orientation data which will later be interpreted as sitting, standing, lying, or off. See Inclinometer for more details.
	Lux (ambient light) sensor enabled. Indicates that the device is collecting light data. See Lux (Ambient Light) for more details.
	Reset

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	Halt
	Wireless enabled
	Bluetooth enabled – central mode
	Bluetooth enabled – peripheral mode
	Bluetooth enabled – central plus mode
	Display enabled
	Display 24-hour format
	LED when collecting
	LED when in delay
	Sleep mode
	Daily summary aggregation
	Epoch summary (60 second)
	Raw Disabled
	Proximity Tagging
	IMU enabled
	Delay
	Steps
	Heart rate

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	Lux enabled
	Inclinometer

TABLE 1 – MODE/CHANNEL ICON DEFINITIONS

More Info

The button in the "More Info" column is for debug purposes by Ametris support and should not be required to operate the device(s).

The data in the Devices grid can be copied and pasted into any text editor by clicking on a cell, pressing and holding the Shift key and clicking on another cell to select a group of cells then pressing "CTRL" to copy the data to the PC clipboard. This can be useful for studies in which device data must be logged.

IMPORTANT: Device drivers must load the first time a device is connected to a USB port. Devices may take a few seconds to load during device driver enumeration. Devices may cause Windows to display the AutoRun prompt (asking the user to choose a default action upon opening. The Ametris software development team is working on eliminating this action.

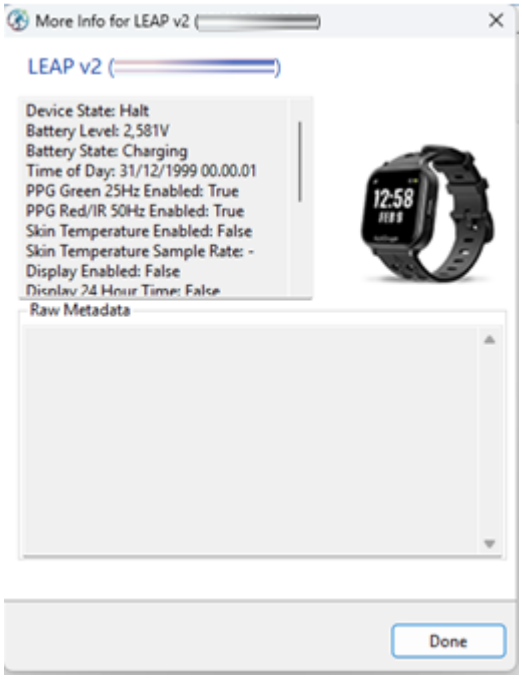

Figure 23 - More information

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The user views the details related to the sensor's enabled status in the watch. Ex. in image above, the following information shows the sensors enabled in the LEAP device.

Initializing Devices

Select a check box corresponding to the devices to be initialized (or select all devices") and click "Initialize." A dialog similar to Figure 23A will appear.

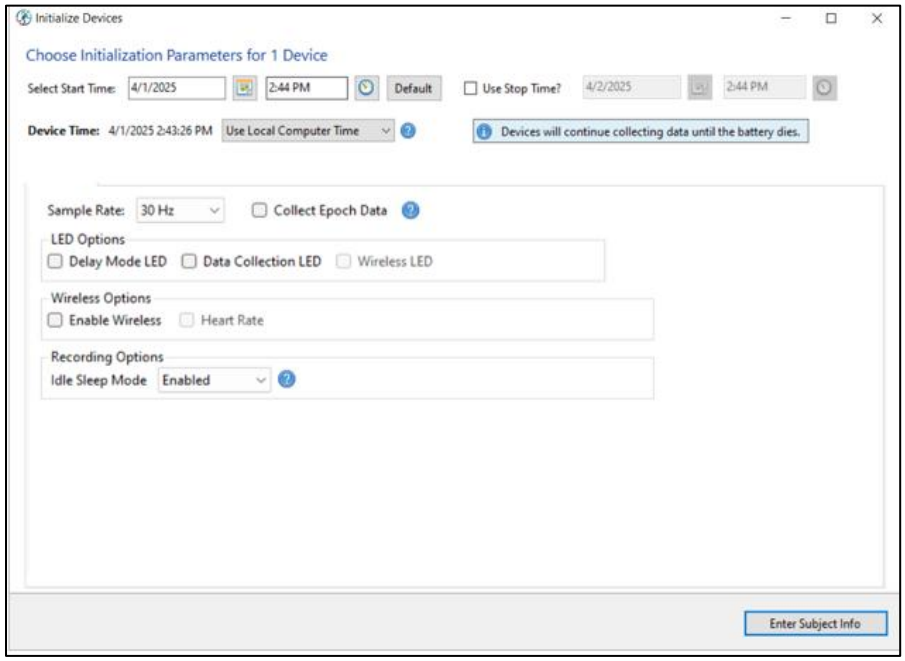

FIGURE 23A - INITIALIZATION DIALOG FOR WGT3X-BT

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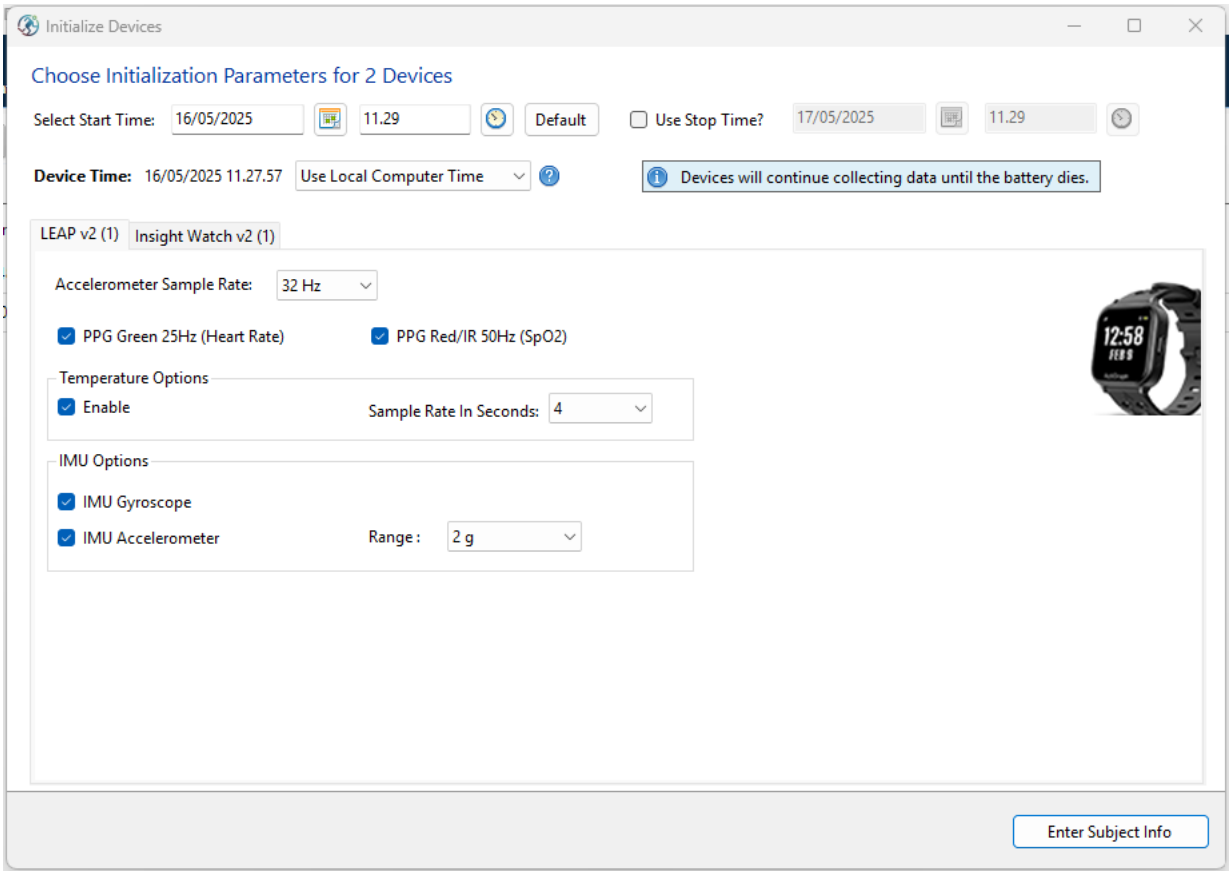

FIGURE 24B - INITIALIZATION DIALOG FOR LEAP V1.0 AND V2.0

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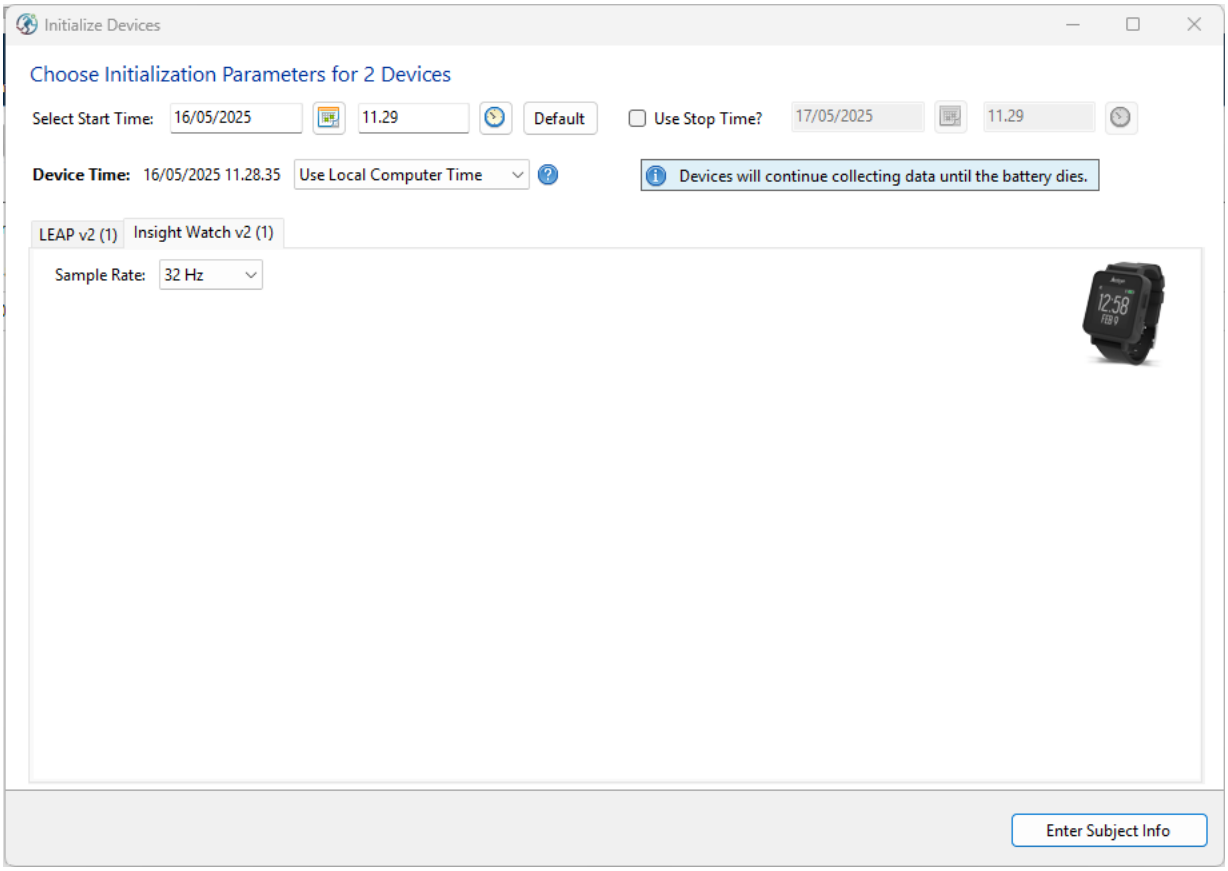

FIGURE 25 - INITIALIZATION DIALOG FOR CPIW

Setting Device Parameters

The 'Initialize Device(s)' screen contains a separate tab for each type of Ametris device connected to the PC and appears after clicking the "Initialize" button at the top of the "Devices" screen. Tabs across the top represent the types of devices to be initialized. If multiple devices of each type are selected, the tab group applies to all devices of that type.

Select the tab for the type of device you wish to configure and set the specific data collection parameters. Filter information can also be set at the time of initialization. All Ametris devices of the same type that are initialized simultaneously will be initialized with the same data collection parameters.

Start Date and Time and Stop Date and Time apply to all devices and cannot be unique for each device group. Stop time is optional.

After data collection parameters have been set up for each model, select the 'Enter Subject Info…' button.

Subject Info

The Subject Name screen allows users to enter a unique subject name for the attached devices. This data will be stored on the device and will be available at download and can help with file naming when data is

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downloaded from the device. To add or change a name, highlight the subject name cell. Note that wGT3X-BT devices (devices with serial numbers beginning with 'MOS') will store more information.

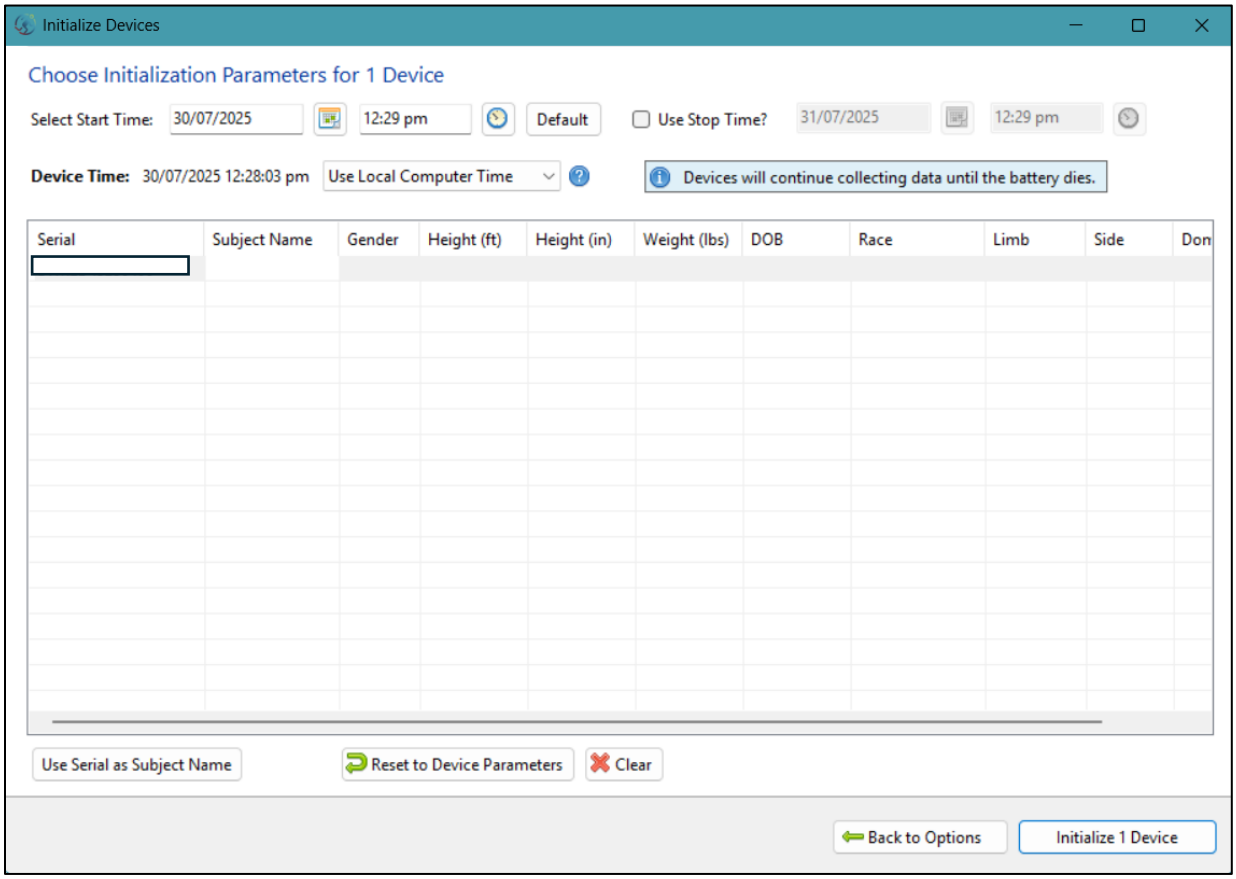

FIGURE 26 – SUBJECT NAME ENTRY FORM

If desired, the "Use Serial Number" button will populate the Subject Name column with the serial number of the device. Similarly, the "Use Device Info" button will automatically populate the Subject Name column with the Subject Name currently stored on the device. The "Clear" button will erase the fields for easier editing.

Important: If any devices have a voltage less than 4.1 volts, we recommend leaving them connected, allowing them to charge fully if time allows. Updated voltage can be viewed by selecting the 'Refresh All' tab (or F5) from the devices screen.

---

wGT3X-BT Biometric Info Storage

wGT3X-BT Devices (MOS) can ***optionally*** store extra biometric information during initialization which can be used for post-processing after downloading data from the device (see Figure 26 for details). wGT3X-BT devices can store the following information in addition to the "Subject Name" which is standard on all devices:

- ***Gender*** – Male or Female
- ***Height*** – Subject height in inches or ft. /inches depending upon the settings.
- ***Weight*** – Subject weight in lbs. or kg, depending upon the settings.

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- ***Date of Birth*** – Subject's date of birth (mm/dd/yyyy)
- ***Race*** – Subject race: Asian/Pacific Islander, Black/African American, White/Caucasian, Latino/Hispanic, Other
- ***Limb*** – The limb on which the device is worn: Wrist, Waist, Ankle, Upper Arm
- ***Side*** – The side of the body that the patient is wearing the device. Left or Right
- ***Dominance*** – Dominant or Non-Dominant. This allows the researcher to store whether or not the wear location is on the subject's dominant or non-dominant side.

This data is stored in the info.txt file as part of the *.gt3x zip file when data is downloaded from the wGT3X-BT device.

When all names have been entered, select the 'Initialize All' button and the progress is displayed in the 'Status' column (refer to Figure 22). When the initialization is complete, the devices are ready to be removed.

LEAP/CPIW Subject Biometric Info Storage

For LEAP/CPIW devices, subject biometric information is not saved during the initialization process, as is the case with other device models. Instead, LEAP/CPIW devices capture and save subject biometrics during the data download process.

For more details on how biometric information is handled during the download process, refer to the "Saving Biometric Data during Download" option under "Downloading Data" heading.

Downloading Devices

File Format

Downloading data from the devices is a simple process. It is important to understand how the data on the device is formatted and what is contained in the file. The device files can be in GT3X, AGSD or AGDC file format. However, when downloading data the accelerometer data can be stored in the *.agd file. The *.agd file schema can be found in Appendix A of this users guide.

Downloading Data

To download data from LEAP, CPIW, wGT3X-BT or GT3X devices, connect your device(s) to the computer – ActiLife will detect those devices and they will appear in the Devices grid. Select (check the box) the devices that you wish to download and click "Download" at the top of the screen. The Download Options screen will appear allowing you to select the type of file naming convention you would like. The names can always be changed later, or you can select 'Prompt for Each Download' to enter unique names for each downloaded device. These options help to prevent name duplication during batch downloading.

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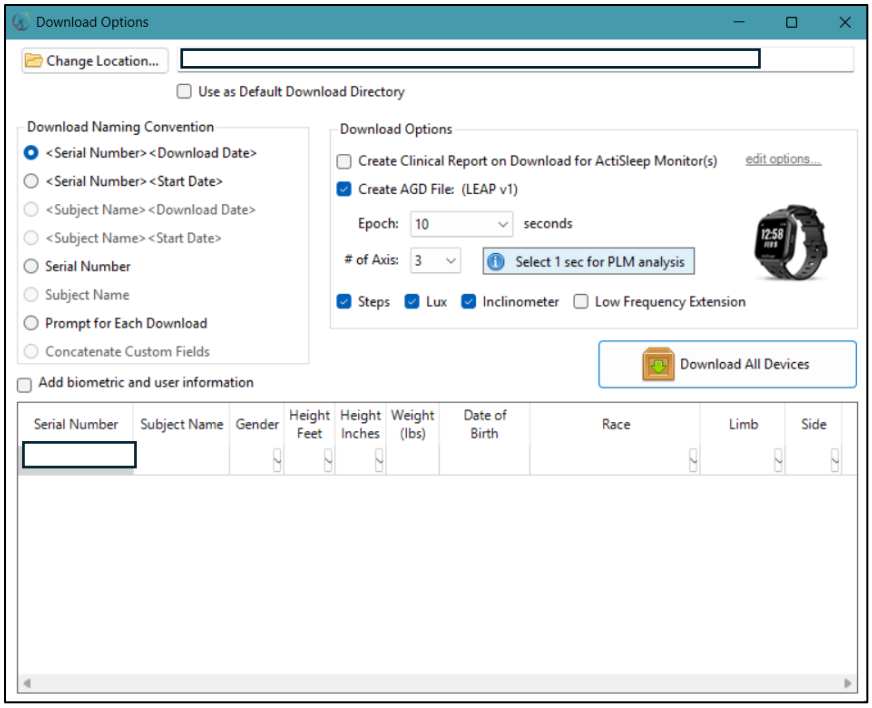

FIGURE 27 – DOWNLOAD OPTIONS WINDOW

To select a different download location, select "Change Location…" and browse to the desired download directory. To make this directory the default download directory, check the box below the download location in the Download Options prompt.

Saving Biometric Data during Download

During the download process, ActiLife gives the user the option to store metadata information associated with each device and corresponding device wearer. After clicking 'Download' from the devices grid, check the box entitled "Add biometric and user information" to expand the details grid below the download form. This form is shown in Figure 28. All of the fields shown here are optional.

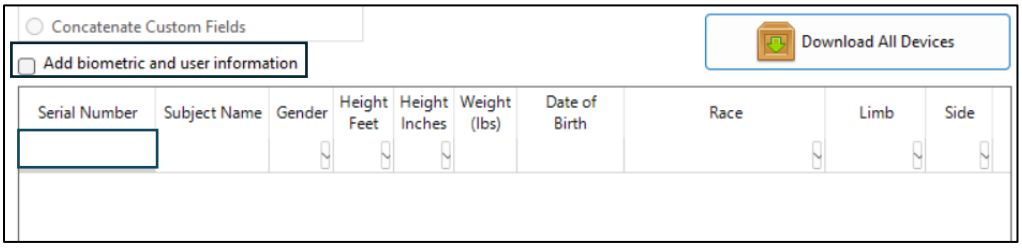

FIGURE 28 - DOWNLOAD OPTIONS WITH BIOMETRIC INFORMATION

Subject Name

Unless it is changed, the" Subject Name" will default to the subject name used to initialize the device. Even if the biometric and user information grid is not expanded for population, the "Subject Name" will be stored with

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the *.gt3x or *.agd file upon download. From this grid, the “Subject Name” can be changed prior to downloading.

Gender

Click the “Gender” column to reveal a dropdown menu. Select Male or Female.

Height

Use the “Height” column to enter the subject’s height in inches, centimeters, or feet/inches. Select a different format by changing the Units of Measurement in the Options menu.

Weight

Use the “Weight” column to enter the subject’s weight in lbs. or kg. Select a different format by changing the Units of Measurement in the Options menu.

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Date of Birth

Use the “Date of Birth” column to edit the subject’s date of birth. A calendar picker is provided, but it may be more convenient to simply type in the subject’s birthday. The date format is mm/dd/yyyy.

Race

Use the “Race” column to select the subject’s race. Select “White/Caucasian,” “Black/African American,” “Latino/Hispanic,” “Pacific Islander,” or “Other”.

Limb

Use the “Limb” column to select where the device was worn. Options include “Wrist,” “Waist,” “Ankle,” and “Thigh.”

Side

Use the “Side” column to specify the device wear location (left or right side of the body).

Dominance

The “Dominance” option allows users to specify whether the wear location side was the subject’s dominant or non-dominant side.

Custom Fields

When custom fields are collected as part of a template (see Building and Using a Template for more details), those custom fields will appear in the metadata grid as shown in Figure 29. Additionally, the “Add Biometric and User Information” check box option will be permanently selected, and entry of the custom fields will be required.

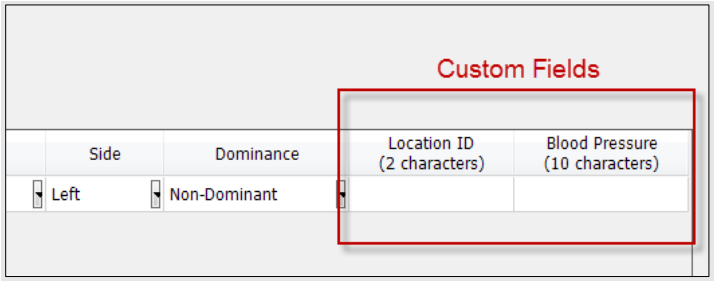

FIGURE 29 – CUSTOM FIELDS IN THE BIOMETRIC AND USER INFORMATION GRID

Low Frequency Extension (LFE)

The Low Frequency Extension (LFE) filter is designed to detect lower amplitude movements over our standard filter. The sensitivity of solid-state MEMS accelerometers like the one utilized in Ametris’s products are very high and can detect even the most minute of movements (+/- 6G's for our GT3X+/wGT3X+/ActiSleep+/wActiSleep+ devices and +/-3G's for our legacy products).

Because we are only interested in movements that are attributable to human activity and not minor vibrations found in our everyday environment, we have an internal acceleration threshold that must be crossed before we consider it human movement related and as a result, record it. This threshold limits the ability of the device

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to measure movement of populations such as the elderly or any population that is very slow and/or exhibits very low acceleration outputs.

To combat this, and in order to provide researchers with the ability to gather useful information about this subject group we have provided the LFE which reduces this threshold. The net effect is that the reduced amplitude movements are now recognized and recorded, yielding information of value.

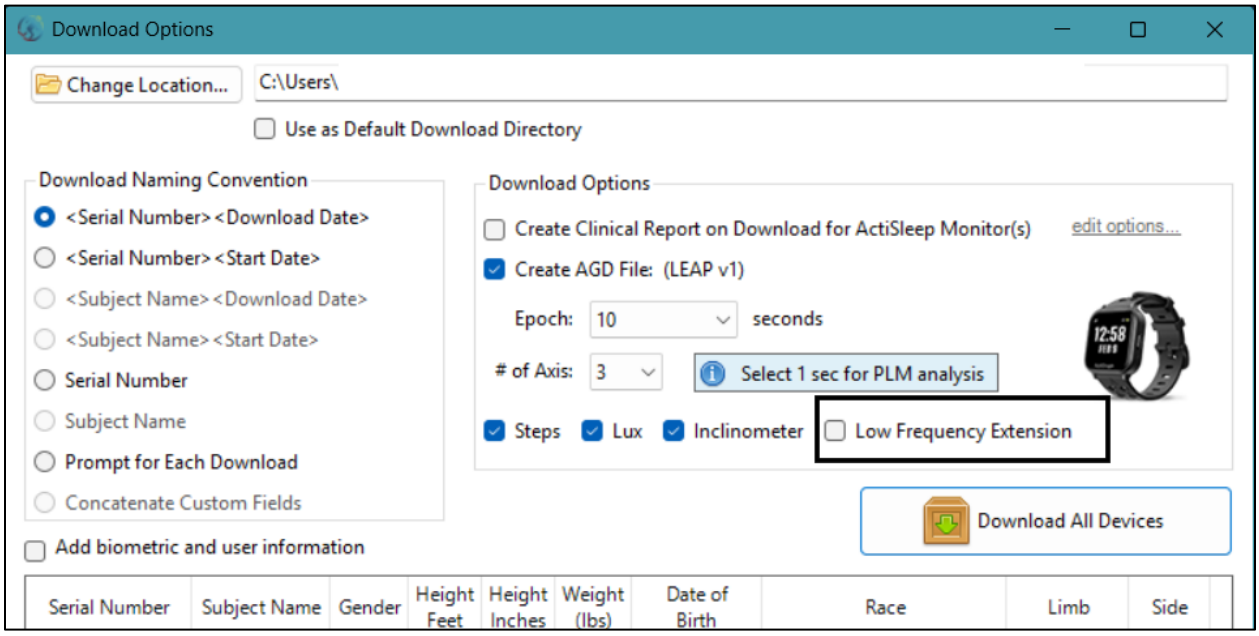

FIGURE 30 – LOW FREQUENCY EXTENSION

Clicking "Download All Devices" from the form will download the data from the selected units and store the data in SQLite format stored with a *.agd file extension (See Appendix A – File Types in ActiLife).

ActiLife no longer stores data in DAT or CSV format. To convert data into one of those formats, select 'File' tab then the Import/Export option as shown in Figure 9.

*ActiLife can automatically create *.csv files on download by selecting the CSV option in the download menu. Note that this only works for GT3X devices if an *.agd file is created during the download process.*

Downloading wGT3X-BT Devices

Downloading data from wGT3X-BT devices is very similar to downloading from other devices. It is important to understand the difference in the file handling for this device. In order to increase the efficiency of the download process, ***data from GT3X devices is downloaded in raw, binary format with file extension *.gt3x*** (see

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Appendix A – File Types in ActiLife which explains the *.gt3x format). This binary format mirrors the proprietary compressed raw data format stored on the device itself and is unreadable by standard text editors. In order to read the data or process the data with ActiLife, the *.gt3x files need to be uncompressed (i.e., exported to *.agd format) using ActiLife. This can occur either during download or later when processing files.

To download data from a wGT3X-BT, select the device(s) from the grid in the Devices tab and click "Download". A prompt similar to Figure 28 will appear. Clicking "Download All Devices" will immediately download all of the data from the device into the user's default download directory.

Scanning of wGT3X-BT Data during Download

Data downloaded from wGT3X-BT devices can be scanned for problems at the time of download. At this time, ActiLife can scan for null data (0s) which may indicate issues with the device accelerometer or non-compliance by the end-user. To enable this scanning, open the Tools -> Options menu and choose the Downloading submenu. In the "Scan of wGT3X-BT Download" section, select the warning threshold. Doing so will warn the user during the download process if the number of 0s within the file exceeds the threshold. To disable this feature, set the threshold to 100%.

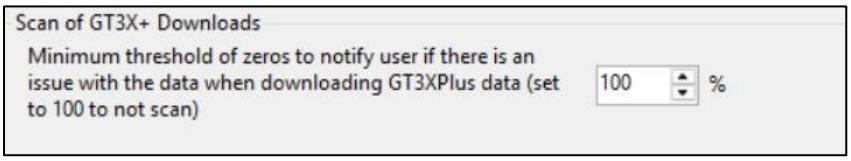

FIGURE 31 – SCANNING OF DATA

Downloading LEAP Devices

Downloading data from a LEAP device is very similar to downloading from other devices. It is important to understand the difference in the file handling for this device. In order to increase the efficiency of the download process, ***data from LEAP devices is downloaded in raw, binary format with file extension *.agsd*** (see Appendix A – File Types in ActiLife which explains the *.agsd format). This binary format mirrors the proprietary compressed raw data format stored on the device itself and is unreadable by standard text editors. To read the data or process the data with ActiLife, the *.agsd files need to be uncompressed (i.e., exported to *.agd format) using ActiLife. This can occur either during download or later when processing files.

To download data from a LEAP device, select the device(s) from the grid in the Devices tab and click "Download". A prompt like Figure 28 will appear. Clicking "Download All Devices" will immediately download all the data from the LEAP device into the user's default download directory.

*Uncompressing *.agsd & *.agdc Files*

Binary *.agsd and *.agdc files can be uncompressed to *agd (for use in ActiLife), *csv, or *.dat file format. Users have the option of creating *.agd files during the download process by checking "Create AGD File" from within the download prompt (see Figure 32). Because LEAP devices record raw accelerometer data (see Appendix A – File Types in ActiLife for details), the parameters for the uncompressed file must be set at the time of download if the "Create AGD File" option is checked. These parameters include the uncompressed epoch length, the number of axes, step counting, lux (light data), inclinometer (standing, sitting, lying, or off detection), and/or low frequency extension. For an explanation of these parameters, see Available Channels (Modes) for details.

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Important: Creating an AGD file during the download process will increase the download time significantly depending upon the size of the download.

Binary *.agsd files can be uncompressed at a later time if desired (e.g., after emailing or sharing the files). To uncompress these files at a later time, select "File -> Import/Export/Convert -> AGSD -> .AGD,.CSV,.DAT " from the ActiLife main menu. An export window similar to the one shown in Figure 33 will appear. Individual *.agsd files can be added by selecting the "Add LEAP Files(s)" option. All of the *.agsd files in a directory can be added by selecting "Add Directory..." Once files are added, the desired file type(s), epoch length, and parameters can be selected within the export tool. Select "Create File(s)" to export these files to the default download directory.

The agsd export tool can also be accessed by clicking "finished downloading" hyperlink from the devices grid after downloading as shown in Figure 34.

Clicking this link as shown in Figure 35A will launch the AGD viewer, since these downloads produce an *.agd file by default (see Appendix A – File Types in ActiLife for more information).

Download Folder

To view the *.gt3x and .agsd files, select "File->Show Download Folder" from the main menu in ActiLife. Files will appear in this folder.

*Uncompressing *.gt3x Files*

Binary *.gt3x files can be uncompressed to *agd (for use in ActiLife), *csv, or *.dat file format. Users have the option of creating *.agd files during the download process by checking "Create AGD File" from within the download prompt (see Figure 32). Because devices record raw accelerometer data (see Appendix A – File Types in ActiLife for details), the parameters for the uncompressed file must be set at the time of download if the "Create AGD File" option is checked. These parameters include the uncompressed epoch length, the number of axes, step counting, lux (light data), inclinometer (standing, sitting, lying, or off detection), and/or low frequency extension. For an explanation of these parameters, see Available Channels (Modes) for details.

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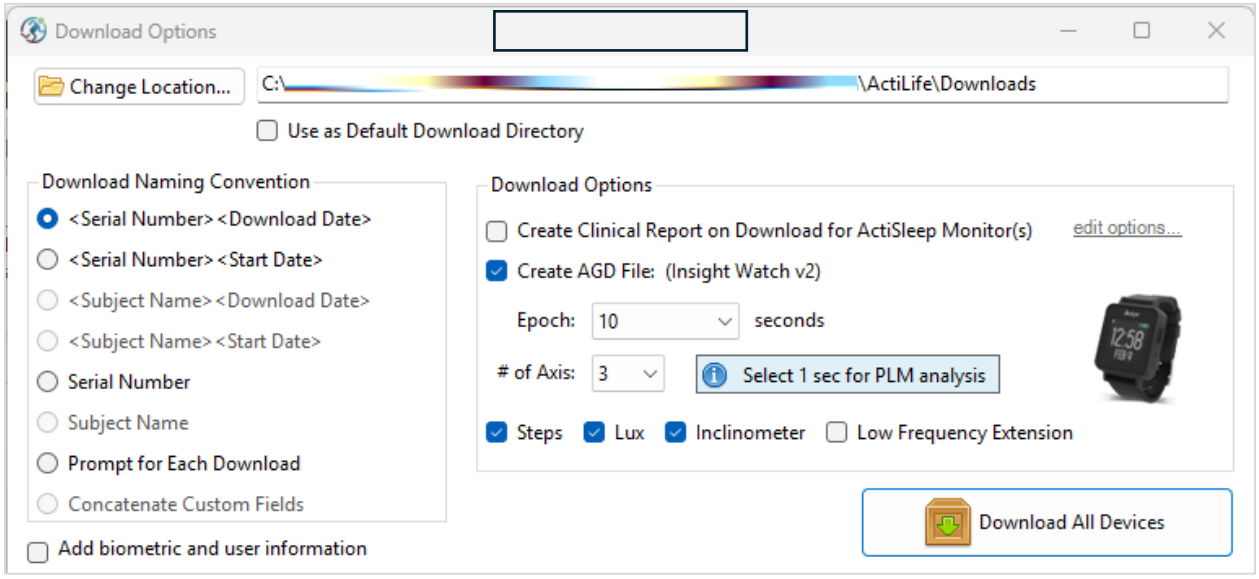

FIGURE 32 - CREATING AN AGD FILE ON DOWNLOAD

Important: Creating an AGD file during the download process will increase the download time significantly depending upon the size of the download.

Binary *.gt3x, *.agsd and *.agdc files can be uncompressed later if desired (e.g., after emailing or sharing the files). To uncompress these files later, select "File -> Import/Export/Convert -> Raw to Epoch -> .AGSD -> .AGD,.CSV,.DAT "from the ActiLife main menu. An export window like the one shown in Figure 33 will appear. Individual *.gt3x files can be added by selecting the "Add Dataset" option. All the *.gt3x, *.agsd and *.agdc files in a directory can be added by selecting "Add Directory..." Once files are added, the desired file type(s), epoch length, and parameters can be selected within the export tool. Select "Export Raw File(s)" to export these files to the default download directory.

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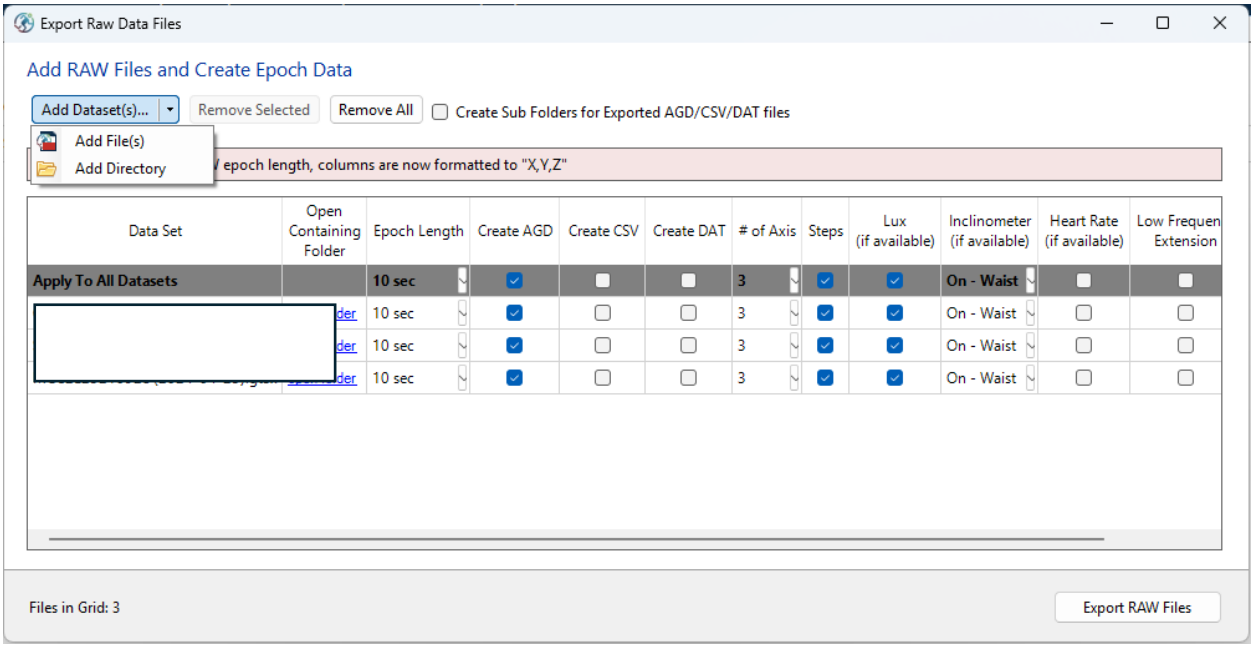

FIGURE 33 –EXPORT TOOL

The export tool can also be accessed by clicking "finished downloading" hyperlink from the devices grid after downloading as shown in Figure 34.

FIGURE 34 – FINISHED DOWNLOADING HYPERLINK IN DEVICES GRID

Clicking this link as shown in Figure 35A will launch the AGD viewer, since these downloads produce an *.agd file by default (see Appendix A – File Types in ActiLife for more information).

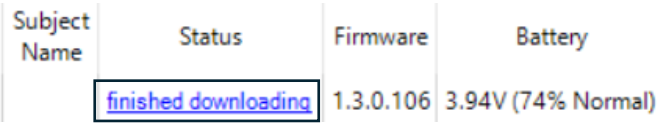

FIGURE 35A – "FINISHED DOWNLOADING…" LINK IN STATUS COLUMN. LINKS TO AGD VIEWER

Building and Using a Template

Templates were created to assist customers who deploy Ametris devices using remote distribution centers or who need to ensure consistency in the initialization and/or download process when multiple people (e.g., lab assistants) are distributing devices to patients. Templates can be created only from within the full version of ActiLife (ActiLife Lite does not support template creation – only template usage).

Once a template is created, the template can be saved as an *.agd file. This file can then be shared via email, jump drive, or any other means to various distribution centers or lab partners. Opening this file will force ActiLife to use the settings defined in the template editor to initialize and download devices, thus ensuring data collection consistency.

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Template Editor

ActiLife Full users will find an option in the File menu entitled "Template Editor." Clicking this option will load a form similar to the one shown in Figure 35B. Use this form to set up the desired default initialization and download parameters defined below in Template Parameters.

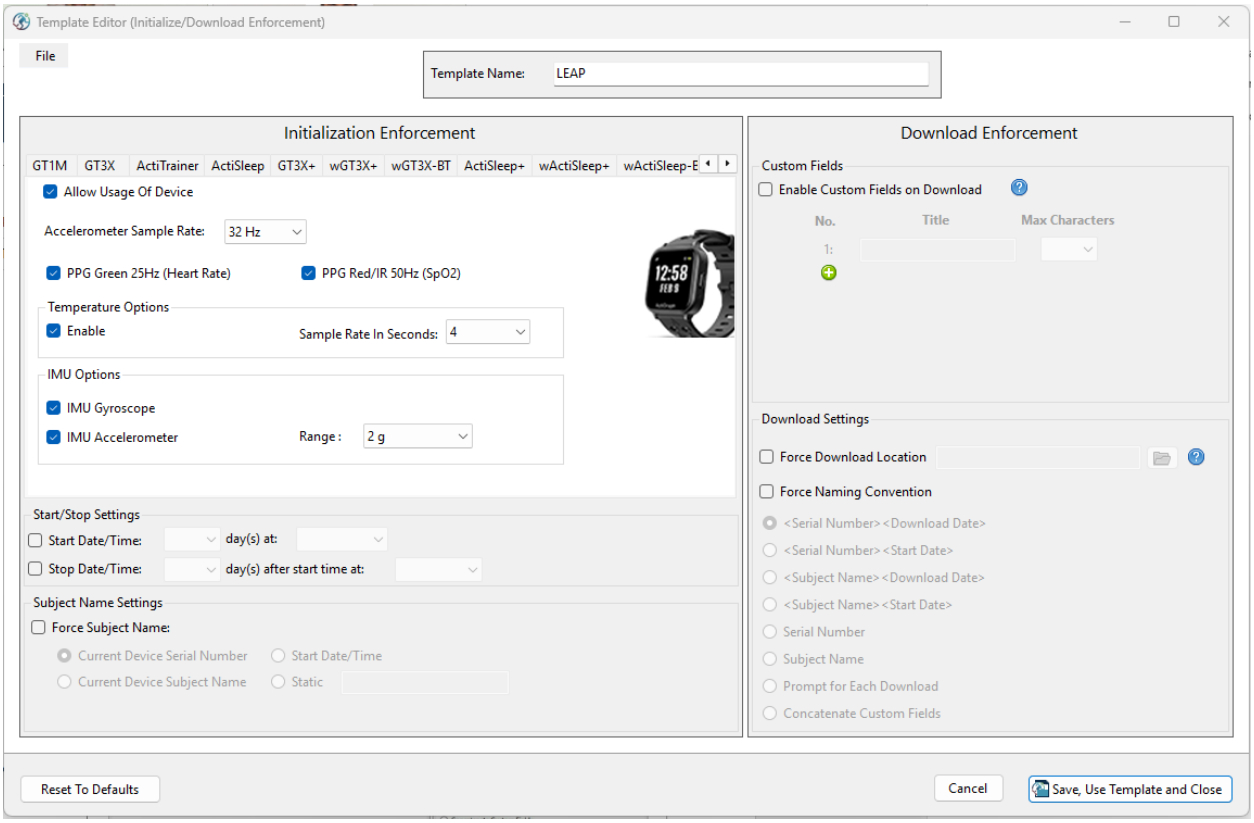

FIGURE 35B – INITIALIZATION/DOWNLOAD TEMPLATE EDITOR

Template Parameters

Initialization Template Options

Use the initialization options on the left side of the template editor to force template users to use specific settings during the initialization process.

Template Name (required)

The name of the template that will appear at the top of ActiLife once the template is loaded. An illustration is shown in Figure 14. This is a required field.

Device Selection

Selecting "Enable Template for *****" within one or more of the device tabs will force ActiLife to use device-level settings during the initialization process for that particular device.

Start/Stop Settings

Check either Start Date/Time or Stop Date/Time to force template users to use a Start or Stop time during the initialization process. Use the Day selection box to choose a forced start time offset (e.g., +0 day, +1 day, +2 days, etc.) and use the time selection box to set the start time. Use "Any" in the Day selection box to give the

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user the flexibility to choose which **day** the device should start collecting data but the rigidity to force a start **time** for data collection. If the template start time has already passed, ActiLife will automatically default to the next day with the same start time. For example, suppose the template is set to force users to start collecting data at "+0 day(s) at: 3:00pm." If a user initializes a device at 4:00pm, the start time will default to the next day at 3:00pm.

The Stop Date/Time option allows the template builder to set how many days the device should collect data before stopping. Note that the Day setting refers to the number of days AFTER the start time. Again, use "Any" in this field to give the user the flexibility of choosing the stop **date** but the rigidity of using a specific stop **time**. Be sure to keep the battery life and memory limitation considerations in mind. For more details about battery life, refer to the specific product manual for the Ametris device you are using.

Leaving either or both of the Start/Stop Settings unchecked will allow the user to select whether or not the start/stop times are used during the initialization process.

Subject Name Settings

Checking this option will force template users to use a certain convention when setting Subject Names for devices during the initialization process. These options are self-explanatory with the exception of the "Static" option. This option will force all Subject Names to exactly match the phrase typed here.

Download Template Options

Use the download options to force template users to use specific settings during the download process.

Custom Fields

Enable the "Custom Fields" option to force users to enter more information during the download process. Use the "Max Characters" dropdown box to select the maximum number of characters allowed for this field. This will prevent users from typing too many characters in this field.

The fields entered here will appear in the download grid as shown
Figure 36 after clicking "Download" from the devices grid. Note that these fields must be populated before users can proceed with the download. In most cases (without a template in use), the "Add biometric and user information" check box can be de-selected (all of the biometric data is optional – see Saving Biometric Data during Download for details). However, when custom fields are enabled in the template, this is required and users are forced to enter values for the custom field parameters. Note that the custom fields are always on the right-hand side of the grid. Users may need to scroll to the right to enter the fields.
Custom fields are stored with the *.gt3x files and/or *.agd files at download time. When exporting *.gt3x files to *.agd format for analysis in ActiLife, the custom fields will be included as part of the export and will be contained in the *.agd file. For details about the *.agd schema, see Appendix A – File Types in ActiLife. In ActiLife version 5.6.0 or later, custom fields appear in the AGD File Viewer.

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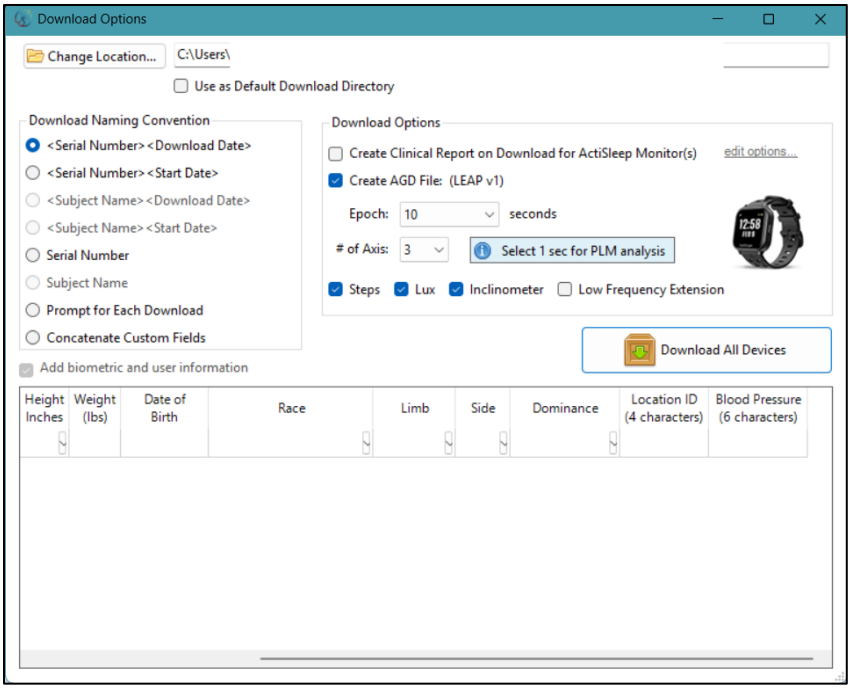

FIGURE 36 – CUSTOM FIELDS AS THEY APPEAR AFTER CLICKING "DOWNLOAD"

Download Settings

Use the "Download Settings" in the download section of the template builder to force template users to utilize a specific file download location and/or a specific file naming convention. By checking the "Force Download Location" and selecting a directory, template users will be forced to use the specific location. Template builders can type in network URLs or any local directory address that may be applicable for the end-users' specific sites.

Note: If the selected directory does not exist, ActiLife will attempt to create the directory (e.g., "C:\PatientDownloads"). If the user does not have administrative permissions or otherwise cannot create the directory, this feature will automatically disable itself, thus allowing the user to select the directory of their choice.

To force a file naming convention for template users, check the "Force Naming Convention" option and select the desired naming convention. During the download process, file names will be of the same format selected here for those users using the template. The "Concatenate Custom Fields" option will concatenate the custom field characters entered by the user during download time. Multiple custom fields will be concatenated with no dashes or separation punctuation. At this time, there are no options for reordering or hyphenating the file name parameters when using the custom field naming convention. These features will be added in later versions of ActiLife.

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Saving and Sharing Templates

Once the template parameters are set as desired, the template can be saved as a file and shared with other users. Users can click the "Save" button in the bottom right-hand corner of the template editor or use the "File" menu to save the template file. From the file menu, a template can be opened to make modifications (click "Open" then browse to the template file). In addition, the template can be saved and immediately put into use by clicking "Save and Use." This option is helpful when testing the newly created template before emailing or sharing the template file.

Once the template is saved, a new file with an *.agt file extension will be created similar to the one shown in Figure 37. This file can be emailed to distribution centers or shared over local networks within organizations. Users who load this template will be forced to use the parameters as they were defined in the template editor.

FIGURE 37 – TEMPLATE FILE SAVED TO A USER'S DESKTOP

Loading Templates

Once the *.agt template file has been shared, ActiLife (Full or Lite) users can simply download the file to their local machine (anywhere) and double-click on the file. Doing so will launch ActiLife and load the template. When done correctly, the template name and "Last Modified" time will appear in the upper right-hand corner of the ActiLife software as shown in Figure 14 on page 19. Once the template has been loaded once, the *.agt file can be removed from the end-user's computer. It is not necessary that the file remains on the user's computer.

An alternative way of loading a template file in ActiLife is to use the "Load Template" option in the File menu. Browse the template file location and click 'Open' to load the template.

When a template is loaded in ActiLife, the template will remain present even after the software has been closed and re-opened. This ensures that the template settings remain unchanged when the host computer is shut down and restarted. To remove a template, click "Remove Template" from the file menu.

Dataset Analysis Overview

To improve the efficiency of our customers' research and to reduce the time spent on post-data collection analysis, the full version of ActiLife includes several **Dataset Analysis** tools. These include the *Wear Time Validation* tool which can be used to filter out intervals of time within the dataset or entire datasets that do not meet patient wear criteria, *Data Scoring* which can be used to estimate energy expenditure, bouts, and more in one or more datasets, a *Sleep Scoring* tool, which is used to generate sleep statistics, and a *Graphing* tool which can be used to look at detailed epoch-by-epoch graphs of a dataset. If all three data analysis tools are used, the file should be processed in the following order: first Sleep, then Wear Time Validation, and finally Data Scoring.

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Wear Time Validation

The Wear Time Validation (WTV) tool in ActiLife allows users to easily flag invalid data (or data collected when a device was not worn) for exclusion from further analysis. WTV also provides a summary of the wear-time and non-wear time results from the datasets. The Data Screening Criteria allow users to define non-wear periods. Data flagged as non-wear is not removed from the *.agd file - it is simply flagged (within the file) as "wear time" or "non-wear time".

The default Wear Time Validation algorithm uses the floating window technique. This algorithm does not define wear or non-wear time from calendar hours but rather looks at contiguous time and discerns how many total hours (and/or minutes) of non-wear time are in the file without regard for breaks in the calendar day/hour. Conversely, the deprecated “Daily Algorithm” looks at calendar hours (e.g., 9:00am – 10:00am) and days (March 2 – March 3) to determine whether or not that hour (or day) is valid or not. The floating window algorithm allows users to the same thing by using the “Flag Entire Day as Invalid…” option in the Optional Screening Parameters section.

The defaults defined for Wear Time screening (60 minutes of consecutive zeros with a 2-minute spike tolerance) were loosely derived from the research note *Identification of accelerometer non-wear time and sedentary behavior,* published in the Research Quarterly for Exercise and Sport, submitted to the journal on June 1, 2010. Permission to share this article publicly has been requested by Ametris to the managing editor of Research Quarterly for Exercise and Sport.

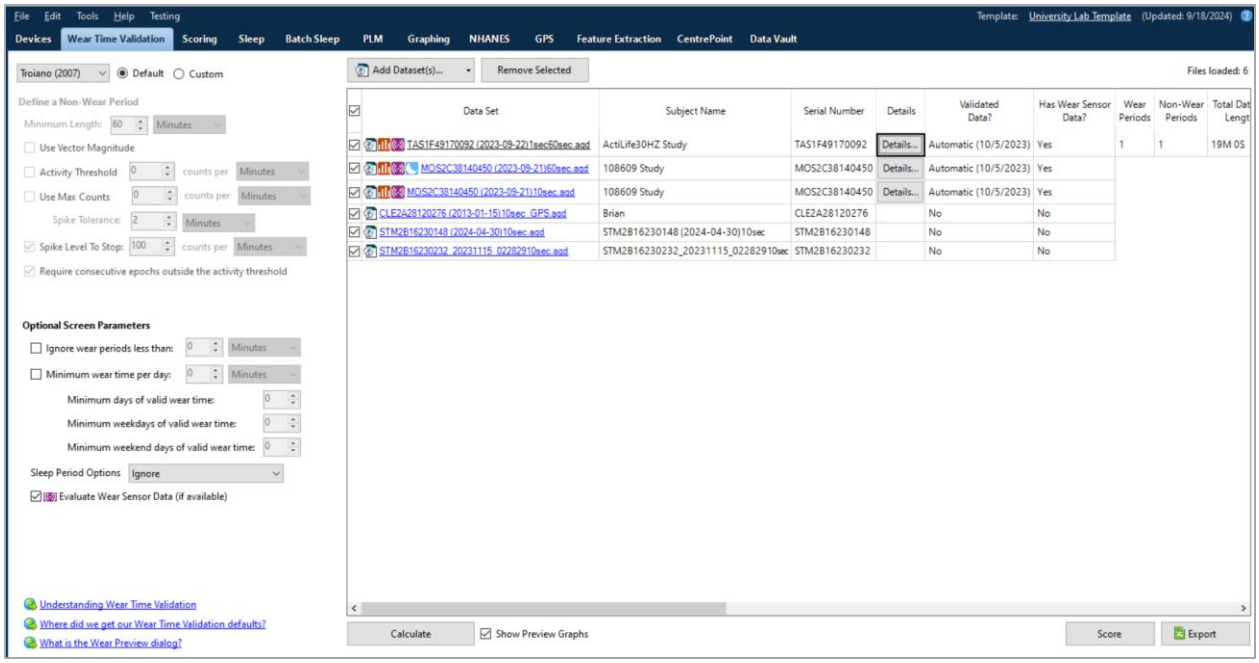

FIGURE 38 - WEAR TIME VALIDATION

Define a non-wear period

This section provides options for defining the non-wear period. ActiLife will use this information to scan data for non-wear bouts.

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Begin non-wear bout after ____ minutes/epochs of consecutive zeros - After scanning the data and detecting the selected number of consecutive zeros, ActiLife will begin flagging data as "non-wear time". The leading zeros detected during this process will be flagged retroactively (after they have been initially scanned). Data will be flagged as "non-wear time" until the Spike Tolerance is exceeded.

Use Vector Magnitude - When checked, ActiLife scans the vector magnitude of three-axis data (when available) to detect wear or non-wear time. When unchecked, ActiLife scans only Axis 1 (the vertical axis - see users' manual for details) to detect wear/non-wear times.

Use an activity threshold of _____ counts per minute/epoch - Instead of looking for zeros to qualify non-wear time, this option allows the user to set a non-zero activity threshold requirement for wear-time. Data below this value will be qualified as "zero".

Spike Tolerance ____ minutes/epochs - This option allows the user to set a "spurious count" tolerance. ActiLife will continue scoring a non-wear bout as non-wear until it detects more than the Spike Tolerance number of minutes/epochs above zero (or above the activity threshold, if that option is enabled).

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Optional Screening Parameters

Ignore wear periods less than _____ minutes/epochs - Because of the WTV algorithms used, some wear periods may be very short (shorter than the spike tolerance). Use this option to set the minimum length of an acceptable wear period.

Minimum wear time per day _____ minutes/epochs - Use this setting to flag an entire 24-hour day as invalid if there are less than the selected amount of valid (wear-time) minutes or epochs in the day.

The Sleep Period Options setting allows users to define how detected sleep periods are treated during wear time validation analysis. Users can choose to:

Mark as Wear Time – Sleep periods will be counted as valid wear time.

Mark as Non-Wear – Sleep periods will be excluded from valid wear time.

Ignore – Sleep periods will not affect wear time calculations and will be omitted from wear time validation.

Once these settings are adjusted, press the "Calculate" button to run the Wear Time Validation algorithm on the selected files.

Viewing Details of Wear Time Validation Results

Summary-level results of the Wear Time Validation process are available in the main grid immediately after the process has been completed. The following parameters are available:

- Wear Periods – The number of wear bouts detected by the algorithm for the entire data set
- Non-Wear Periods - The number of non-wear bouts detected by the algorithm for the entire data set.
- Wear Length – Total time the device was worn.
- Non-Wear Length – Total time the device was not worn.
- Avg Length Wear Period – Average length of the wear periods (or bouts).
- Avg Length Non-Wear Period - Average length of the non-wear periods (or bouts).
- Wear % - Percentage of wear-time for the entire data set
- Non-Wear % - Percentage of non-wear-time for the entire data set
- Avg Wear Time per Total Days (All Days) – Total wear time divided by the total number of days in the dataset.
- Avg Wear Time per Days with Wear Time – Total wear time divided by the total number of days in the dataset that have >0 wear time.
- Avg Non-Wear Time per Total Days - Total non-wear time divided by the total number of days in the dataset that have >0 wear time.
- Avg Non-Wear Time per Days with Wear Time - Total non-wear time divided by the total number of days in the dataset that have >0 wear time.

After the wear-time has been calculated, details of each wear and non-wear bout can be viewed by clicking the "Details" button to the right of each dataset file name as shown in Figure 39A.

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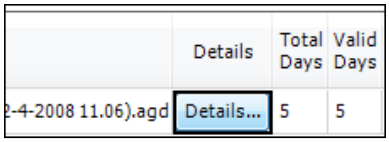


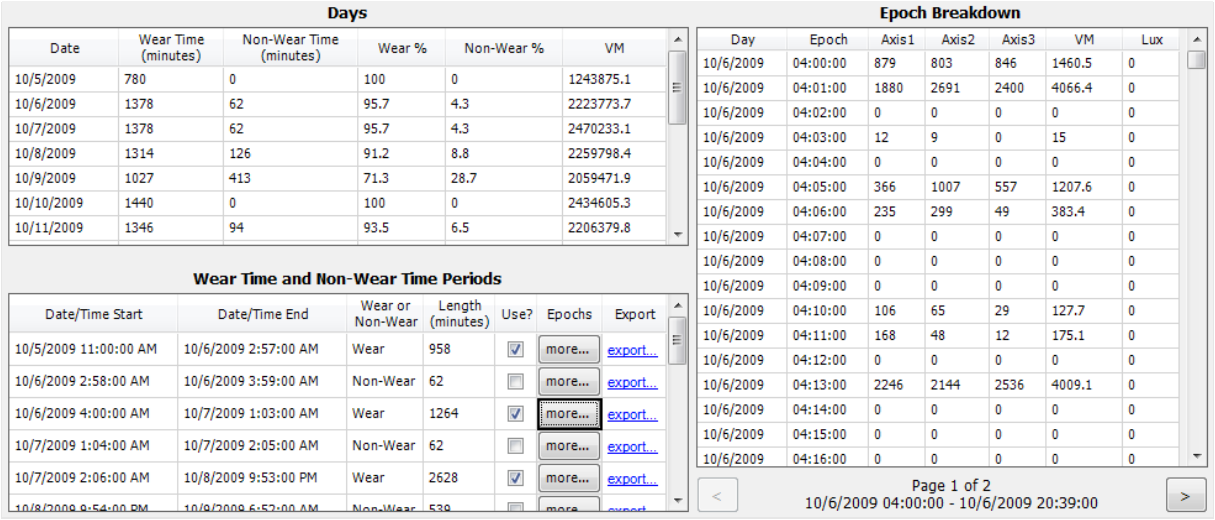
	Details	Total Days	Valid Days
2-4-2008 11.06).agd	Details...	5	5

FIGURE 39A – DETAILS VIEW SHOWS EPOCH-BY-EPOCH VALIDATION

Details about which days are considered "valid" can be seen in the details view. An example is shown in Figure 339B. The *Days* section details out the number of Wear Time and Non-Wear-Time (in minutes) per calendar day. The percentages of wear and non-wear for each day are also available here. The VM column represents the total "Total Vector Magnitude Counts" for that day (see Appendix B – Vector Magnitude for more details). This number can be used to gauge relative activity from day-to-day.

The *Wear Time and Non-Wear Time Periods* section details the wear and non-wear bouts as detected by the Wear Time Validation tool. The "Use?" column indicates whether or not that particular bout will be considered or excluded when calculating output scores in the Data Scoring tool. Non-wear periods are never used, and wear periods are always used by default. This can be changed by checking or un-checking the bout of interest. Clicking "Save and Close" will store those changes in the *.agd file.

Clicking the "More" button next to a wear or non-wear bout will reveal the epoch level breakdown for that particular bout on the right-hand side. All data in this view can be copied/pasted by selecting the columns/rows of interest, pressing "CTRL+C" on the keyboard to copy, then pressing "CTRL+V" to paste the data into a spreadsheet or text editor. Use the individual "export" links to export a wear or non-wear period into a *.csv file.



Days

Date	Wear Time (minutes)	Non-Wear Time (minutes)	Wear %	Non-Wear %	VM
10/5/2009	780	0	100	0	1243875.1
10/6/2009	1378	62	95.7	4.3	2223773.7
10/7/2009	1378	62	95.7	4.3	2470233.1
10/8/2009	1314	126	91.2	8.8	2259798.4
10/9/2009	1027	413	71.3	28.7	2059471.9
10/10/2009	1440	0	100	0	2434605.3
10/11/2009	1346	94	93.5	6.5	2206379.8

Wear Time and Non-Wear Time Periods

Date/Time Start	Date/Time End	Wear or Non-Wear	Length (minutes)	Use?	Epochs	Export
10/5/2009 11:00:00 AM	10/6/2009 2:57:00 AM	Wear	958	☑	more...	export...
10/6/2009 2:58:00 AM	10/6/2009 3:59:00 AM	Non-Wear	62	☐	more...	export...
10/6/2009 4:00:00 AM	10/7/2009 1:03:00 AM	Wear	1264	☑	more...	export...
10/7/2009 1:04:00 AM	10/7/2009 2:05:00 AM	Non-Wear	62	☐	more...	export...
10/7/2009 2:06:00 AM	10/8/2009 9:53:00 PM	Wear	2628	☑	more...	export...

Epoch Breakdown

Day	Epoch	Axis1	Axis2	Axis3	VM	Lux
10/6/2009	04:00:00	879	803	846	1460.5	0
10/6/2009	04:01:00	1880	2691	2400	4066.4	0
10/6/2009	04:02:00	0	0	0	0	0
10/6/2009	04:03:00	12	9	0	15	0
10/6/2009	04:04:00	0	0	0	0	0
10/6/2009	04:05:00	366	1007	557	1207.6	0
10/6/2009	04:06:00	235	299	49	383.4	0
10/6/2009	04:07:00	0	0	0	0	0
10/6/2009	04:08:00	0	0	0	0	0
10/6/2009	04:09:00	0	0	0	0	0
10/6/2009	04:10:00	106	65	29	127.7	0
10/6/2009	04:11:00	168	48	12	175.1	0
10/6/2009	04:12:00	0	0	0	0	0
10/6/2009	04:13:00	2246	2144	2536	4009.1	0
10/6/2009	04:14:00	0	0	0	0	0
10/6/2009	04:15:00	0	0	0	0	0
10/6/2009	04:16:00	0	0	0	0	0

< Page 1 of 2 >
10/6/2009 04:00:00 - 10/6/2009 20:39:00

FIGURE 336B – DETAIL BREAKDOWN OF WEAR AND NON-WEAR TIME FOR A DATASET

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Export Report

The “Export Report” option exports the information in the Wear Time Validation grid to a comma separated value file for sharing and manipulation. Detailed data can be exported to CSV format from the “Details” view of each dataset.

Score Selected

This option pushes the selected files into the Data Scoring tab. This is typically the next step after Wear-Time Validation. This button speeds up the process by eliminating the need to manually search for the files from the Data Scoring file importer.

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Data Scoring

Data Scoring in ActiLife allows users to analyze the details of their dataset(s) by examining Energy Expenditure, METs, Activity Cut Points, Activity Bouts, and Heart Rate Energy Expenditure. Figure 39C illustrates the Data Scoring tool in action.

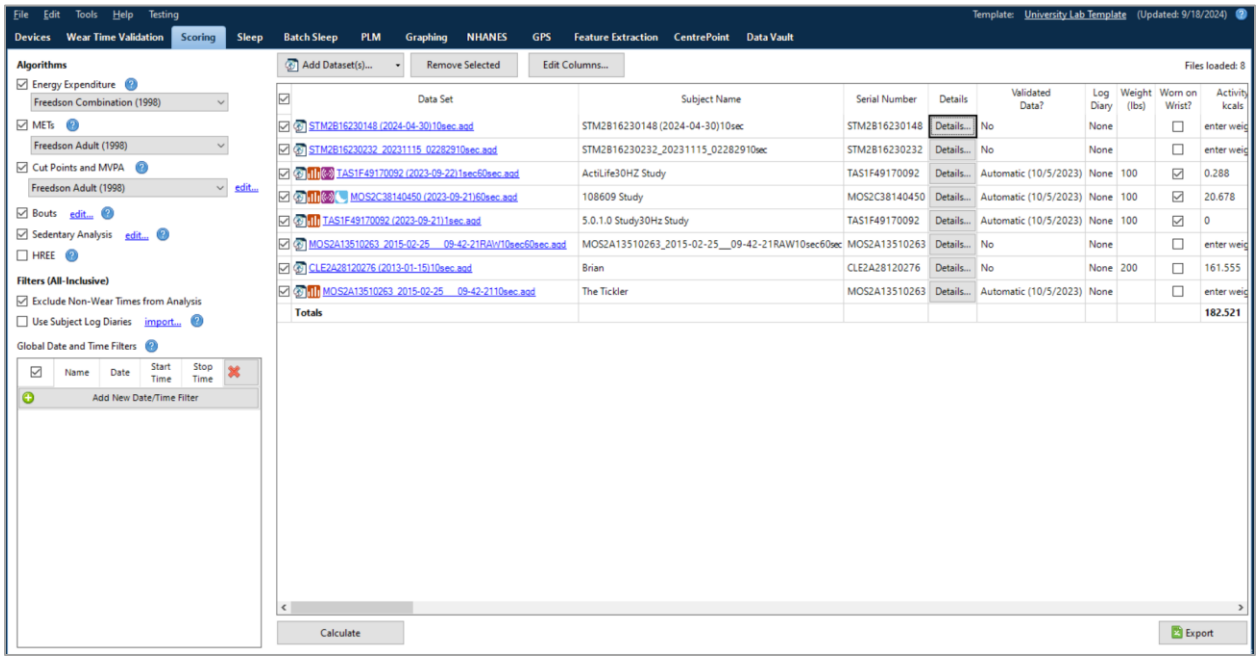

FIGURE 379C - DATA SCORING

Date and Time Filters

Date and time filtering allows users to isolate the data scoring to specific dates or times of interest. The results shown in the Data Scoring tool only apply to the date and time filters shown in the Date and Time Filters grid. If no filters are present, the Data Scoring results are not limited to any dates or times but include the entire scope of the datasets.

Multiple filters can be added simultaneously to specifically target certain days or times. To add a filter, click the "+" button from within the Date and Time Filters grid as shown in Figure 339D. Only checked filters will be applied during data scoring. Multiple filters can be checked which forces the Data Scoring tool to generate results for two different time periods. For example, creating a Weekend Mornings filter for Weekends from 6am-10am and then a Weekend Afternoons filter for Weekends from 3pm-6pm would produce data scoring results for both of those time periods only.

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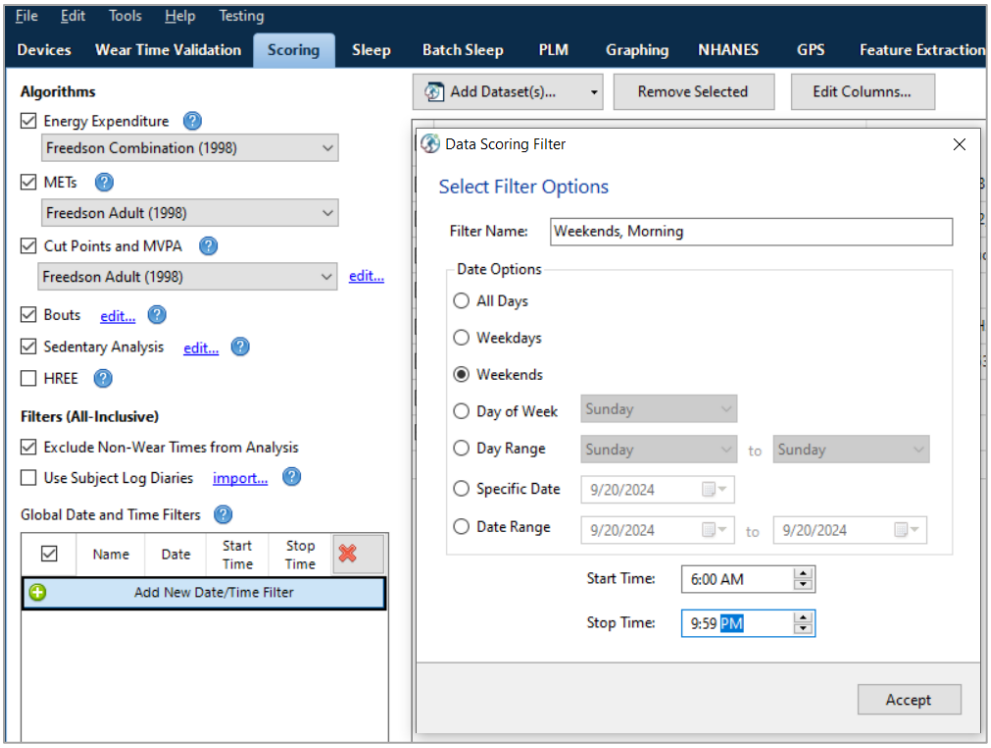

FIGURE 338D - DATE/TIME FILTER ENTRY

Date and time filters can be removed by clicking the "X" icon to the right of the filter. Remove all filters by clicking the "X" at the top of the grid. Date and Time Filters persist in ActiLife even if the program is closed and re-opened.

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Data Scoring Parameters and Algorithms

There are five optional parameters that can be calculated from within the Data Scoring tool: Energy Expenditure, METs, Cut Points, Bouts, and Heart Rate Energy Expenditure (HREE). Each parameter has multiple algorithms from which to choose. Each algorithm has been derived by independent researchers from around the world using Ametris devices. To view details about the origin of each algorithm, click the "?" icon to the right of each scoring parameter. Check the checkbox next to each parameter you wish to calculate for your dataset(s). Unchecked parameters will not be calculated, displayed, or exported.

Energy Expenditure

To calculate energy expenditure, check the box next to the "Energy Expenditure" parameter in the Data Scoring tool. Each dataset in the Data Scoring grid must have an associated body. Weights can be added by clicking on the "Weight" box in the Data Scoring grid and typing in the subject's weight.

Important: The "Apply Scaling Factor" option scales down activity counts using an internally developed algorithm intended for wrist-worn devices. If overly reduced counts are observed when using the Scaling Factor, we recommend switching to Energy Expenditure or Cut Point algorithms that rely on vector magnitude. In some populations, the Scaling Factor may reduce activity counts more than intended, resulting in under-detection of vigorous and very vigorous activity levels.

METs

METs, or metabolic equivalent of task, can also be calculated from within the Data Scoring tool. Multiple algorithms are available. When calculating Children's METS (Using the "Children Freedson" equation), an age must be entered for each file. If the device was worn on the wrist, the subject's gender is required.

Cut Points

Cut point data scoring option allows users to break out the proportion of time (total epochs) within each dataset the subject spent in different categories of activity intensity. Multiple validated cut point sets are available by default from within ActiLife. Users can create their own cut point set by clicking the "edit..." link to the right of the Cut Point dropdown and clicking the "+" icon at the bottom of the list as shown in Figure 39E. Enter a Set Name for the new cut point set and type in the maximum values for each level (click the "+" icon to create new Cut Points). Once complete, click "Save".

When the "Cut Points based on Vector Magnitude" box is checked, ActiLife will look at the Vector Magnitude count levels for each epoch. When left unchecked, the cut points apply only to the Axis 1 values for each epoch.

Details about the default Cut Point algorithms in ActiLife can be found by clicking the "?" icon next to the Cut Points option.

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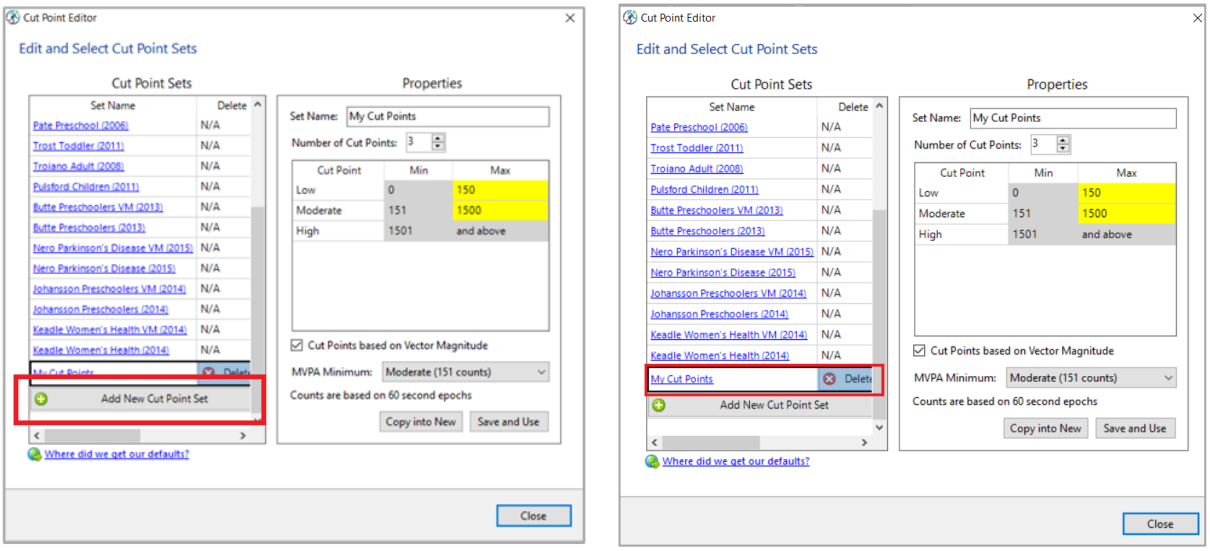

FIGURE 39E - CUSTOM AND DEFAULT CUT POINTS

Bouts

Bouts of activity can be detected within each data set in the Data Scoring tab. Use the "Bouts" option to define a bout length, the minimum per-epoch count level, the maximum per-epoch count level and the drop time.

Min Length

This option tells ActiLife the minimum bout length to look for.

Min Counts

This option tells ActiLife the minimum count value for each consecutive epoch in the bout.

Max Counts

This option tells ActiLife the maximum count value for each consecutive epoch in the bout.

Drop Time

The drop time setting acts as a tolerance for bout detection and is best explained through an example. Suppose the bout detection settings (above) are set to Min Length = 10, Min Counts = 1953, and Max Counts = 50000. With the spike tolerance set to 0, the Bout tool will only identify a bout of activity as 10 consecutive epochs of data with a minimum activity count of 1953 and a maximum activity count of 50000. Table 2 illustrates a valid bout while Table 3 illustrates an invalid bout when Drop Time = 0. Because the value 1500 that occurs at 09:03 in Table 3 is below the Minimum Count Level and because there is no allowable tolerance, these epochs fail to register as a legitimate bout. The epoch string in Table 3 would, however, qualify as a valid bout if Drop Time were set to 1 or higher since the highlighted cell would actually count as a valid bout epoch.

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09:01:00	09:02:00	09:03:00	09:04:00	09:05:00	09:06:00	09:07:00	09:08:00	09:09:00	09:10:00
2000	2100	2500	4000	6124	4510	2164	4518	2540	6000

TABLE 2 - EXAMPLE OF A VALID BOUT WITH DROP TIME = 0

09:01:00	09:02:00	09:03:00	09:04:00	09:05:00	09:06:00	09:07:00	09:08:00	09:09:00	09:10:00
2000	2100	1500	4000	6124	4510	2164	4518	2540	6000

TABLE 3 - EXAMPLE OF AN INVALID BOUT WITH DROP TIME = 0

With a Drop Time = 2, the epoch string in Table 4 would be considered a valid bout since there are exactly 2 epochs that are outside of the min/max epoch levels (they count as valid epochs). If the epoch value at 06:10 were outside of the min/max range, that epoch would mark the end of the bout (it would be 10 epochs long). The epoch string in Table 5 would not qualify as a valid bout under these conditions.

06:00:00	06:01:00	06:02:00	06:03:00	06:04:00	06:05:00	06:06:00	06:07:00	06:08:00	06:09:00
2000	2100	2500	4000	1274	4510	2164	862	2540	6000

TABLE 4 - EXAMPLE OF A VALID BOUT WITH DROP TIME = 2

09:01:00	09:02:00	09:03:00	09:04:00	09:05:00	09:06:00	09:07:00	09:08:00	09:09:00	09:10:00
2000	2100	1500	4000	1824	4510	2164	1619	2540	6000

TABLE 5 - EXAMPLE OF AN INVALID BOUT WITH DROP TIME = 2

Once a bout is detected, the bout does not end until the drop time tolerance is exceeded. Suppose the epoch string in Table 4 continued as follows: 06:10 – 4305; 06:11 – 3390; 06:12 – 5530; 06:13 – 9930; 06:14 – 100. The epoch at 06:14 would mark the end of the bout which would be 14 minutes long.

Bout Example

- Minimum Bout Length: 10 minutes
- Minimum Count Level to be considered a Bout: 1953
- Maximum Count Level to be considered a Bout: 5724
- Tolerance/Drop Time (in minutes): 2
- Dataset collected in one-minute epoch lengths
- A string of epoch values from the dataset
- 1805, 2048, 3159, 4651, 4216, 4673, 5531, 1846, 2615, 2648, 3894, 4869, 5201, 5756, 6165
- This string contains one bout:
- 2048, 3159, 4651, 4216, 4673, 5531, 1846, 2615, 2648, 3894, 4869, 5201
- The value 1846 is considered the first “drop” time
- The value 5756 is considered the second drop time
- The value 6165 is considered the third and final drop time. ActiLife regresses the dataset once 6165 is detected to find the last “good” value. This defines the end of the dataset.

The “Use Vector Magnitude” option within the bout parameter settings forces ActiLife to use the Vector Magnitude combination of all three axes for each epoch when making bout level determinations. With this option unchecked, ActiLife only uses Axis 1.

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Heart Rate EE

The Heart Rate EE option calculates the following variables from any datasets that are loaded in the Data Scoring tab.

ADL Heart Rate: Average Daily Living Heart Rate. This is the average base (resting) heart rate of all ADL qualified epochs in the dataset. In order to qualify as ADL heart rate, an epoch must contain heart rate data below 79 beats per minute and one-minute activity data above 100 counts per epoch.

Avg Active Heart Rate: The average active heart rate in a given dataset. In order to qualify as active heart rate, epoch activity must exceed 1951 counts per minute epoch and heart rate must exceed 80 beats per minute.

HR Delta: The difference between the Average Active Heart Rate and the Average Daily Living Heart Rate for a given dataset

Avg Active Caloric Expenditure: The average minute-by-minute caloric expenditure (kcal) for all epochs that match the "Active Heart Rate" qualifier used to calculate Average Active Heart Rate. Calories are calculated using the Freedson Equation (1997).

Calibration Ratio: Average Active Caloric Expenditure / HR Delta. This value is used to determine calories-per-BPM, or calories that should be associated with the subject's BPM rate (Active Heart Rate) when activity counts are not reliable.

The HREE algorithm should not be used as a standard for measuring activity energy expenditure and is only an estimate of overall energy expenditure when ambulatory movement is not reliable. For example, HREE may be used when a user is riding a bicycle or lifting weights.

Use Validated Data if Available

The "Use Validated Data if Available" checkbox option (shown in Figure 44) tells ActiLife whether to use only the wear time as calculated by the Wear Time Validation tool (checked) or whether to use all epochs within the file (unchecked) to perform the Data Scoring.

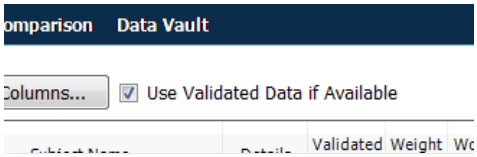

FIGURE 44 - USE VALIDATED DATA IF AVAILABLE

Data Scoring Columns

There are 75 columns of possible optional calculations that can be made within the Data Scoring tool. Select the "Edit Columns" option to view the selected columns and to enable/disable columns. Enabling more columns will extend the time required for ActiLife to perform the calculations and the batch data export (if used).

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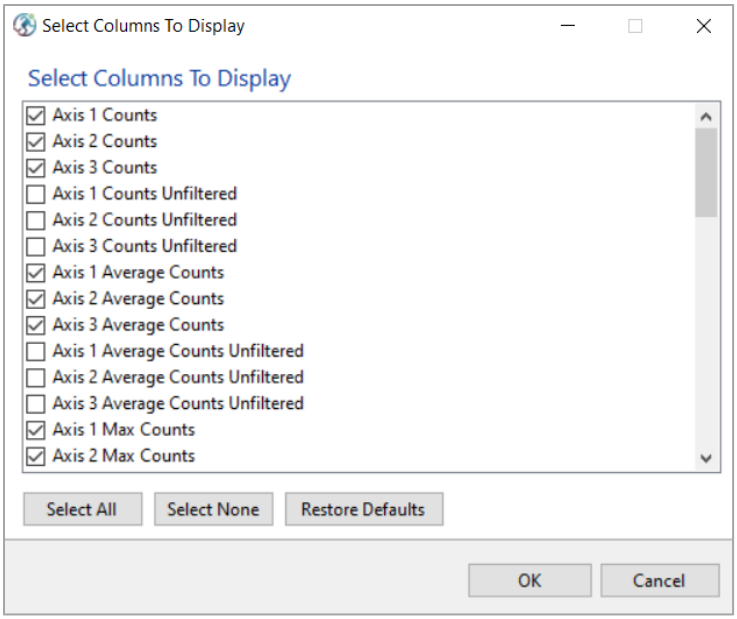

FIGURE 45 - DATA SCORING COLUMNS

The following parameters can be extracted from user datasets in the Data Scoring tab.

1. **Subject** - Name of the subject
2. **Filename** - Filename of the subject
3. **Epoch** - Epoch length in seconds
4. **Weight** - The weight of the subject in lbs.
5. **Age** - The age of the subject in years
6. **Gender** - The gender of the subject
7. **Date** - Date in local format
8. **Hour** - Hour in local format
9. **Day of Week** - Day of the week name in local format
10. **Day of Week Num** - Day of the week number: 1=Monday, 2=Tuesday, etc.
11. **kcals** - kcals during this hour
12. **METs** - MET rate for a period of time
13. **Bouts** - Number of Bouts starting in a period of time
14. **Total Time in Bouts** - Time of bouts during a period of time
15. **Avg Time per Bout** - Average length of time (in minutes) of bouts during a period of time
16. **Total Counts in Bouts** - Total counts in bouts during a period of time
17. **Bout Start** - The date and time of the start of a bout
18. **Bout End** - The date and time of the end of a bout
19. **Time in Bout** - The time of a bout in minutes
20. **ADL Heart Rate** - Average Non-Sedentary HR between 41 and 79
21. **Average Active Heart Rate** - Average HR during active activity (above light)
22. **Heart Rate Delta** - The difference between Average Active Heart Rate and ADL Heart Rate
23. **Average Active Caloric Expenditure** - Average amount of calories burned above light activity
24. **Calibration Ratio** - Ratio of Average Active Caloric Expenditure divided by Heart Rate Delta
25. **Light** - Length of time in Light in minutes
26. **Moderate** - Length of time in Moderate in minutes

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27. **Vigorous** - Length of time in Vigorous in minutes
28. **Very Vigorous** - Length of time in Very Vigorous in minutes
29. **Axis 1 Counts Scored** - Sum of counts for Axis 1 (Y-Axis) during scored time
30. **Axis 2 Counts Scored** - Sum of counts for Axis 2 (X-Axis) during scored time
31. **Axis 3 Counts Scored** - Sum of counts for Axis 3 (Z-Axis) during scored time
32. **Axis 1 Counts Non-Scored** - Sum of counts for Axis 1 (Y-Axis) during non-scored time
33. **Axis 2 Counts Non-Scored** - Sum of counts for Axis 2 (X-Axis) during non-scored time
34. **Axis 3 Counts Non-Scored** - Sum of counts for Axis 3 (Z-Axis) during non-scored time
35. **Axis 1 Counts Total** - Sum of counts for Axis 1 (Y-Axis) during scored and non-scored time
36. **Axis 2 Counts Total** - Sum of counts for Axis 2 (X-Axis) during scored and non-scored time
37. **Axis 3 Counts Total** - Sum of counts for Axis 3 (Z-Axis) during scored and non-scored time
38. **Axis 1 Average Counts Scored** - Average of counts for Axis 1 (Y-Axis) during scored time
39. **Axis 2 Average Counts Scored** - Average of counts for Axis 2 (X-Axis) during scored time
40. **Axis 3 Average Counts Scored** - Average of counts for Axis 3 (Z-Axis) during scored time
41. **Axis 1 Average Counts Non-Scored** - Average of counts for Axis 1 (Y-Axis) during non-scored time
42. **Axis 2 Average Counts Non-Scored** - Average of counts for Axis 2 (X-Axis) during non-scored time
43. **Axis 3 Average Counts Non-Scored** - Average of counts for Axis 3 (Z-Axis) during non-scored time
44. **Axis 1 Average Counts Total** - Average of counts for Axis 1 (Y-Axis) during scored and non-scored time
45. **Axis 2 Average Counts Total** - Average of counts for Axis 2 (X-Axis) during scored and non-scored time
46. **Axis 3 Average Counts Total** - Average of counts for Axis 3 (Z-Axis) during scored and non-scored time
47. **Axis 1 Max Counts Scored** - Maximum count value for Axis 1 (Y-Axis) during scored time
48. **Axis 2 Max Counts Scored** - Maximum count value for Axis 2 (X-Axis) during scored time
49. **Axis 3 Max Counts Scored** - Maximum count value for Axis 3 (Z-Axis) during scored time
50. **Axis 1 Max Counts Non-Scored** - Maximum count value for Axis 1 (Y-Axis) during non-scored time
51. **Axis 2 Max Counts Non-Scored** - Maximum count value for Axis 2 (X-Axis) during non-scored time
52. **Axis 3 Max Counts Non-Scored** - Maximum count value for Axis 3 (Z-Axis) during non-scored time
53. **Axis 1 Max Counts Total** - Maximum count value for Axis 1 (Y-Axis) during scored and non-scored time
54. **Axis 2 Max Counts Total** - Maximum count value for Axis 2 (X-Axis) during scored and non-scored time
55. **Axis 3 Max Counts Total** - Maximum count value for Axis 3 (Z-Axis) during scored and non-scored time
56. **Axis 1 CPM Scored** - Counts Per Minute for Axis 1 (Y-Axis) during scored time
57. **Axis 2 CPM Scored** - Counts Per Minute for Axis 2 (X-Axis) during scored time
58. **Axis 3 CPM Scored** - Counts Per Minute for Axis 3 (Z-Axis) during scored time
59. **Axis 1 CPM Non-Scored** - Counts Per Minute for Axis 1 (Y-Axis) during non-scored time
60. **Axis 2 CPM Non-Scored** - Counts Per Minute for Axis 2 (X-Axis) during non-scored time
61. **Axis 3 CPM Non-Scored** - Counts Per Minute for Axis 3 (Z-Axis) during non-scored time
62. **Axis 1 CPM Total** - Counts Per Minute for Axis 1 (Y-Axis) during scored and non-scored time
63. **Axis 2 CPM Total** - Counts Per Minute for Axis 2 (X-Axis) during scored and non-scored time
64. **Axis 3 CPM Total** - Counts Per Minute for Axis 3 (Z-Axis) during scored and non-scored time
65. **Vector Magnitude Counts Scored** - Vector Magnitude of all 3 Axis during scored time
66. **Vector Magnitude Counts Non-Scored** - Vector Magnitude of all 3 Axis during non-scored time

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67. **Vector Magnitude Counts Total** - Vector Magnitude of all 3 Axis during scored and non-scored time
68. **Vector Magnitude Average Counts Scored** - Average Vector Magnitude of all 3 Axis during scored time
69. **Vector Magnitude Average Counts Non-Scored** - Average Vector Magnitude of all 3 Axis during non-scored time
70. **Vector Magnitude Average Counts Total** - Average Vector Magnitude of all 3 Axis during scored and non-scored time
71. **Vector Magnitude Max Counts Scored** - Maximum Vector Magnitude of all 3 Axis during scored time
72. **Vector Magnitude Max Counts Non-Scored** - Maximum Vector Magnitude of all 3 Axis during non-scored time
73. **Vector Magnitude Max Counts Total** - Maximum Vector Magnitude of all 3 Axis during scored and non-scored time
74. **Vector Magnitude CPM Scored** - Vector Magnitude Counts Per Minute during scored time
75. **Vector Magnitude CPM Non-Scored** - Vector Magnitude Counts Per Minute during non-scored time
76. **Vector Magnitude CPM Total** - Vector Magnitude Counts Per Minute during scored and non-scored time
77. **Steps Counts Scored** - Sum of Step Counts during scored time
78. **Steps Counts Non-Scored** - Sum of Step Counts during non-scored time
79. **Steps Counts Total** - Sum of Step Counts during scored and non-scored time
80. **Steps Average Counts Scored** - Average Step Counts during scored time
81. **Steps Average Counts Non-Scored** - Average Step Counts during non-scored time
82. **Steps Average Counts Total** - Average Step Counts during scored and non-scored time
83. **Steps Max Counts Scored** - Maximum Step Counts during scored time
84. **Steps Max Counts Non-Scored** - Maximum Step Counts during non-scored time
85. **Steps Max Counts Total** - Maximum Step Counts during scored and non-scored time
86. **Steps Per Minute Scored** - Steps Per Minute during scored time
87. **Steps Per Minute Non-Scored** - Steps Per Minute during non-scored time
88. **Steps Per Minute Total** - Steps Per Minute during scored and non-scored time
89. **Lux Average Counts Scored** - Average Lux Value during scored time
90. **Lux Average Counts Non-Scored** - Average Lux Value during non-scored time
91. **Lux Average Counts Total** - Average Lux Value during scored and non-scored time
92. **Lux Max Counts Scored** - Maximum Lux Value during scored time
93. **Lux Max Counts Non-Scored** - Maximum Lux Value during non-scored time
94. **Lux Max Counts Total** - Maximum Lux Value during scored and non-scored time
95. **Number of Epochs Scored** - Number of epochs during scored time
96. **Number of Epochs Non-Scored** - Number of epochs during non-scored time
97. **Number of Epochs Total** - Number of epochs during scored and non-scored time
98. **Time Scored** - Length of scored time
99. **Time Non-Scored** - Length of non-scored time
100. **Time Total** - Length of scored and non-scored time
101. **Calendar Days Scored** - Number of Calendar Days during scored time
102. **Calendar Days Non-Scored** - Number of Calendar Days during non-scored time
103. **Calendar Days Total** - Number of Calendar Days during scored and non-scored time
104. **Wear Time Start** - The start of a wear time
105. **Wear Time End** - The end of a wear time

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Extracting Step Counts for Leap

Step count can be extracted from the LEAP device and ActiLife using the following process:

The steps count for the LEAP device will be different from older model devices as this new device is "raw-only" and DOESN'T collect epoch level data onboard. You can make a few conversions after downloading data from the LEAP device to get steps. The process is as follows:

1. Download a .AGD file from a LEAP device via ActiLife (Requires ActiLife **Version 7.1.0.0** and above as the earlier versions will NOT generate Step Counts).
2. The AGD file must be set to a **60-second epoch**.
3. If the above 2 conditions are **not met**, then the step counts will show as zero.
4. Convert the .AGD file to a .CSV using FILE -> Import/Export/Convert -> (Epoch to Epoch) .AGD to .CSV and using the "Output Single CSV" option in the conversion window.
5. This will generate a CSV file containing the Step counts for your LEAP device as output.

Batch Exporting

Results from the Data Scoring tool can be batch exported to a Microsoft Excel ® spreadsheet. The resulting exports will contain a full list of all subjects with corresponding Data Scoring results broken down by hours, days, and Summary. Bout details and Wear Time Validation can also be exported along with a separate sheet showing which algorithms were used to produce the results and a "Definitions" sheet which defines all of the exported parameters.

To begin the export, click the "Export" button after performing a calculation in the Data Scoring tab. Check the "Create Batch View..." option as shown in Figure 46. Select any of the desired export options and click "Export..."

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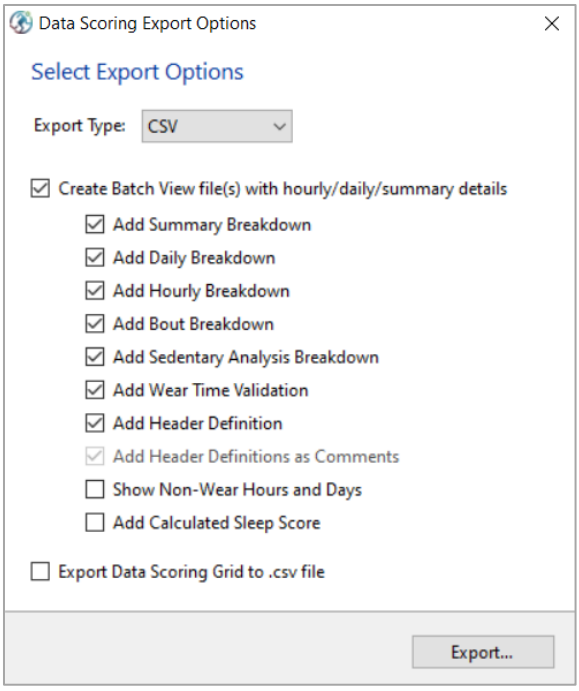

FIGURE 46 - DATA SCORING EXPORT OPTIONS

Depending on the number of variables and files, the export process could take anywhere from 10 seconds to 2 hours.

Sleep Analysis

Sleep analysis can be performed on any dataset to determine sleep efficiency and other sleep statistics that may indicate sleep problems. Any combinations of the various initialization modes are allowed for a given dataset file (activity, dual-axis, steps and heart rate). ActiLife will attempt to re-integrate data collected at epoch intervals of less than 60 seconds as all scoring is performed using 60 second epoch cycles.

To begin scoring a dataset, click the “Select Dataset” option from the top of the Sleep Scoring tool and browse to an .agd file that contains data collected during sleep episodes. Graphs of each day in the dataset will appear in the “Sleep Scoring” view.

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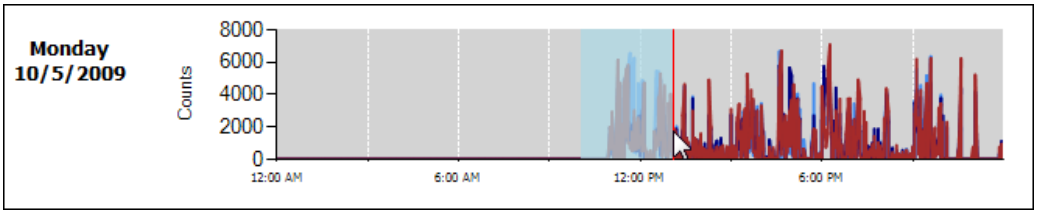
FIGURE 47 – SLEEP SCORING

Areas on the graphs can be magnified by dragging the mouse pointer over the area of interest as shown in Figure 48. To return to the normal view, click the small circle in the bottom left-hand corner of the graph.



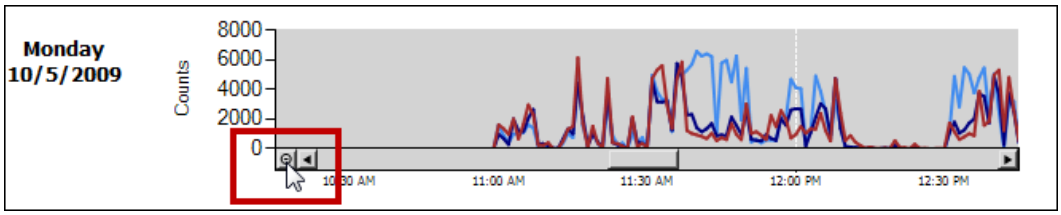


FIGURE 48 – GRAPHING

Manually Entering Sleep Times

Sleep times (time in or out of bed) can be manually entered into the Sleep Analysis tool using two different techniques. To key-in sleep times, select the "Add Bed Time" button on the right of the Sleep Scoring tool. Enter the subject's exact time in bed and time out of bed and click "ok." The selected time slot will be highlighted in translucent red on the graph.

Sleep times can also be added directly on the graph itself by clicking anywhere on the graph and using the arrow keys to navigate to the sleep episode start time. Once a suitable start time is located, right-click

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anywhere on the graph and choose “Add New In Bed Time Here” This will mark the start of the sleep episode. Repeat this process and choose “Accept Out Of Bed Time” to mark the end of the sleep episode. Figure 49 illustrates this process.

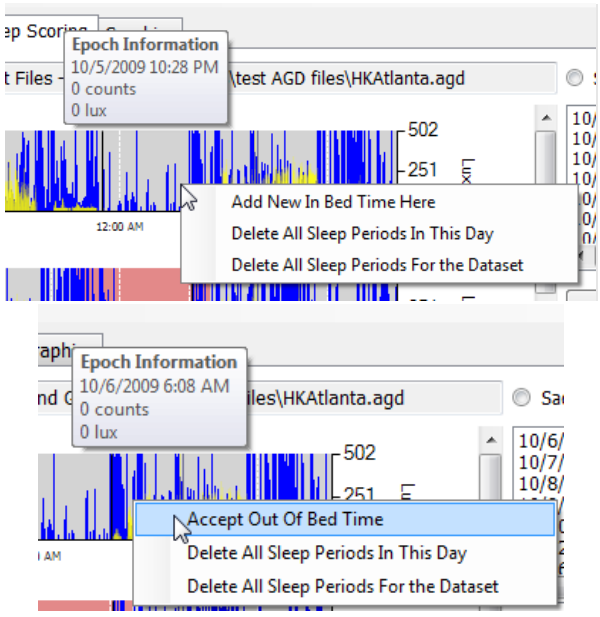

FIGURE 49 – MARKING SLEEP EPISODES GRAPHICALLY

Automatically Entering Sleep Times

Users can automatically estimate bed times (Time in Bed [TOB] and Time Out of Bed [TOB]) in ActiLife by pressing the “Detect Sleep Periods” button. ActiLife will estimate bed times for the current data set and apply the selected algorithm to those bed times.

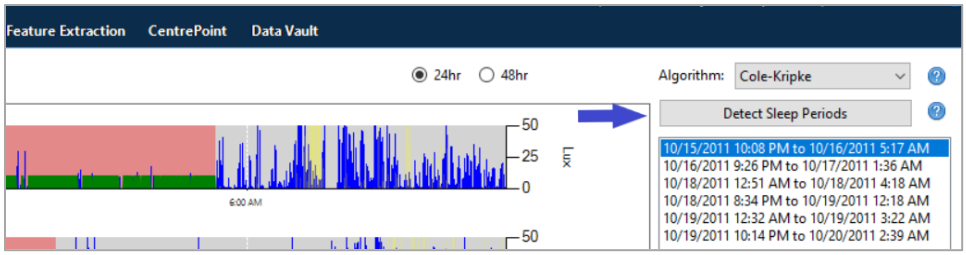

FIGURE 50 - AUTO SCORE SLEEP TIMES

The Auto Score feature will not ignore non-wear times (as estimated by the Wear Time Validation tool), but the algorithm is designed to ignore gaps in the sleep data as shown in Figure 51.

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FIGURE 51 - AUTO SCORE IGNORES PERIODS WHEN DEVICE WAS REMOVED

Editing Auto Scored Times

The bed times estimated by the Auto Score feature can be easily adjusted by right-clicking on the sleep period of interest, choosing "Adjust Out Bed Time" (or "Adjust In Bed Time"), using the left or right arrow keys on the keyboard to adjust the time, then right-clicking anywhere on the graph and selecting "Finished Entering Bed Times". This is illustrated in Figure 40.

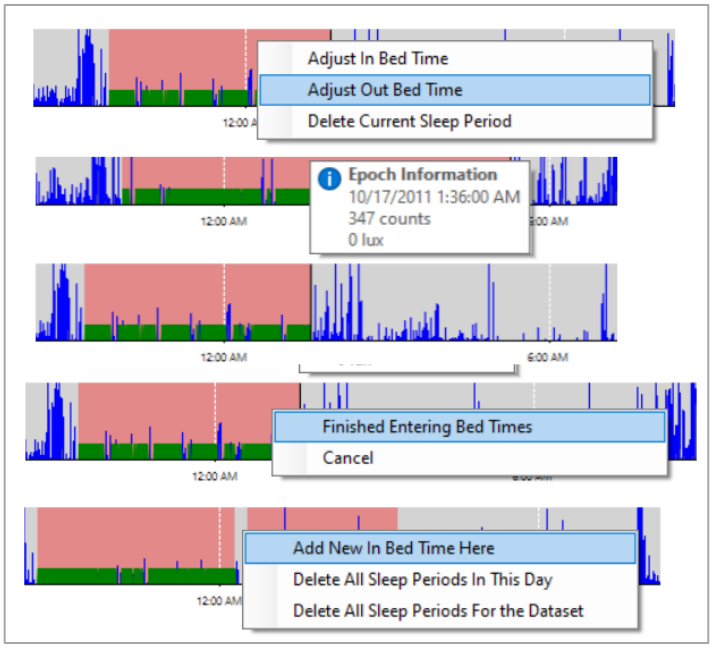

FIGURE 40 - ADJUSTING BED TIMES

Removing Sleep Times

Sleep periods can be removed by right-clicking on them on the graph and choosing "Delete Current Sleep Period." To delete all of the sleep periods for a particular day or for the entire dataset, choose the proper corresponding option ("Delete All Sleep Periods in this Day" or "Delete All Sleep Periods for the Dataset").

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Sleep periods can also be removed by selecting the sleep period in the list to the right and clicking the "Remove" button below the list.

Activity and Lux Scale

The "Activity Scale" and "Lux Scale" settings below the sleep graphs adjust the maximum scale shown for Activity and Lux counts on the sleep graphs. Changing the value scales all of the graphs simultaneously.

Changing Graph Colors

Graph colors for activity, lux, the sleep score period, and the score indicator can be changed easily by clicking the color palette beside the corresponding item and choosing a different color as shown in Figure 53. Note that the "Period Color" is translucent and may appear slightly lighter than its selected color.

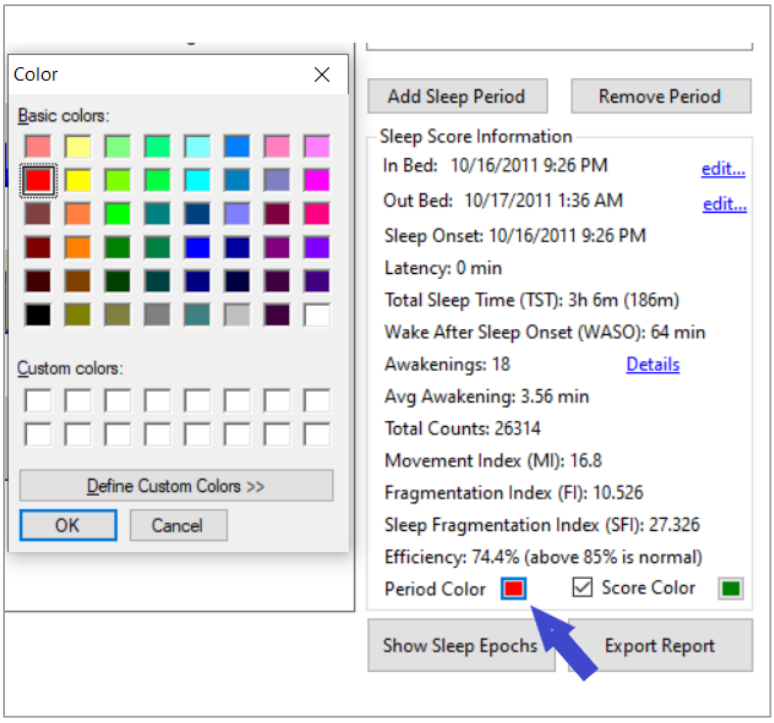

FIGURE 53 – COLOR PALETTE FOR SLEEP SCORING GRAPH

Lux

Lux, or ambient light, is measured by Ametris's ActiSleep+ monitor, the ActiTrainer and the wGT3X-BT devices. Ambient light may affect subject sleeping habits and thus is a useful tool in analyzing circadian rhythms and sleeping patterns. If lux data was recorded by the Ametris device, it will appear in yellow on the sleep graphs as shown below in Figure 54. The lux data can be hidden by deselecting the "Show LUX data" option at the bottom of the screen. Details regarding the significance of the lux values are revealed by hovering the mouse pointer over the "Lux Info" link at the bottom of the screen as shown in Figure 55. Note that these levels are only estimates and are not meant for exact interpretation of the light detected by the device.

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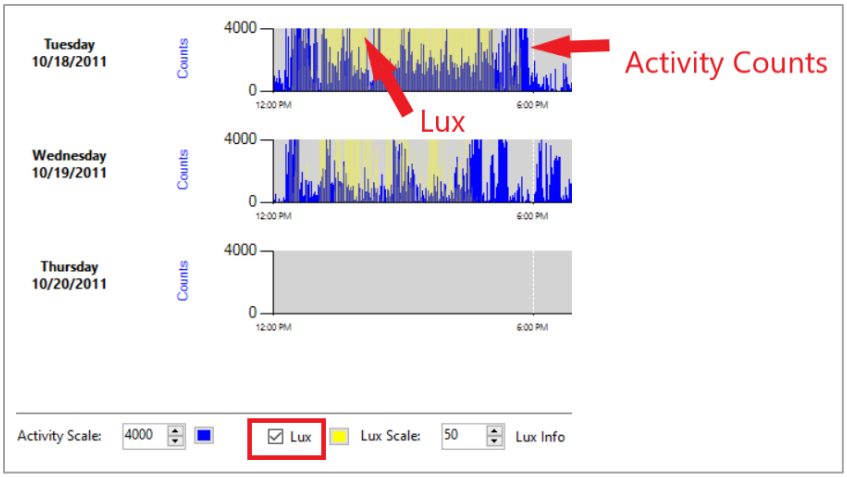

FIGURE 54 – LUX DATA OVERLAY ON SLEEP GRAPHS

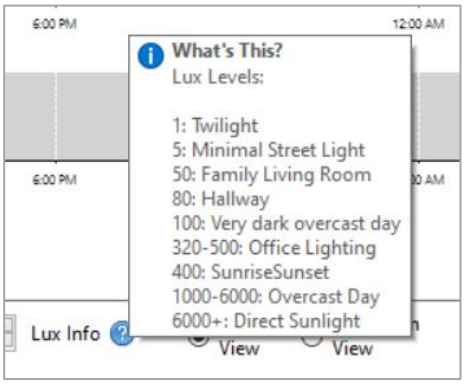

FIGURE 55 – LUX THRESHOLDS

Sleep Scoring Algorithms

The Sleep Analysis tool comes standard with two validated algorithms (Sadeh [1]or Cole-Kripke[2]) to determine minute-by-minute asleep/awake status. These algorithms are selectable by the user and can be changed instantly for comparison purposes. The algorithms are described below. Select the desired algorithm by choosing it from the "Algorithm" drop-down menu at the top right-hand corner of the Sleep Analysis tool. More information is available about the origin of the algorithms by clicking "Sleep Algorithm Information" link below the algorithm dropdown menu.

[1] "Automatic Sleep/Wake Identification From Wrist Activity", Roger J. Cole, Daniel F. Kripke, etal, Sleep 12(5):461-469, 1992 American Sleep Disorders Association and Sleep Research Society
[2] "Activity-Based Sleep-Wake Identification: An Emprical Test of Methodological Issues", Avi Sadeh, K.M. Sharkey and M. A. Carskadoon, Sleep17(3): 201-207, 1994 American Sleep Disorders Association and Sleep Research Society

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Cole-Kripke Algorithm

The Cole-Kripke algorithm is considered appropriate for use with adult populations because it was developed using subjects ranging from 35 to 65 years of age. Roger J. Cole and Daniel F. Kripke adapted a scoring method developed by J. B. Webster with an experimental wrist ActiGraph for the AMI ActiGraph in 1992. It was developed using 10, 30 and 60 epochs, with the highest level of accuracy resulting from data collected at 10 second epoch periods.

The algorithm was adapted to the ActiGraph ActiSleep monitor by performing a side-by-side test using the AMI device and the ActiSleep monitor worn together. The data were scaled then put through the algorithms until the ActiSleep monitor sleep score matched that from the AMI device.

Sadeh Algorithm Summary

The Sadeh algorithm was developed by Dr. Avi Sadeh from Tel-Aviv University in Israel and is considered appropriate for younger populations because it was developed using subjects ranging from 10 to 25 years of age. He used the same device that Cole-Kripke used to develop their algorithm, and ActiGraph therefore adapted it in the same way by scaling our data until it matched up with the scoring results of the AMI device. In general terms, this algorithm determines a subject's sleep state by examining the ActiGraph activity over an 11-minute sliding window. For any given window, a "Sleep Score" (whether the person is asleep or not) can be determined by applying this formula. After selecting a sleep time (Time In Bed (TIB) and Time Out of Bed (TOB)) each minute of sleep data is analyzed this way.

Custom Sleep Algorithms

A custom sleep scoring algorithm that uses the same "sliding window" concept as the Sadeh and Cole-Kripke algorithms can be created using the "Create New" option from the Algorithm dropdown menu.

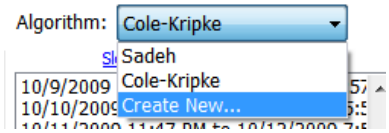

FIGURE 41 - CUSTOM SLEEP ALGORITHM

The *Custom Sleep Scoring Parameters* form shown in Figure 57 will load.

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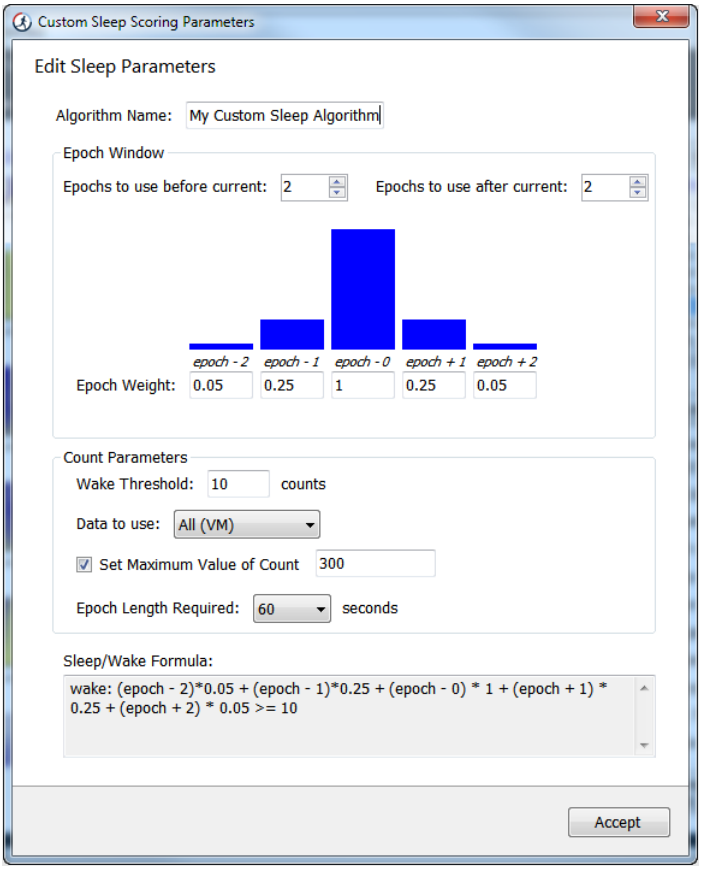

FIGURE 57 - CUSTOM SLEEP SCORING DESIGN FORM

This tool will allow users to customize the following settings.

Algorithm Name

The Algorithm Name is the name that will appear in the drop-down menu after the algorithm design is complete.

Epoch Window

The sliding window technique works as follows: All epochs in a given dataset are scanned. Each epoch of data receives a sleep or a *wake* score based on its count level as well as the count levels of other epochs before and after itself. This "window" of epochs and surrounding epochs then "slides" to the next epoch (and surrounding epochs) and the process repeats.

The *Epoch Window* defines the sliding window and the weighting which is given to the current and surrounding epochs in order to determine whether to score the current epoch as *sleep* or *wake*. To increase the size of the window, adjust the "Epochs to use before current" and "Epochs to use after current" options; the graphic will increase or decrease in width automatically.

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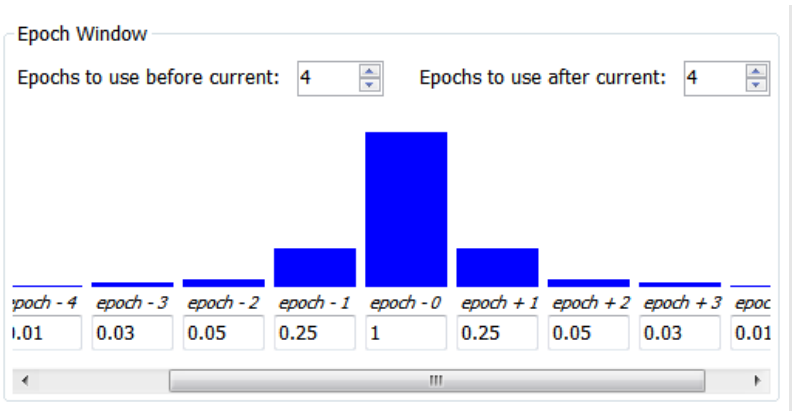

FIGURE 58 - CUSTOM SLEEP SCORE EPOCH WINDOW

Adjust the numbers below the surrounding epochs to change the weighting. Change the Wake Threshold in the Count Parameters section to adjust the comparison level. The Sleep/Wake formula at the bottom of the Custom Sleep Algorithm tool shows the formula used to determine whether the current epoch (*epoch-0*) is scored as *wake* or *sleep*. In the formula show in Figure 59, the current epoch will be scored as wake if the formula is greater than or equal to 10.

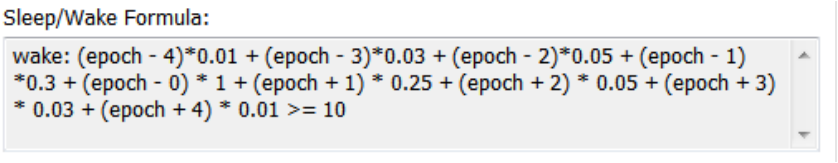

FIGURE 59 - SLEEP/WAKE FORMULA

Count Parameters

Wake Threshold – This is the value which the sliding window is compared to in order to determine *sleep* or *wake* status for *epoch-0*

Data to Use: Users have the option of using Axis 1, Axis 2, or Axis 3 data to calculate the custom sleep score. Alternatively, the Vector Magnitude (VM) of all 3 axes can be used.

Set Maximum Value of Count – Use this option to put a limit on the maximum weight a particular epoch can have on the sleep/wake formula. For instance, if (epoch-2)*0.05 = 500 (see Figure 59), setting the Maximum Value of Count to 300 would actually limit that epoch's contribution to 300 (rather than 500).

Epoch Length Required – This option allows users to specify a required epoch length for datasets using the new customized formula. Datasets that do not meet this requirement cannot be used – ActiLife will automatically attempt to reintegrate lesser epoch sized datasets up to the required epoch length.

Portability of the Custom Sleep Algorithm

Once the custom algorithm has been written, it can be shared with other ActiLife users. Simply run the custom algorithm against an *.agd dataset to produce the Sleep Score Information for that dataset. That *.agd will then contain the custom sleep score algorithm. Whenever the *.agd file is shared with other users, this algorithm will automatically appear in their algorithm dropdown menu in the Sleep Analysis tool.

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Sleep Score Information

Both algorithms will yield the following information within ActiLife's Sleep Scoring tool for each sleep period. Sleep period scores can be seen by clicking on the sleep period of interest on the right-hand side of the screen (see Figure 47 for an illustration).

Sleep Onset - The first minute that the algorithm scores "asleep."

Total Sleep Time (TST) – The total number of minutes scored as "asleep."

Wake after Sleep Onset (WASO) – The total amount of time a subject is awake during a sleep period, minus the sleep latency.

Awakenings - The number of different awakening episodes as scored by the algorithm. This is sometimes referred to as Frequency of Awakenings (shown as the number of awakenings per night).

Avg Awakening – The average length, in minutes, of all awakening episodes.

Total Counts – The total actigraphy counts summed together for the entire sleep period.

Efficiency – Number of sleep minutes divided by the total number of minutes the subject was in bed (i.e., the difference between the In-Bed and Out Bed time).

ActoGram View

The ActoGram view option provides ActiLife users with the ability to quickly discern circadian patterns in sleep behavior by scaling and compressing the sleep graphs. Enable the ActoGram view by choosing the radio button corresponding to this view at the bottom of the Sleep Scoring tool. Figure 60 illustrates an ActoGram view.

Several options exist for editing the ActoGram view.

Show 6 Hour Ticks – This option will toggle the periodic 6-hour hash marks on the ActoGram graph.

Show Hourly Ticks – This option will toggle the periodic hourly hash marks on the ActoGram graph.

Graphs Per Page – Use this option to compress or expand the ActoGram view vertically.

Lux – This check box toggles the ambient light data on the ActoGram view (in yellow)

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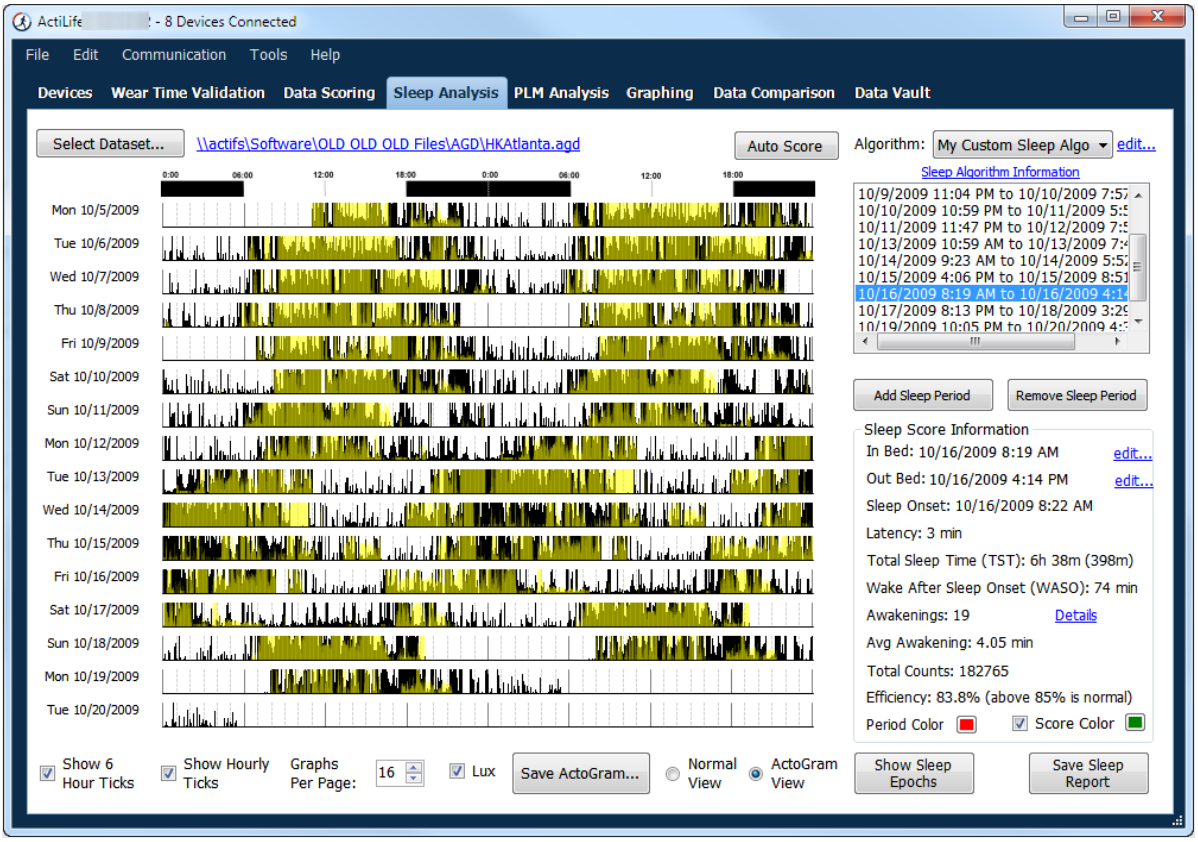

FIGURE 60 – ACTOGRAM VIEW

Saving the ActoGram

The ActoGram can be saved as a sharable image by clicking "Save ActoGram" at the bottom of the graph. This option will give the user the option to export the ActoGram to a .jpg image for sharing.

Show Sleep Epochs

Clicking the "Show Sleep Epochs" button will load a matrix of each epoch in the dataset with details about whether the epoch was scored as a "Sleep Epoch" (indicated by an "S") or a "Wake Epoch" (indicated by a "W"). This list can be exported to CSV by clicking "Save" at the bottom of the form or by copying and pasting the values. In addition, the entire list can be copied to the clipboard by clicking the corresponding button – the list can then be pasted into any text editor.

Save Sleep Report

Sleep scores produced in the Sleep Scoring tab can be exported to either a CSV or PDF file by clicking the "Save Sleep Report" option at the bottom right-hand side of the screen. Select the desired output from the options dialog that appears. Browse to the export location, type a file name, and click "Save" to begin the export.

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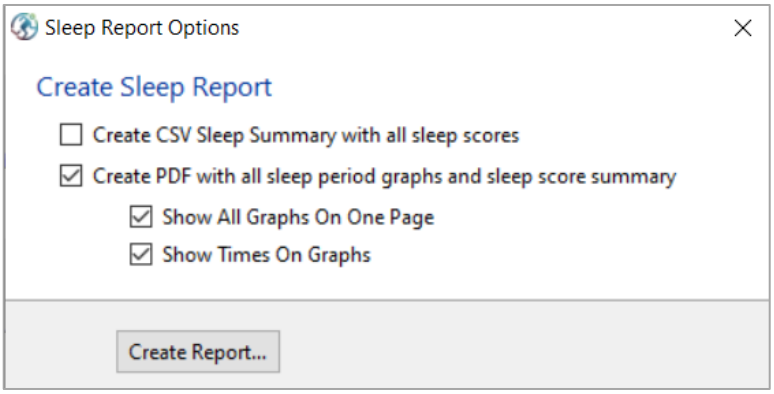

FIGURE 61 – SAVE SLEEP REPORT DIALOG

Batch Sleep

Overview

In ActiLife 6.13, a new tab was added to ActiLife to let you run multiple files through sleep scoring.

Batch sleep lets you run multiple AGDs through sleep processing and quickly generate exports. Instead of calculating one file at a time using the standard sleep tab, batch sleep can automatically calculate sleep periods for 1 or 10,000 files.

Batch Sleep Output

The batch sleep tab calculates the following averages for each file:

- Number of sleep periods
- Average in bed time
- Average out of bed time
- Average efficiency
- Average onset time
- Average latency
- Average total sleep time (TST)
- Average WASO (*Wakefulness After Sleep Onset*)
- Average number of awakenings
- Average length of awakenings
- Average total counts

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- Average movement index
- Average fragmentation index
- Average sleep fragmentation index

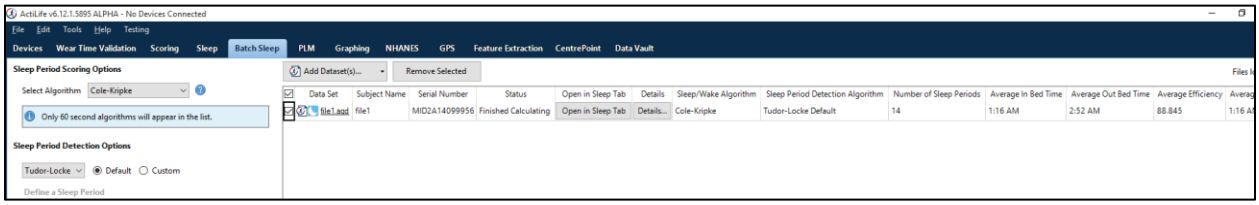

FIGURE 62 - BATCH SLEEP

For each sleep period in a file, ActiLife provides:

- In bed time
- Out of bed time
- Efficiency
- Onset time
- Latency
- Total sleep time (TST)
- WASO
- Number of awakenings
- Average length of awakenings
- Total counts
- Movement index
- Fragmentation index
- Sleep fragmentation index

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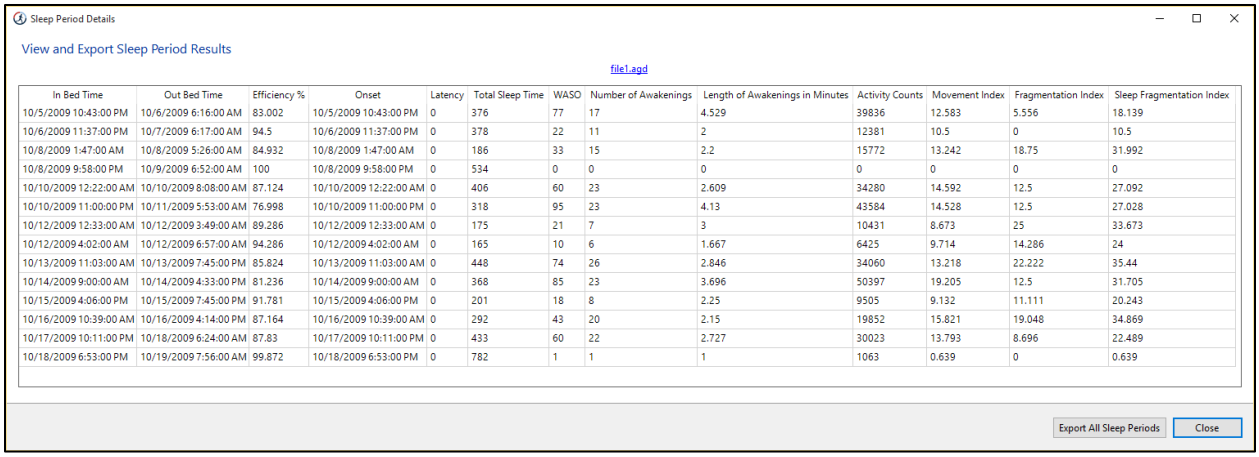

In Bed Time	Out Bed Time	Efficiency %	Onset	Latency	Total Sleep Time	WASO	Number of Awakenings	Length of Awakenings in Minutes	Activity Counts	Movement Index	Fragmentation Index	Sleep Fragmentation Index
10/5/2009 10:43:00 PM	10/6/2009 6:16:00 AM	83.002	10/5/2009 10:43:00 PM	0	376	77	17	4.529	39836	12.583	5.556	18.139
10/6/2009 11:37:00 PM	10/7/2009 6:17:00 AM	94.5	10/6/2009 11:37:00 PM	0	378	22	11	2	12381	10.5	0	10.5
10/8/2009 1:47:00 AM	10/8/2009 5:26:00 AM	84.932	10/8/2009 1:47:00 AM	0	186	33	15	2.2	15772	13.242	18.75	31.992
10/8/2009 9:58:00 PM	10/9/2009 6:52:00 AM	100	10/8/2009 9:58:00 PM	0	534	0	0	0	0	0	0	0
10/10/2009 12:22:00 AM	10/10/2009 8:08:00 AM	87.124	10/10/2009 12:22:00 AM	0	406	60	23	2.609	34280	14.592	12.5	27.092
10/10/2009 11:00:00 PM	10/11/2009 5:53:00 AM	76.998	10/10/2009 11:00:00 PM	0	318	95	23	4.13	43584	14.528	12.5	27.028
10/12/2009 12:33:00 AM	10/12/2009 3:49:00 AM	89.286	10/12/2009 12:33:00 AM	0	175	21	7	3	10431	8.673	25	33.673
10/12/2009 4:02:00 AM	10/12/2009 6:57:00 AM	94.286	10/12/2009 4:02:00 AM	0	165	10	6	1.667	6425	9.714	14.286	24
10/13/2009 11:03:00 AM	10/13/2009 7:45:00 PM	85.824	10/13/2009 11:03:00 AM	0	448	74	26	2.846	34060	13.218	22.222	35.44
10/14/2009 9:00:00 AM	10/14/2009 4:33:00 PM	81.236	10/14/2009 9:00:00 AM	0	368	85	23	3.696	50397	19.205	12.5	31.705
10/15/2009 4:06:00 PM	10/15/2009 7:45:00 PM	91.781	10/15/2009 4:06:00 PM	0	201	18	8	2.25	9505	9.132	11.111	20.243
10/16/2009 10:39:00 AM	10/16/2009 4:14:00 PM	87.164	10/16/2009 10:39:00 AM	0	292	43	20	2.15	19852	15.821	19.048	34.869
10/17/2009 10:11:00 PM	10/18/2009 6:24:00 AM	87.83	10/17/2009 10:11:00 PM	0	433	60	22	2.727	30023	13.793	8.696	22.489
10/18/2009 6:53:00 PM	10/19/2009 7:56:00 AM	99.872	10/18/2009 6:53:00 PM	0	782	1	1	1	1063	0.639	0	0.639

FIGURE 63 - SLEEP PERIOD RESULTS

Batch Sleep Export

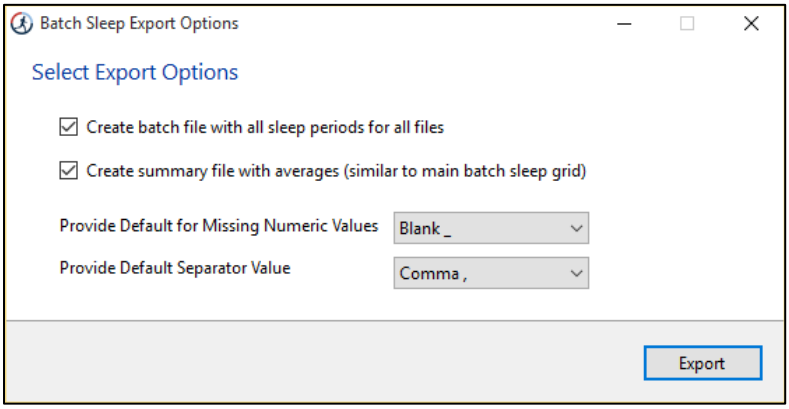

FIGURE 64 - BATCH SLEEP EXPORT OPTIONS

You can choose from two different exports. The first export is a batch file which has every sleep period for every file selected.

This is a CSV file with a row for each sleep period and the metrics for each of those sleep periods.

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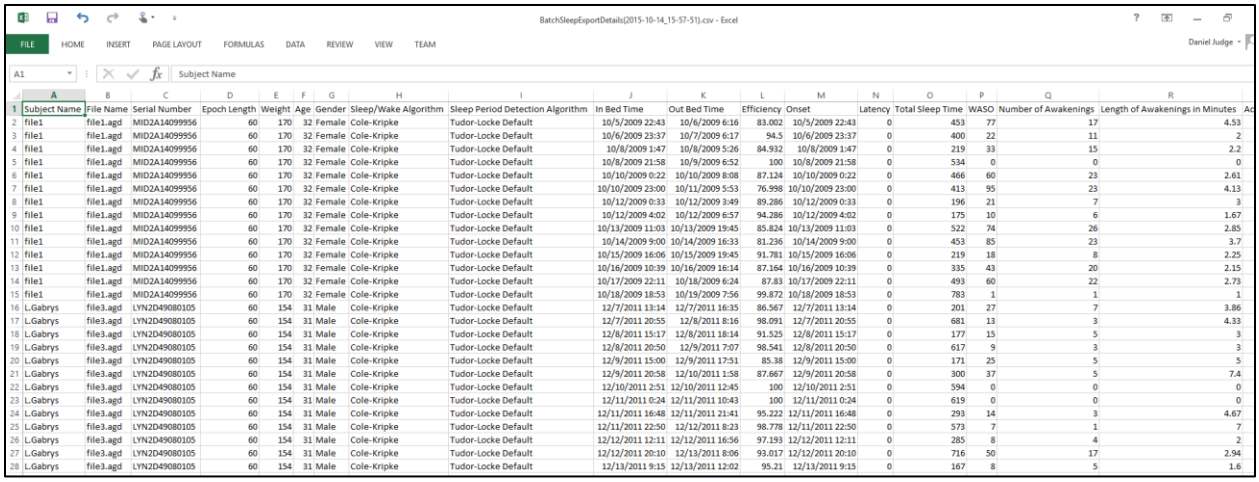
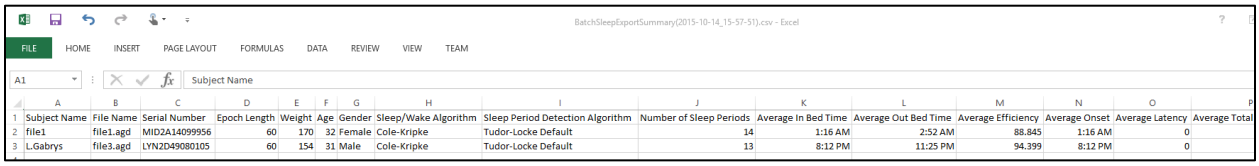


Subject Name	File Name	Serial Number	Epoch Length	Weight	Age	Gender	Sleep/Wake Algorithm	Sleep Period Detection Algorithm	In Bed Time	Out Bed Time	Efficiency	Onset	Latency	Total Sleep Time	WASO	Number of Awakenings	Length of Awakenings in Minutes
file1	file1.agd	MID2A14099956	60	170	32	Female	Cole-Kripke	Tudor-Locke Default	10/5/2009 22:43	10/6/2009 6:16	83.002	10/5/2009 22:43	0	453	77	17	4.53
file1	file1.agd	MID2A14099956	60	170	32	Female	Cole-Kripke	Tudor-Locke Default	10/6/2009 23:37	10/7/2009 6:17	94.5	10/6/2009 23:37	0	400	22	11	2
file1	file1.agd	MID2A14099956	60	170	32	Female	Cole-Kripke	Tudor-Locke Default	10/8/2009 1:47	10/8/2009 5:26	84.932	10/8/2009 1:47	0	219	33	15	2.2
file1	file1.agd	MID2A14099956	60	170	32	Female	Cole-Kripke	Tudor-Locke Default	10/8/2009 21:58	10/9/2009 6:52	100	10/8/2009 21:58	0	534	0	0	0
file1	file1.agd	MID2A14099956	60	170	32	Female	Cole-Kripke	Tudor-Locke Default	10/10/2009 0:22	10/10/2009 8:08	87.124	10/10/2009 0:22	0	466	60	23	2.61
file1	file1.agd	MID2A14099956	60	170	32	Female	Cole-Kripke	Tudor-Locke Default	10/10/2009 23:00	10/11/2009 5:53	76.998	10/10/2009 23:00	0	413	95	23	4.13
file1	file1.agd	MID2A14099956	60	170	32	Female	Cole-Kripke	Tudor-Locke Default	10/12/2009 0:33	10/12/2009 3:49	89.286	10/12/2009 0:33	0	196	21	7	3
file1	file1.agd	MID2A14099956	60	170	32	Female	Cole-Kripke	Tudor-Locke Default	10/12/2009 4:02	10/12/2009 6:57	94.286	10/12/2009 4:02	0	175	10	6	1.67
file1	file1.agd	MID2A14099956	60	170	32	Female	Cole-Kripke	Tudor-Locke Default	10/13/2009 11:03	10/13/2009 19:45	85.824	10/13/2009 11:03	0	522	74	26	2.85
file1	file1.agd	MID2A14099956	60	170	32	Female	Cole-Kripke	Tudor-Locke Default	10/14/2009 9:00	10/14/2009 16:33	81.236	10/14/2009 9:00	0	453	85	23	3.7
file1	file1.agd	MID2A14099956	60	170	32	Female	Cole-Kripke	Tudor-Locke Default	10/15/2009 16:06	10/15/2009 19:45	91.781	10/15/2009 16:06	0	219	18	8	2.25
file1	file1.agd	MID2A14099956	60	170	32	Female	Cole-Kripke	Tudor-Locke Default	10/16/2009 10:39	10/16/2009 16:14	87.164	10/16/2009 10:39	0	335	43	20	2.15
file1	file1.agd	MID2A14099956	60	170	32	Female	Cole-Kripke	Tudor-Locke Default	10/17/2009 22:11	10/18/2009 6:24	87.83	10/17/2009 22:11	0	493	60	22	2.73
file1	file1.agd	MID2A14099956	60	170	32	Female	Cole-Kripke	Tudor-Locke Default	10/18/2009 18:53	10/19/2009 7:56	99.872	10/18/2009 18:53	0	783	1	1	1
L.Gabrys	file3.agd	LYN2D49080105	60	154	31	Male	Cole-Kripke	Tudor-Locke Default	12/7/2011 13:14	12/7/2011 16:35	86.567	12/7/2011 13:14	0	201	27	7	3.86
L.Gabrys	file3.agd	LYN2D49080105	60	154	31	Male	Cole-Kripke	Tudor-Locke Default	12/7/2011 20:55	12/8/2011 8:16	98.091	12/7/2011 20:55	0	681	13	3	4.33
L.Gabrys	file3.agd	LYN2D49080105	60	154	31	Male	Cole-Kripke	Tudor-Locke Default	12/8/2011 15:17	12/8/2011 18:14	91.525	12/8/2011 15:17	0	177	15	5	3
L.Gabrys	file3.agd	LYN2D49080105	60	154	31	Male	Cole-Kripke	Tudor-Locke Default	12/8/2011 20:50	12/9/2011 7:07	98.541	12/8/2011 20:50	0	617	9	3	3
L.Gabrys	file3.agd	LYN2D49080105	60	154	31	Male	Cole-Kripke	Tudor-Locke Default	12/9/2011 15:00	12/9/2011 17:51	85.38	12/9/2011 15:00	0	171	25	5	5
L.Gabrys	file3.agd	LYN2D49080105	60	154	31	Male	Cole-Kripke	Tudor-Locke Default	12/9/2011 20:58	12/10/2011 1:58	87.667	12/9/2011 20:58	0	300	37	5	7.4
L.Gabrys	file3.agd	LYN2D49080105	60	154	31	Male	Cole-Kripke	Tudor-Locke Default	12/10/2011 2:51	12/10/2011 12:45	100	12/10/2011 2:51	0	594	0	0	0
L.Gabrys	file3.agd	LYN2D49080105	60	154	31	Male	Cole-Kripke	Tudor-Locke Default	12/11/2011 0:24	12/11/2011 10:43	100	12/11/2011 0:24	0	619	0	0	0
L.Gabrys	file3.agd	LYN2D49080105	60	154	31	Male	Cole-Kripke	Tudor-Locke Default	12/11/2011 16:48	12/11/2011 21:41	95.222	12/11/2011 16:48	0	293	14	3	4.67
L.Gabrys	file3.agd	LYN2D49080105	60	154	31	Male	Cole-Kripke	Tudor-Locke Default	12/11/2011 22:50	12/12/2011 8:23	98.778	12/11/2011 22:50	0	573	7	1	7
L.Gabrys	file3.agd	LYN2D49080105	60	154	31	Male	Cole-Kripke	Tudor-Locke Default	12/12/2011 12:11	12/12/2011 16:56	97.193	12/12/2011 12:11	0	285	8	4	2
L.Gabrys	file3.agd	LYN2D49080105	60	154	31	Male	Cole-Kripke	Tudor-Locke Default	12/12/2011 20:10	12/13/2011 8:06	93.017	12/12/2011 20:10	0	716	50	17	2.94
L.Gabrys	file3.agd	LYN2D49080105	60	154	31	Male	Cole-Kripke	Tudor-Locke Default	12/13/2011 9:15	12/13/2011 12:02	95.21	12/13/2011 9:15	0	167	8	5	1.6

FIGURE 65 - BATCH SLEEP PERIODS EXPORT

The second export is a summary CSV file with one row per file exported. It provides the same averages that the main grid in the batch sleep tab shows.



Subject Name	File Name	Serial Number	Epoch Length	Weight	Age	Gender	Sleep/Wake Algorithm	Sleep Period Detection Algorithm	Number of Sleep Periods	Average In Bed Time	Average Out Bed Time	Average Efficiency	Average Onset	Average Latency	Average Total
file1	file1.agd	MID2A14099956	60	170	32	Female	Cole-Kripke	Tudor-Locke Default	14	1:16 AM	2:52 AM	88.845	1:16 AM	0	
L.Gabrys	file3.agd	LYN2D49080105	60	154	31	Male	Cole-Kripke	Tudor-Locke Default	13	8:12 PM	11:25 PM	94.399	8:12 PM	0	

FIGURE 66 - BATCH SLEEP PERIODS SUMMARY FILE

Batch Sleep Algorithms and Calculations

Batch sleep works with any 60-second sleep/wake algorithm. ActiLife ships with two algorithms: Cole-Kripke and Sadeh. For more information on which algorithm to choose, please see our help article that details the two algorithms. Any 60-second custom algorithms that you generate will also work with batch sleep.

Sleep Period Detection Algorithms

To detect sleep periods, ActiLife currently offers the Tudor-Locke algorithm and a custom ActiGraph internal algorithm. If you are interested in more information, please check out the help article that details the two algorithms.

Overwrite Previous Sleep Periods

ActiLife will not overwrite any of your previous sleep periods unless you choose to do so. There is an option in the "Overwriting Existing Data Options" to recalculate sleep periods.

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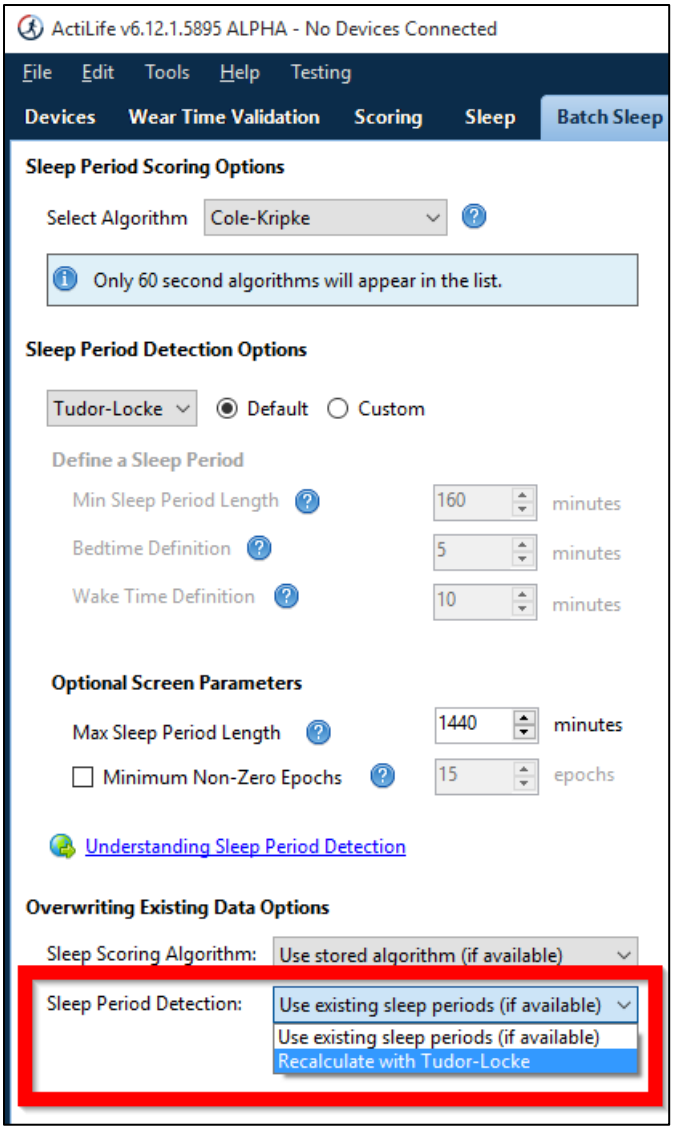

FIGURE 67 - RECALCULATE EXISTING SLEEP PERIODS

If you accidentally choose this open and your files have sleep periods already, ActiLife will warn you that you are going to overwrite sleep periods in those files.

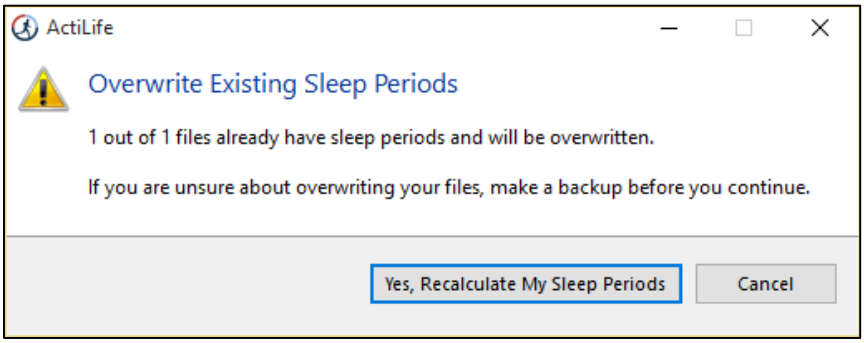

FIGURE 68 - OVERWRITE WARNING MESSAGE

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Batch Sleep File Format

The batch sleep feature works with any 60-second AGD from an Ametris device. If you would like to upgrade your license to include the advanced sleep features, please contact our Support Team at Support@Ametris.Com. These advanced sleep features also include actogram data charting in sleep tab, PLM tool, and custom sleep algorithms.

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Heart Rate Data Extraction from Leap Devices

In order to calculate heart rate, heart rate variability and cardiac rhythms, the following steps must be performed:

1. Initialize a LEAP device to collect raw accelerometer and ppg data. The Heart Rate program will synchronize data from accelerometer and PPG sensors. Sampling accelerometer data at 32Hz is sufficient.

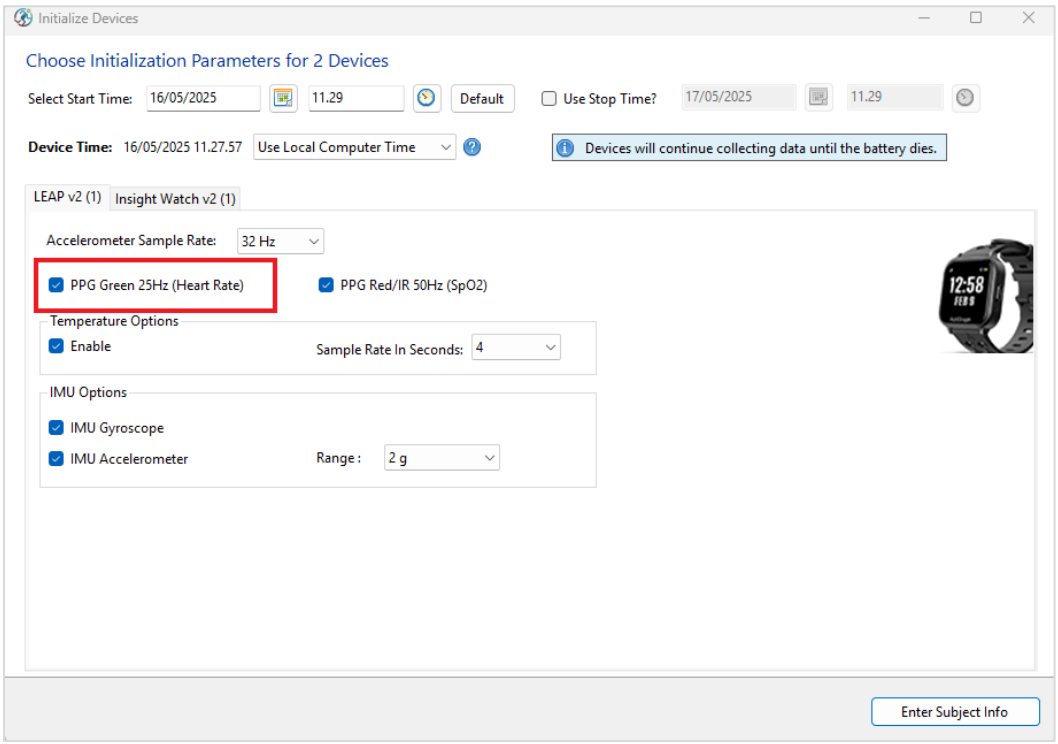

FIGURE 69 - INITIALIZATION WITH PPG GREEN 25HZ

2. Collect data from the LEAP device.
3. Download data from the LEAP device. This file will be in .agsd format. The default download directory is Documents\ActiGraph\ActiLife\Downloads.
4. To generate raw and PPG 25Hz CSV file compatible with the **Heart Rate program**, it is recommended to select “Use ISO Date format” and “Use United States Region Settings” options.
5. Convert the agsd file to raw csv files. You will get a ppg.csv file, alongside a raw.csv file.

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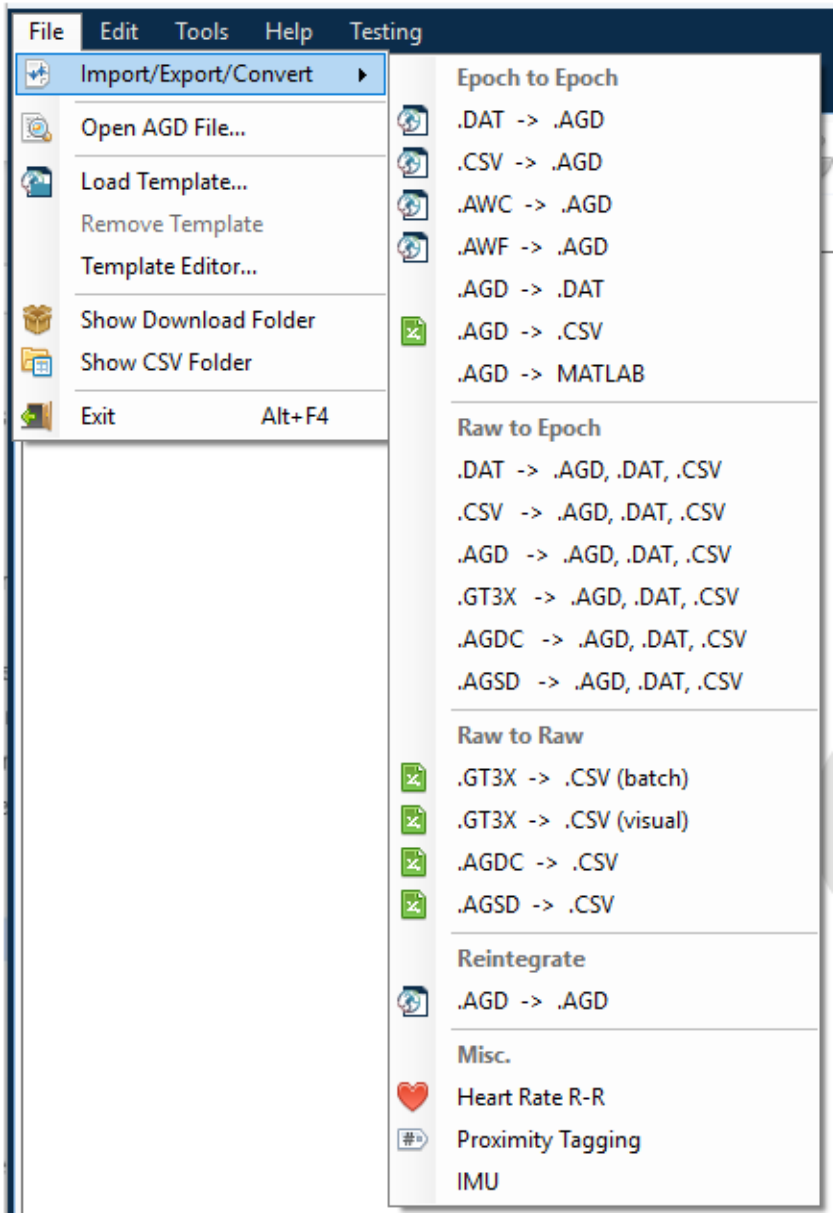

FIGURE 71 - CONVERT AGSD TO CSV

6. Do NOT resample the accelerometer data (this is deselected by default)

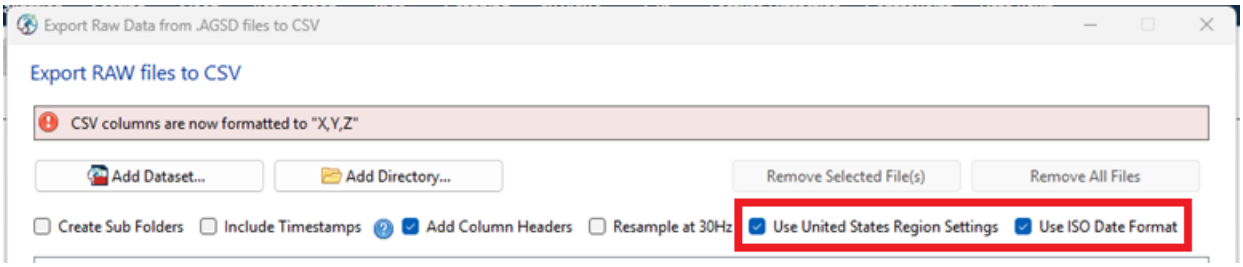

FIGURE 72 - RESAMPLING AGSD FILE

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7. You now have a raw accelerometer data csv (“RAW.csv”), and a raw PPG data csv (“ppg.csv”). These will both be utilized in our command prompt to retrieve heart rate data.
8. If your time zone is NOT United States, please ensure you select the “Use United States Region Settings” checkbox.
9. Click “Use ISO Date Format” checkbox to ensure that the output file contains date in ISO format.
10. The exported file should now contain data with Date in ISO format.
11. This can be imported into the HR exe as explained in “Heart rate Algorithm” section.
12. Open your command prompt by either searching “Command Prompt” in your windows search, or by using the WIN+R shortcut and then entering “cmd” before clicking OK.

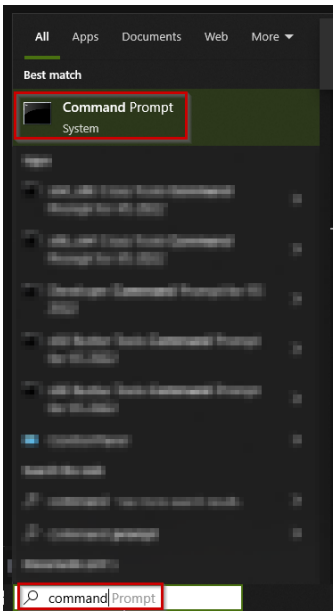

FIGURE 73A - COMMAND PROMPT

13. Enter the hr.exe file directory into the command prompt first to make sure we are utilizing the heart rate program (do not run it yet).

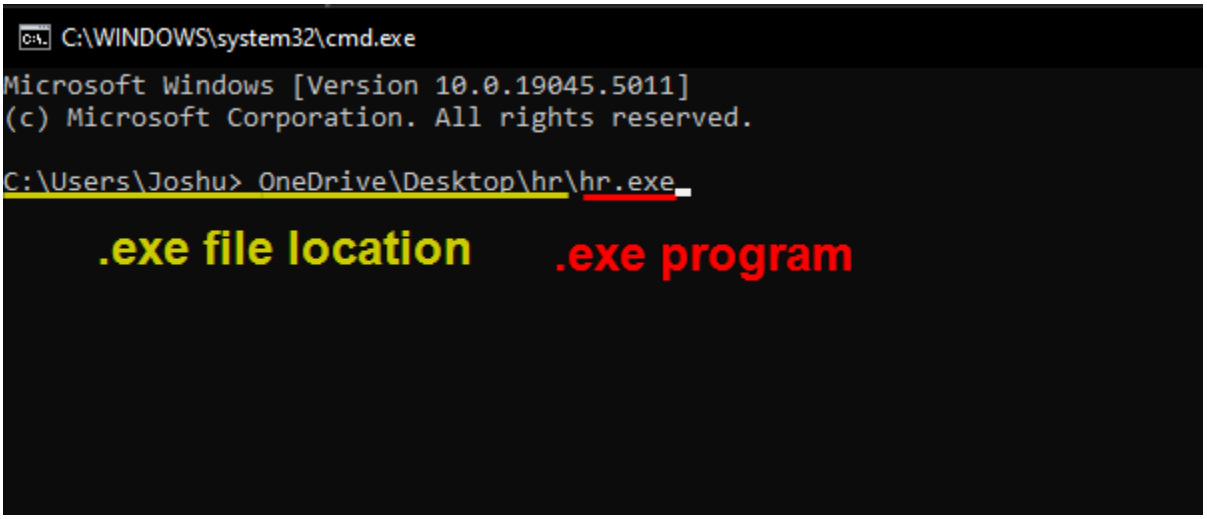

FIGURE 73B - COMMAND PROMPT HR.EXE FILE

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14. Enter the file directories for both the raw accelerometer data file (use –a) “RAW.csv” and the raw PPG data file (use –p) “ppg.csv”, then dictate your time zone (use –z).

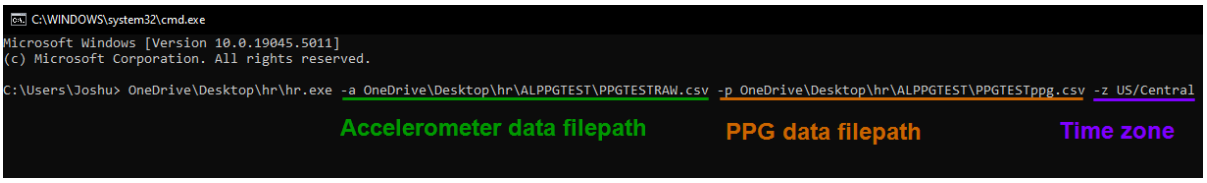

FIGURE 73C - RAW FILE DIRECTORIES

15. Lastly, enter the program(s) that you want to run, choosing their output directory and output filenames. A list of programs can be found later. In this screenshot, we will run IBI endpoints as an example.

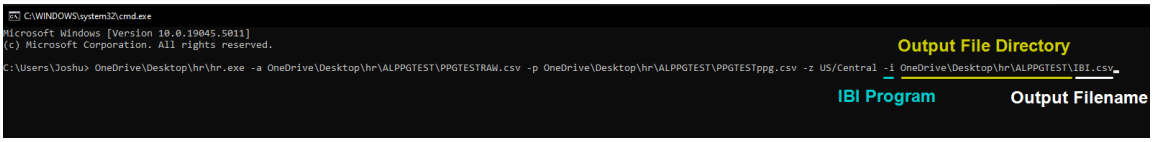

FIGURE 73D - PROGRAM AND OUTPUT DIRECTORY

16. Press Enter to execute the algorithm.

Examine the output files. By default, they are in the folder from where the algorithm is executed. The files can be viewed in, for example, Excel.

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Heart rate algorithm

The heart rate command line programs allow measuring heart rate, heart rate variability and cardiac rhythm from accelerometer and green PPG data collected using a LEAP device. This program can be downloaded from the Ametris Website's ActiLife page after entering the appropriate ActiLife 7 License Key.

Graphical user interface

The graphical user interface allows the analysis of one set of accelerometer and PPG csv files. Double click on the program to run it. You will be presented with the interface shown in the following figure.

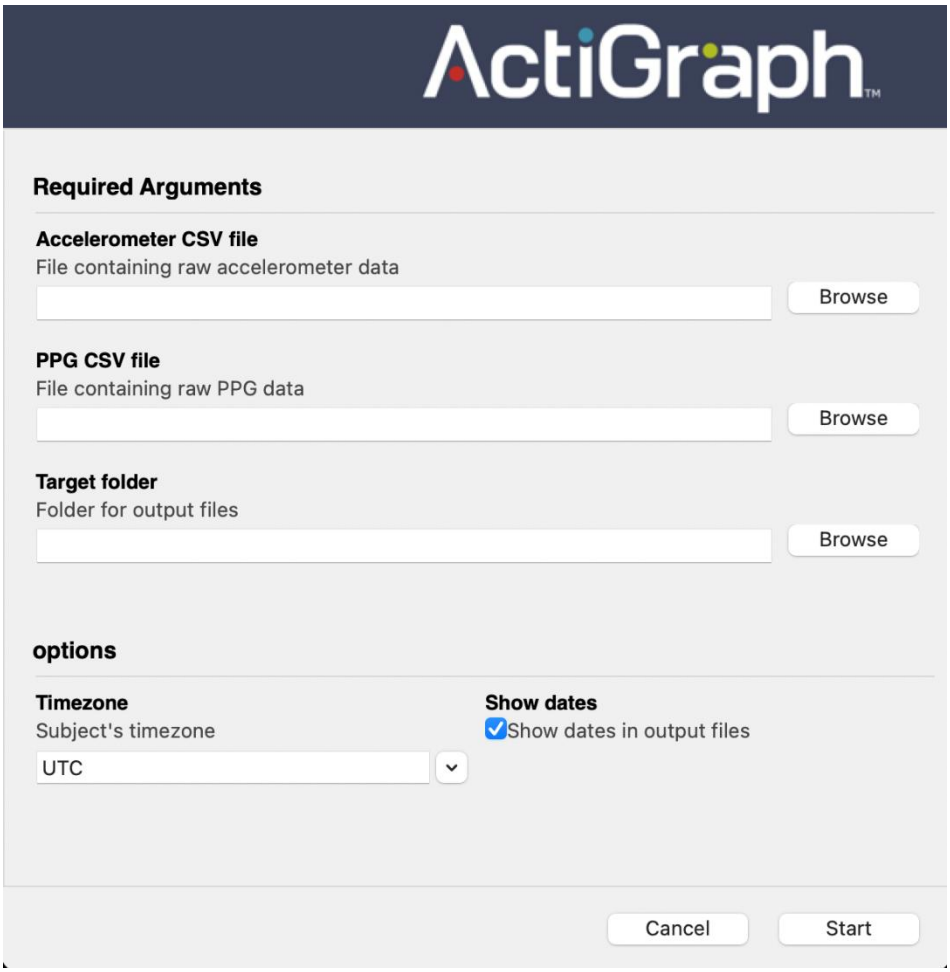

FIGURE 74 - HEART RATE GRAPHICAL USER INTERFACE

You can select input files for both accelerometer and PPG data. Then, choose a folder where output files will be created. Finally. Select a time zone from the list of available time zones. You can type part of the timezone's name (e.g. "Central" for "US/Central") to narrow down the list.

Clicking on start will start the process and output files will be visible in the selected target folder.

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Command line client

The program can be run from the command line. In order to access the command line on a computer running Microsoft Windows, you can press and hold the Windows key, and press R. Then, type `cmd` and press enter. You can run the program by typing in its full path.

The following parameters are supported:

Short name	Long name	Description	Default value
-a	--accel-input-path	Accelerometer Input file path	NA
-p	--ppg-input-path	PPG Input file path	NA
-z	--timezone	Timezone	UTC
-s	--show-dates	Show dates in the output files. If set to False, only time and day-of-the-week data is shown.	True
-e	--hr-output-filename-epochs	Heart Rate Output file name	HeartRate.csv
-d	--hr-output-filename-days	Heart Rate Daily Aggregations Output file name	HeartRateDays.csv
-u	--hrv-output-filename-epochs	Heart Rate Variability Output file name	HeartRateVar.csv
-v	--hrv-output-filename-days	Heart Rate Variability Daily Aggregations Output file name	HeartRateVarDays.csv
-b	--cr-output-filename-epochs	Cardiac Rhythm Output file name	CardiacRhythm.csv
-c	--cr-output-filename-days	Cardiac Rhythm Daily Aggregations Output file name	CardiacRhythmDays.csv
-i	--ibi-output-filename	Inter-beat Interval Output file name	InterBeatInterval.csv

TABLE 6 - COMMAND LINE

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The list of available parameters can also be seen using the `--help` switch. The version of the tool can be seen using the `–version` switch

The program expects two csv files to be provided as inputs. One file must contain raw accelerometer data exported from ActiLife. The other must contain raw green PPG data, also expected from ActiLife. Both files need to be formatted as CSV files.

The command line tool needs to read both files into memory before it can process them and will need to align and resample the data. Because of this, it needs generous amounts of RAM. A computer with at least 32 GB of RAM is recommended to be able to process large files.

PLM Analysis

The Periodic Leg Movement (PLM) tool allows users to detect and score periodic leg movements in patients with PLM disorder or restless leg syndrome. This analysis serves as a cost-effective alternative to polysomnography (PSG) analysis.

Note: Ametris is working with leading sleep institutions to obtain research-backed validation on the PLM Analysis tool. However, at this time, the PLM analysis uses existing research to make estimates on the presence of PLM in patients.

Initializing Devices for PLM Analysis

To use the tool, initialize a monitor through the devices tab to start collecting data at the desired time. During initialization, ActiLife users have the option to print a sleep diary by navigating to the Tool's menu. The sleep diary can be used by patients who choose to wear the devices for several nights in their own homes or for doctors who are logging into multiple patients' sleep behaviors. Patients should be instructed to use the sleep diary to keep track of the time in bed (TIB) and time out of bed (TOB) for purposes of analysis.

Attach the monitor to the top interior of the patient's left and right feet around the ball of the foot as shown in the image below. This can be accomplished with bandage wrapping or with straps available from Ametris. Patients should wear the device during the entire duration of their total time in bed.

FIGURE 75 - WEAR LOCATION FOR PLM ANALYSIS

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Downloading Devices

After patients have worn the devices for the desired number of sleep periods, collect the devices and download them using the Devices tab. Monitors will produce an *.agd file on download. Data should be downloaded at 1s epochs. This file can be used for scoring PLM in the PLM tab. The wGT3X-BT and LEAP devices will create a *.gt3x or an *.agsd file on download. This file contains the raw acceleration data collected by the devices and needs to be post-processed (i.e., converted to *.agd format) prior to PLM scoring. This can be accomplished by choosing "Create AGD File" from the download dialog as shown in the figure below. Select 1s epoch and 3 axes. The other options are optional, but "Low Frequency Extension" should not be selected.

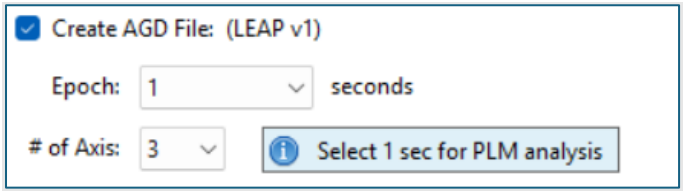

FIGURE 76 - DOWNLOAD SETTINGS FOR PLM ANALYSIS

After downloading, an AGD file will be created in the download folder which is also selected at the time of download.

Scoring the PLM Data

To score periodic leg movements, open the PLM tab and select the left and right leg *.agd files. Click the "Add Sleep Periods" button and select the entry method.

- *Add Period Using Bed Times* – Use this option to manually enter in times as recorded by the doctor or patient on the sleep diary.
- *Import from Separate AGD File* – Use this option to import sleep times from another AGD file that already contains the same sleep times.
- *Enter Period Graphically* – Coming soon.

Select which axis or axes to use to score the PLM data. The Vector Magnitude option combines all three axes using the vector magnitude formula. See Appendix B – Vector Magnitude for more information.

Select the thresholds for detecting legitimate "movement".

Note: these thresholds only set the level at which PLM activity occurs. ActiLife's built-in algorithm determines whether or not the movement qualifies as PLM.

- *Onset Threshold* – The threshold (in counts-per-epoch) at which PLM movement detection starts
- *Decay Threshold* – The threshold (in counts-per-epoch) at which PLM movement detection ends.

Onset and decay thresholds are available to introduce hysteresis into the movement detection.

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Interpreting the Periodic Limb Movement Output

After scoring files for Periodic Leg Movement, click on the different sleep periods to view the graph and PLM stats for each sleep period.

Graphs

Clicking on a sleep period will load a PLM score graph. The green background represents the total time in bed (sleep period) as logged by the user. The graph will automatically show data 1 hour before the time in bed and 1 hour after the time out of bed. The blue horizontal line represents the onset threshold, and the red horizontal line represents the decay threshold. The bar graph below the main activity graph gives users a quick reference to PLM bouts (bouts of activity that meet the qualifications of Periodic Leg Movement). Both graphs can be zoomed in or out simultaneously by dragging the mouse over the area of interest. To zoom back out, click the small circle in the lower left-hand corner of the graph until the desired zoom level is achieved.

Stats

- *PLMI (per hour)* - PLMI stands for Periodic Leg Movement Indices. This value represents the number of qualifying periodic leg movements per hour, averaged over the entire sleep period.
- *Minutes of PLM Kicks* - The total number of minutes of "kicks" or activity spikes that exceed the onset threshold AND the total minutes of consecutive "kicks" thereafter that exceed the decay threshold.
- *Number of PLM Kicks* - The number of "kicks" or activity spikes that exceed the onset threshold AND the number of consecutive "kicks" that exceed the decay threshold.
- *Number of PLM Bouts* - A count of the number of bouts of PLM that occurred during the selected sleep period.
- *Average PLM Bout Length (min)* - The average length, in minutes, of all of the PLM bouts for the selected sleep period.
- *Minutes of PLM Bouts* - The total time, in minutes, of PLM bouts. This time is different from the PLM kicks because kicks do not necessarily qualify as valid PLM.
- *Avg PLMS Intensity* - The average intensity of the PLM during Sleep of all of the PLM bouts. Essentially, this is the duty cycle of all PLM bouts. Avg PLMS Intensity = total minutes of valid PLM / total PLM bout length

For more information regarding the source of our PLM calculations, see our online FAQ, "How were the Periodic Leg Movement algorithms derived?".

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Graphing

ActiLife's graphing tab allows users to quickly see graphs of each day in a given dataset. Click "Select Dataset" and browse to an .agd file containing data. The graphs will load vertically and will be ordered from latest to most recent date, ascending downward. Zooming is accomplished by dragging the mouse over the area of interest. Graphs can be reset by clicking the small icon in the bottom left-hand corner of the graph.

Exporting

Graphs can be exported to a PDF by clicking "Export to PDF" in the top right corner of the Graphing tab. Selecting "Keep any zoom information" will output the graph with the current zoom view (if any). Individual days can be exported to pdf by checking or unchecking the days in the Export dialog.

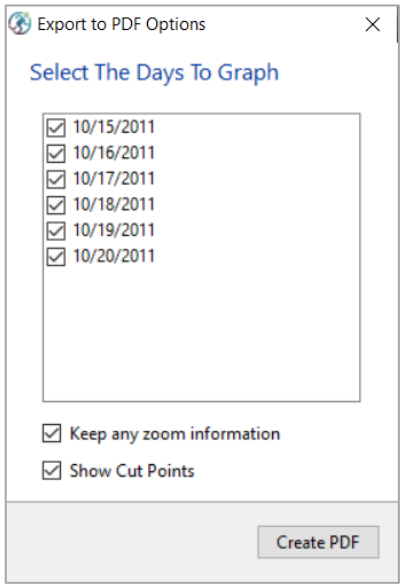

FIGURE 77 - GRAPHING EXPORT DIALOG

Mode Options

The "Mode Options" section to the right of the graphs gives users the ability to add or remove data items and change the color of various items on the graphs. If a dataset contains three-axis activity information (i.e., if the device was set to collect three-axis data upon initialization), all three axes will be available for selection (not disabled) in the "Mode Options" section. Deselecting any axis will remove it from the graph view. Multiple axes can be enabled simultaneously; however, in order to avoid cluttering the graph view, only one alternative data point can be shown simultaneously with activity data. To enable Steps, Heart Rate, Lux, or Inclination, select the radio button corresponding to the correct data point. A legend explaining the meaning of each data point will appear below the "Mode Option" section when a given data point is selected as shown in Figure 42. Axis values can be scaled by entering new values into the activity scale boxes to the right of the graphs.

Parameter graph colors can be selected by clicking the palette icon to the right of the variable of interest and choosing the desired color. The graph will immediately update with the new color.

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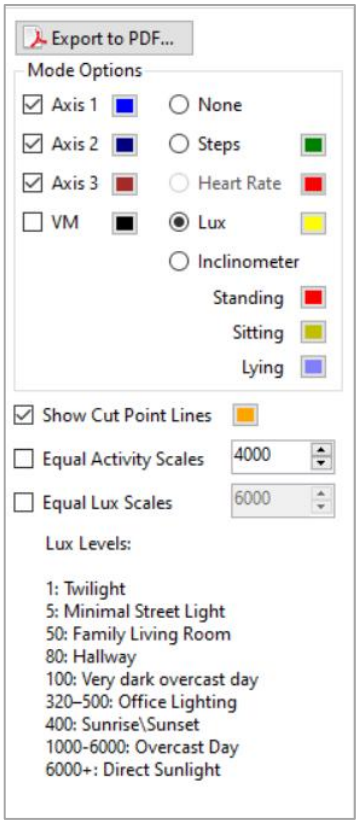

FIGURE 42 – GRAPH LEGENDS

Axes Scaling

Unless specified, each day shown in the graphing area is scaled individually according to the maximum values collected on that day. By checking the "Equal Scales" option on the right, all activity graphs will be scaled evenly according to the number in the scale box. These scale boxes can be seen in Figure 42.

Inclinometer

The inclinometer tool can be used to detect positional information when any 3-axis device is worn on the waist or thigh. Thigh-worn devices are inherently better at detecting sedentary (sitting/lying) versus non-sedentary (standing/stepping) than are waist-worn devices.

If an *.agd dataset contains no inclinometer data, a message similar to the one shown in Figure 43 will appear. To utilize the inclinometer tool, select "Inclinometer" when initializing a GT3X or when creating an *.agd file from a WGT3X-BT device. It is important that the device wear-location be specified for any *.agd file. To edit the wear location, open the *.agd file in the AGD File Viewer and edit the biometric information; update the "Limb" to be either "Waist" or "Thigh".

Note: Only Waist and Thigh worn devices can be used with the Inclinometer tool

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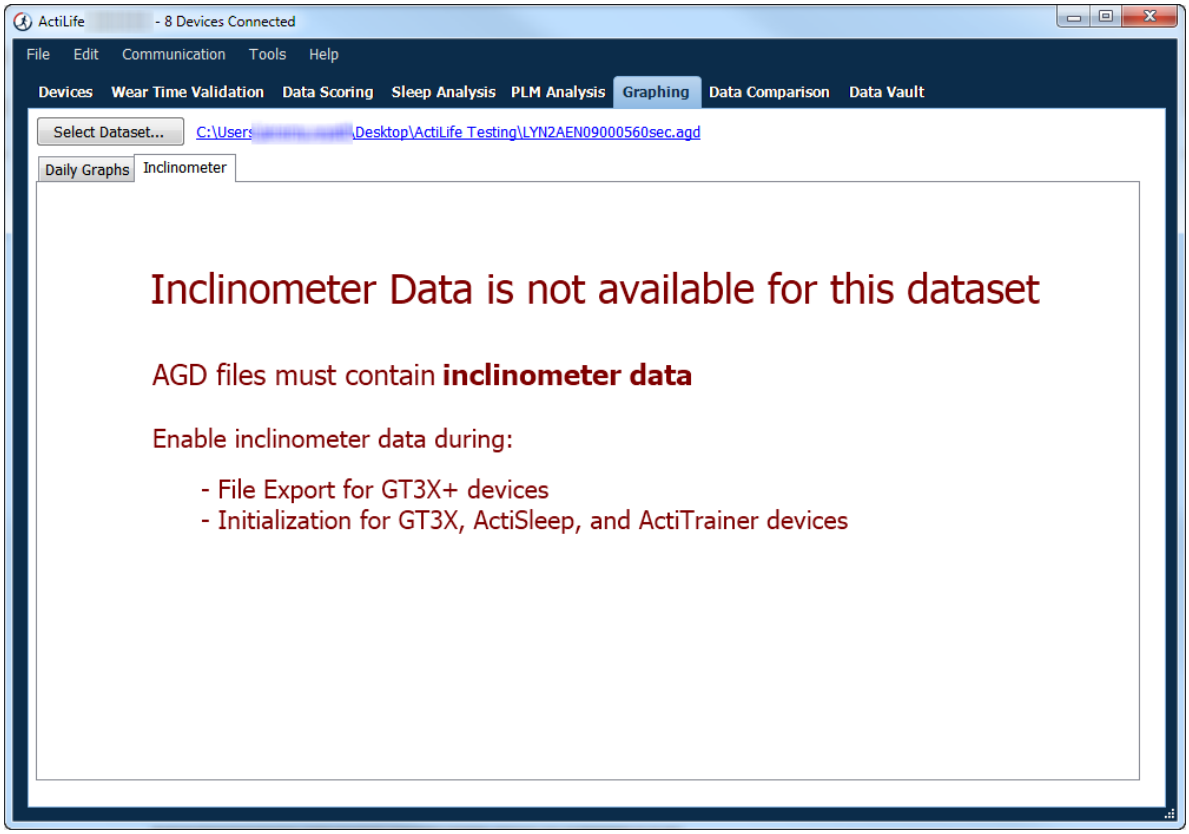

FIGURE 43 - FILE WITH NO INCLINOMETER DATA

Once an appropriate file has been loaded, the Inclinometer tool will display a breakdown of hourly positional information as shown in Figure 80. The calendar on the right can be used to navigate among days in the dataset to quickly jump to an area of interest. Any notes written in the Notes area will be stored with the *.agd file and will be available in the PDF report and in any subsequent interaction with the Inclinometer tool for that particular file.

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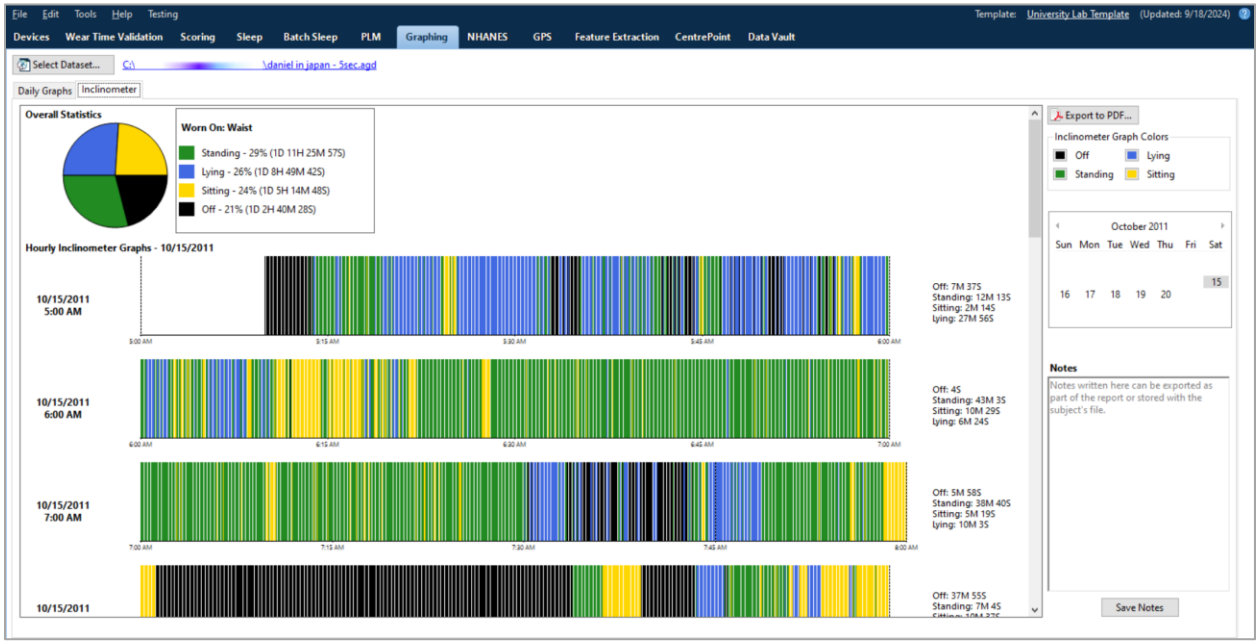

FIGURE 80 - INCLINOMETER OUTPUT

Note that the graph colors can be changed by using the color palette on the right-hand side as well.

Creating an Inclinometer Report

A PDF report of the Inclinometer output can be created by clicking the "Export to PDF..." button. Users will be given the option to choose which days to export to the report.

Important: The inclinometer feature was designed by the Ametris engineering team as a viable way to detect user positional trends over a period of time. The thigh worn algorithm is best suited for positional detection as it is difficult to algorithmically determine the difference between sitting and standing for waist-worn devices. For more information about the waist-worn inclinometer algorithm, see our Inclinometer White Paper.

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Data Comparison (NHANES)

The Data Comparison tool allows users to compare ambulatory activity data collected during private studies with other public activity datasets that were generated from Ametris devices. At the time of this writing, data comparison can be made against public dataset – the 2002-2003 and 2003-2004 National Health and Nutrition Examination Survey (NHANES) collected by the Center for Disease Control and Prevention. More information about this dataset can be found at http://www.cdc.gov/nchs/nhanes/about_nhanes.htm.

The goal of the data comparison tool is to provide ActiLife users with the ability to objectively compare their own actigraphy data with that of national or world-wide standards in an effort to understand correlations among the datasets. As more datasets become available, ActiLife will continue to expand this offering, eventually providing various disease research study information and chronic illness baseline data.

Loading Datasets for Comparison

As datasets are added to the Wear Time Validation and Data Scoring tools, they are automatically loaded into the Data Comparison tool. To view these datasets (or to load more), click the "Load/Edit Subjects..." button at the top of the Data Comparison grid. A form similar to the one shown in Figure 81 will appear. Rows highlighted in **red** indicate that more metadata information is required in order to fully compare this user to the other users in the baselines database(s). In the example shown in Figure 81, the user shown in red will be compared on all parameters except for weight. That is, three females and three males will appear in the gender comparison, but only five users will be compared in the weight category.

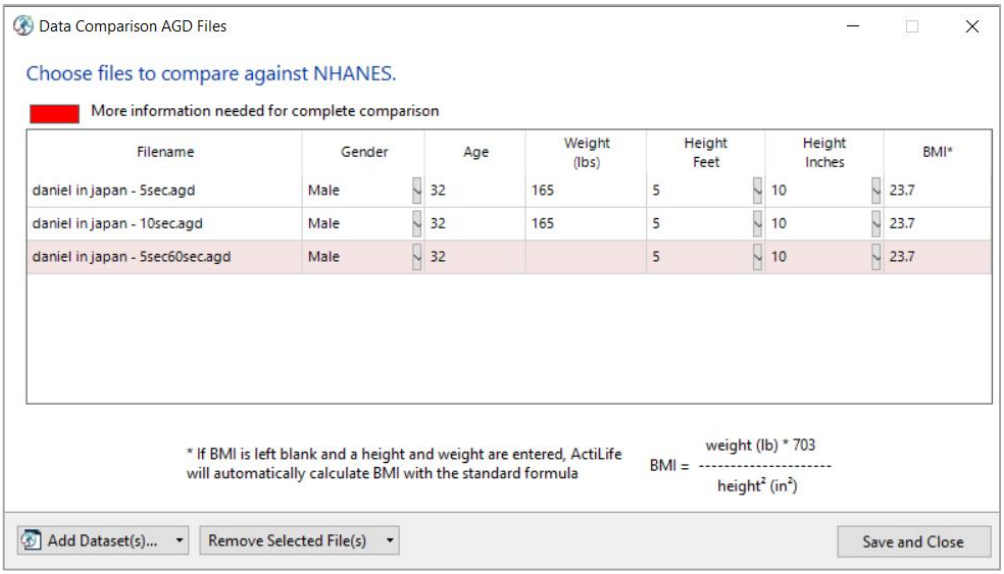

FIGURE 81 – DATA COMPARISON SUBJECT FORM

Once all edits are complete, click "Save and Close" from the subject form.

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Selecting NHANES Comparisons

The NHANES Data Filter allows the user to set comparison parameters. To compare the user dataset to only males in the NHANES data population, select "Male" from the Gender dropdown. To set a custom age range for comparison, choose "Custom" from the Age dropdown and type in a custom age range to compare against. Use this process for all of the filter parameters until the desired comparisons are set. To apply the same filter parameters to the user dataset, check the box "Apply Filter to Your AGD Files". This will force ActiLife to use only those datasets that meet the filter qualifications from both the NHANES data and the user's local data.

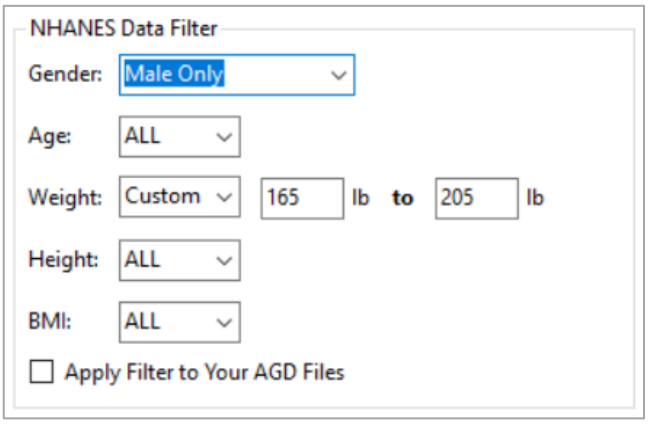

FIGURE 82 - NHANES AND SUBJECT DATA FILTER

The results of the filter will be summarized below the Data Filter section as shown in Figure 83.

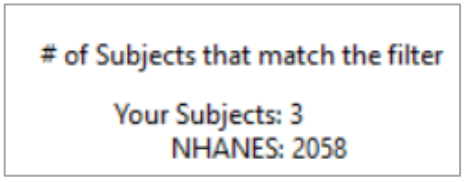

FIGURE 83 - FILTER RESULTS

Click "Calculate" to run the comparison. Once the calculation is complete, the resultant graphs will appear on the right-hand side. Use the "Select Graphs" options to turn specific graphs on or off. Double-click on any graph to make it larger. These graphs show comparison between the user's data and the NHANES data set. Double click the graph again to return to the normal view.

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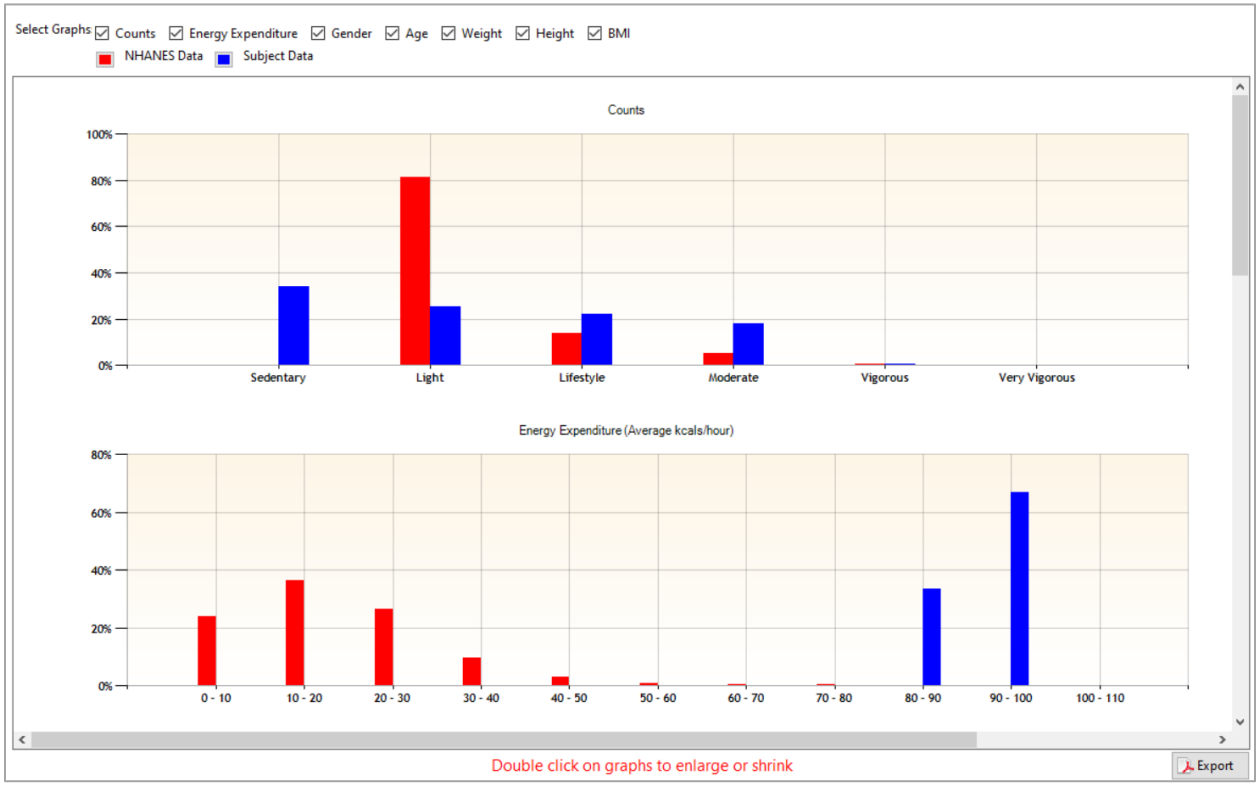

FIGURE 84 - ENLARGED AGE COMPARISON GRAPH

Exporting Data Comparison Results

To export the graphical results of the comparisons, click the "Export" button in the lower right-hand corner of the Data Comparison tool. Select a location and a file name and click "Save." This will generate a printable/shareable PDF document of the Data Comparison tool's graphic results.

GPS

About the GPS Correlator

The GPS tab in ActiLife 6.3.0 and later gives the user the option to correlate their epoch level actigraphy data with time-stamped GPS data.

Supported GPS Devices and Input Formats

Garmin (*.tcx)

Qstarz (*.csv)

iTrail (*.csv)

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ActiLife's Correlator Output Types

A CSV file having actigraphy data correlated with GPS data (including GPS latitude, longitude, elevation, speed, and distance if available).

An Activity intensity map (*.kmz file compatible with Google Earth and Google Maps)

In addition, the source GPS data will be saved in the actigraphy data file (*.agd). This eliminates the need to re-import the GPS data for future re-calculations. The correlation process does not affect the actigraphy data in any way.

Using the GPS Correlator

To begin, click the "Select Dataset" button and select an *.agd file that contains epoch-level actigraphy data from an ActiGraph device that was worn simultaneously with a GPS logging device. Any epoch level greater than 1 second is allowed. If this file contains GPS correlated data, the GPS correlator tool will give the option to delete or select another GPS dataset to replace the existing GPS data.

In the GPS Data section, select a device type and browse to the GPS file that contains the time-stamped GPS data. ActiLife will prompt with an alert if this data does not align with actigraphy data in the *.agd file selected above.

In the results section, select the desired output(s). "Create a CSV correlation output" will create a CSV file that contains both the epoch level actigraphy data and GPS data in separate columns, correlated by timestamps. The "Create an intensity map (KMZ) output" option will create a KMZ file which contains correlated GPS data points and cut point intensity levels (see image below). Users can open the KMZ file in various programs including Google Maps. Select the desired cut point set (defaults in ActiLife - read more here) or create a new custom set by clicking the "edit" link to the right of the cut point selection combo box. Checking the box "Open with Google Earth" will automatically load the intensity map in Google Earth after the correlation is complete (Google Earth must be installed on the same computer as ActiLife).

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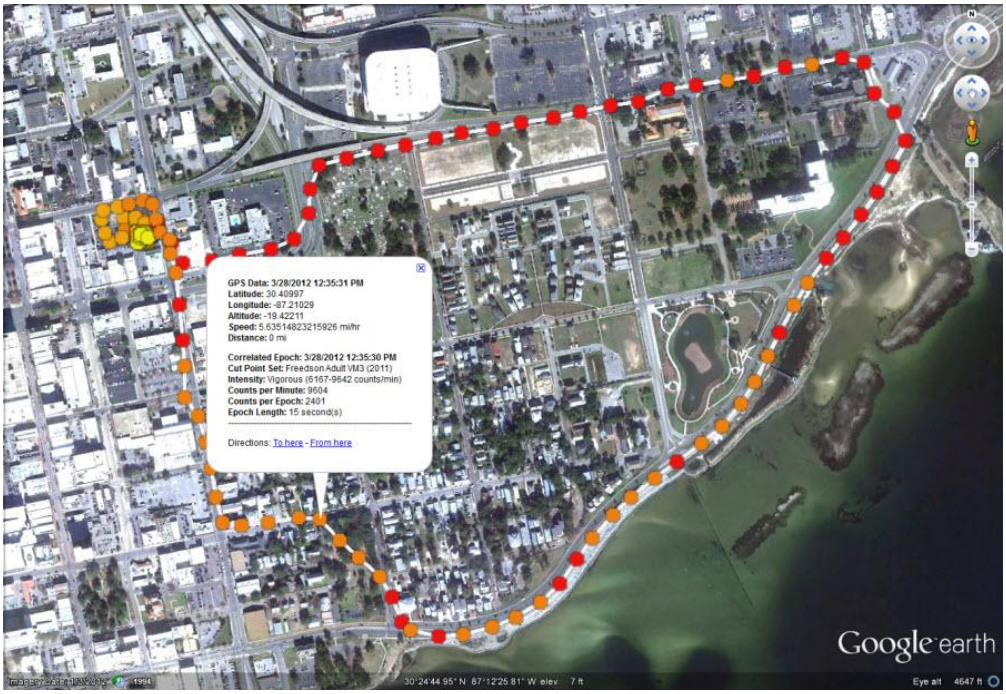

FIGURE 85 - GOOGLE EARTH

Time Correlation

Often, the epoch size of a selected *.agd accelerometry file will not align with the timestamp from a GPS monitor. To accommodate this anomaly, the GPS correlator will align the GPS points and *.agd epochs **by aligning each epoch with the next closest GPS point where the correlated GPS point is before the next epoch**. The table below illustrates.

ActiGraph Epoch Timestamp	Example GPS Timestamp
10:03:00	10:03:20
10:04:00	10:04:30
10:05:00	10:05:42
10:06:00	None (no 10:06:xx data)
10:07:00	10:07:49
10:08:00	10:08:01

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10:09:00	10:09:07
10:10:00	10:10:37
10:11:00	10:11:40

GPS Outputs

The GPS correlator produces potentially three (3) outputs:

1. The dataset (*.agd file) will be modified to include ALL of the GPS data. For example, if GPS data and actigraphy are at different resolutions (e.g., 10s epochs and 1s GPS data), the correlator tool will insert ALL of the GPS data into the *.agd file. The original actigraphy data will not be affected. ActiLife will properly handle the file regardless of the presence of the GPS data. The GPS data can be deleted from the *.agd file at any time.

2. If selected, a CSV output will be generated. Epoch-level actigraphy data always takes priority during the correlation process. If present, excess data from the higher resolution GPS file is discarded. For example, a 10s epoch actigraphy file correlated with a 1s epoch GPS file will result in a 10s epoch CSV file. The correlator tool will use the closest matching GPS timestamp to correlate with each 10s epoch actigraphy count. In addition, GPS data points that are not within the timespan of the first and last activity data point are not output.

3. If selected, a KMZ output file will also be generated. Similar to the generation of a CSV file, the KMZ output will be driven by the epoch-level actigraphy resolution. A 10s epoch actigraphy file correlated with a 1s epoch GPS file will result in a 10s resolution KMZ file; excess GPS data will be discarded in this file.

Feature Extraction

Feature Extraction Tool

The Feature Extraction tool in ActiLife allows users to analyze specific time and frequency domain features of the high-resolution raw data produced by Ametris's "w" and "BT" series of devices (GT3X+, ActiSleep+, wGT3X+, wActiSleep+ and wGT3X-BT).

Overview of High-Resolution Raw Data

Ametris's "w" series devices are capable of measuring up to +/-6 *g*s in three dimensions; "BT" series devices are capable of measuring up to +/-8 *g*s in three dimensions. The orientation of the device and the corresponding axes are shown below.

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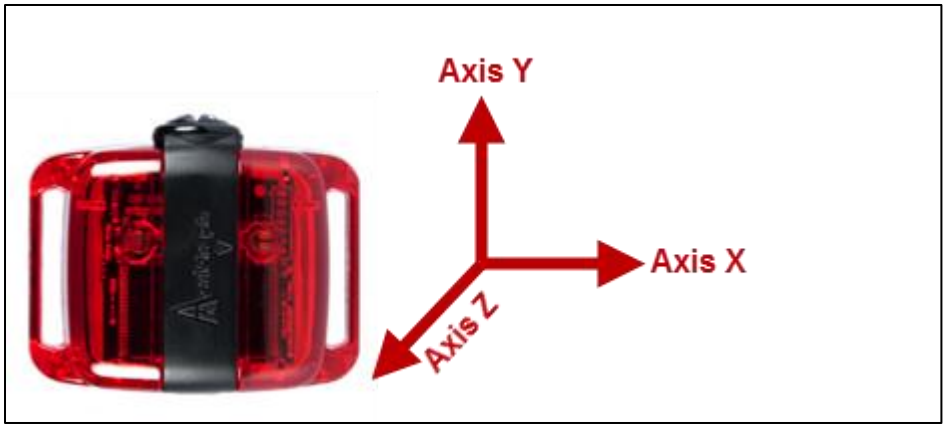

FIGURE 86 - DEVICE ORIENTATION

When oriented perfectly in each vertical, horizontal or perpendicular direction, the accelerometer will produce a negative *g* value for that axes output as shown below (the other axes readings will be zero).

FIGURE 87 - AXIS DESCRIPTION

The Ametris device will sample and store data for each axis, reading at a rate between 30-100Hz as selected by the user at the time of initialization. The data stored during this time is what we refer to as "raw data." Use ActiLife to download the data from the device. Doing so will produce a *.gt3x file. This *.gt3x file is an archive file (zip) that contains several files, including a *.bin file which contains the raw sample data

*(NOTE: This sample data is bit-packed using a special algorithm and is subject to change at any time. Use ActiLife to process *.gt3x files to guarantee the data remains consistent from device-to-device)*

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Extracting Features

Once data has been collected, the Feature Extraction tool can be used to isolate certain time and/or frequency domain characteristics from the raw data. Use the "Add Dataset(s)" option to select up to 100 *.gt3x files for analyses in the Feature Extraction tool.

Terms Defined

- **Array:** Is an array of raw data samples with width equal to *window size* * *sample rate*. E.g., For a Window Size = 10s and a Sample Rate = 30Hz, the array will contain 300 samples for each 10s period within the file. The array is used to break up the file for feature analysis.
- **Feature:** Is the desired feature to extract from the selected array.
- **Window Size:** Defines the time interval of the selected array.
- **Sample Rate:** The data sample rate set at time of initialization (30-100Hz in 10Hz increments)
- $X(i)$ $Y(i)$ $Z(i)$ These are the arrays, referenced below, that relate to data from the X, Y and Z axes.
- x represents any array (X, Y or Z)
- **Array Length:** The length of the array depends on the Window Size and the Sample Rate. E.g., 30Hz Sample Rate and 1s Window Size = array length of 30

To Extract Features:

Step 1: Select arrays from the Time or Frequency domain section

Available Arrays

- X = accelerometer X-axis data
- Y = accelerometer Y-axis data
- Z = accelerometer Z-axis data
- Vector Magnitude = square root of the sum of the squares of each axis

$$VM = \sqrt{X^2 + Y^2 + Z^2}$$

- First Order Differential of X = the first order differential of the accelerometer X-axis data

$$N_x = length(X(i))$$
$$\sum_{i=1}^{N_x-1} X'(i) = X(i) - X(i-1)$$

- First Order Differential of Y = the first order differential of the accelerometer Y-axis data

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$$N_y = length(Y(i))$$
$$\sum_{i=1}^{N_y-1} Y'(i) = Y(i) - Y(i-1)$$

- First Order Differential of Z = the first order differential of the accelerometer Z-axis data

$$N_z = length(Z(i))$$
$$\sum_{i=1}^{N_z-1} Z'(i) = Z(i) - Z(i-1)$$

Step 2: Select the features to be extracted

Time Domain Features:

- Min = determines the minimum value of the selected array
  - *min(x)*
  - *min(y)*
  - *min(z)*
- Max = determines the maximum value of the selected array
  - *max(x)*
  - *max(y)*
  - *max(z)*
- Mean = determines the mean value of the selected array

$$\mu = \frac{1}{n}\sum_{i=1}^{n} X(i)$$

- Standard Deviation = determines the standard deviation of the selected array

$$\sigma = \frac{1}{n-1}\sum_{i=1}^{n}(X(i) - \mu)^2$$

- Correlation XY = determines the correlation between the accelerometer X & Y axes

$$\rho_{XY} = \frac{\sum_{i=1}^{n}(X(i)-\mu_X)*(Y(i)-\mu_Y)}{\sqrt{\sum_{i=1}^{n}(X(i)-\mu_X)^2 * \sum_{i=1}^{n}(Y(i)-\mu_Y)^2}}$$ where μ is the mean of the X or Y array

- Correlation XZ = determines the correlation between the accelerometer X & Z axes

$$\rho_{XZ} = \frac{\sum_{i=1}^{n}(X(i)-\mu_X)*(Z(i)-\mu_Z)}{\sqrt{\sum_{i=1}^{n}(X(i)-\mu_X)^2 * \sum_{i=1}^{n}(Z(i)-\mu_Z)^2}}$$ where μ is the mean of the X or Z array

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- Correlation YZ = determines the correlation between the accelerometer Y & Z axes

$$\rho_{YZ} = \frac{\sum_{i=1}^{n}(Y(i)-\mu_Y)*(Z(i)-\mu_Z)}{\sqrt{\sum_{i=1}^{n}(Y(i)-\mu_Y)^2*\sum_{i=1}^{n}(Z(i)-\mu_Z)^2}}$$ where μ is the mean of the Y or Z array

- Median Crossing = determines the number of zero crossings of the median of the selected array

  Step #1: Determine the Median of the array
  - Sort the array: $S_x = sorted(x)$
  - Get the length of the array: $N_x = length(x)$
  - If array length is odd, Median = $S_x\left(\frac{N_x}{2}\right)$
  - If array length is even, Median = $\left(\frac{S_x\left(\frac{N_x}{2}-1\right)+S_x\left(\frac{N_x}{2}\right)}{2}\right)$

  Step #2: Subtract the Median value from the original array: $X_{new} = X - Median$
  Count the number of zero crossings the new array X_{new}

- Entropy = determines the measure of uncertainty of the selected array.

- 10th Percentile = determines the 10th percentile rank of the selected array.

- 25th Percentile = determines the 25th percentile rank of the selected array.

- 50th Percentile = determines the 50th percentile rank of the selected array.

- 75th Percentile = determines the 75th percentile rank of the selected array.

- 90th Percentile = determines the 90th percentile rank of the selected array.

  Step #1: Sort the array:
  - $S_x = sorted(x)$

  Step #2: Get the length of the array:
  - $N_x = length(x)$

  Step #3: Calculate the percentile ranks:
  - $\underset{i=1}{^{N_x}}P_n(i) = \frac{100}{N_x} * (i - 0.5)$

  Step #4: Find the index of the percentile ranks that encompass the desired percentile:
  - $\underset{i=1}{^{N_x-1}}index = if\ \left((p \geq P_n(i)) \,\&\, (p < P_n(i+1))\right)$

  Step #5: Interpolate between percentile ranks and sorted array values to determine percentile:
  - $p = S_x(index) - \frac{(S_x(index+1)-S_x(index))}{(P_n(index+1)-P_n(index))} * P_n(index)$

The percentile rank formula is discussed at http://en.wikipedia.org/wiki/Percentile_rank

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Frequency Domain Features:

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- Dominant Frequency = calculates the frequency content of the selected array, which is above the selected cutoff frequency, then determines which frequency has the highest magnitude.

  Step #1: Perform a fast fourier transform (FFT) on the selected array.
  - $FFTdata = FFT(X)$

  Step #2: Calculate the magnitude using the real and imaginary compenents of the FFT data.
  - FFTmagnitude = $\sqrt{FFTdata.real^2 + FFTdata.imag^2}$

  Step #3: Zero all magnitude data below the cutoff and above the Nyquist frequency frequency.

  Step #4: Search the array for the highest magnitude and return the frequency.

- Dominant Frequency Magnitude = calculates the frequency content of the selected array, which is above the selected cutoff frequency, then determines the highest magnitude of all frequencies.

  Step #1: Perform a fast fourier transform (FFT) on the selected array.
  - $FFTdata = FFT(X)$

  Step #2: Calculate the magnitude using the real and imaginary compenents of the FFT data.
  - FFTmagnitude = $\sqrt{FFTdata.real^2 + FFTdata.imag^2}$

  Step #3: Zero all magnitude data below the cutoff and above the Nyquist frequency frequency.

  Step #4: Search the array for the highest magnitude, normalize it, and return that value.
  - FFTmagnitude Normalized = FFTmagnitude * 2 / (length of array)
  - Since we dropped half the FFT we multiply by 2 to maintain the same energy level.

- Entropy = determines the measure of uncertainty of the frequency content of the selected array which is above the selected cutoff frequency.

Special Note about Entropy Calculations

ActiLife will support a normalized and an un-normalized entropy calculation for both frequency and time-domain calculations. For an overview of entropy calculation methods for these types of data (and justification for non-normalized outputs), see Nonparametric Entropy Estimation, an Overview, J. Beirlant, E. J. Dudewicz, L. Gyorfi, and E. C. van der Meulen (1997), Volume 6, pp. 17– 39 at http://jimbeck.caltech.edu/summerlectures/references/Entropy%20estimation.pdf

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Step 3: Select the Window Size

The "Window Size" option selects the time interval that the array should span and can be different for Time and Frequency outputs.

Step 4: Select the Frequency Cutoff (for Frequency Domain Analytics Only)

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The "Frequency Cutoff" option allows the user to select the lowest allowable frequency that can be included in the analysis. Any frequency components below the selected frequency will be ignored during the analysis.

Viewing Results

After clicking "Calculate" at the bottom, the results can be viewed in ActiLife by clicking the "Results" button to the right of the file(s) as shown below

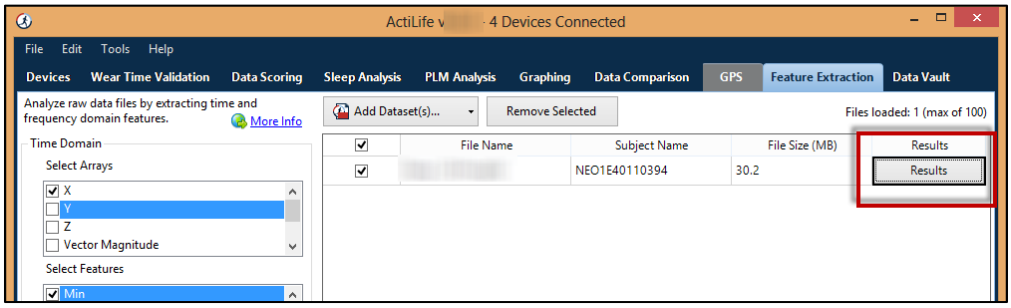

FIGURE 88A - FEATURE EXTRACTION RESULTS

In the results example shown below, the Time Domain output is set to a Window Length of 1s while the Frequency Domain output is set to a Window Length of 10s. Note that the Frequency Domain output latches for 10s while the Time Domain output updates every 1s.

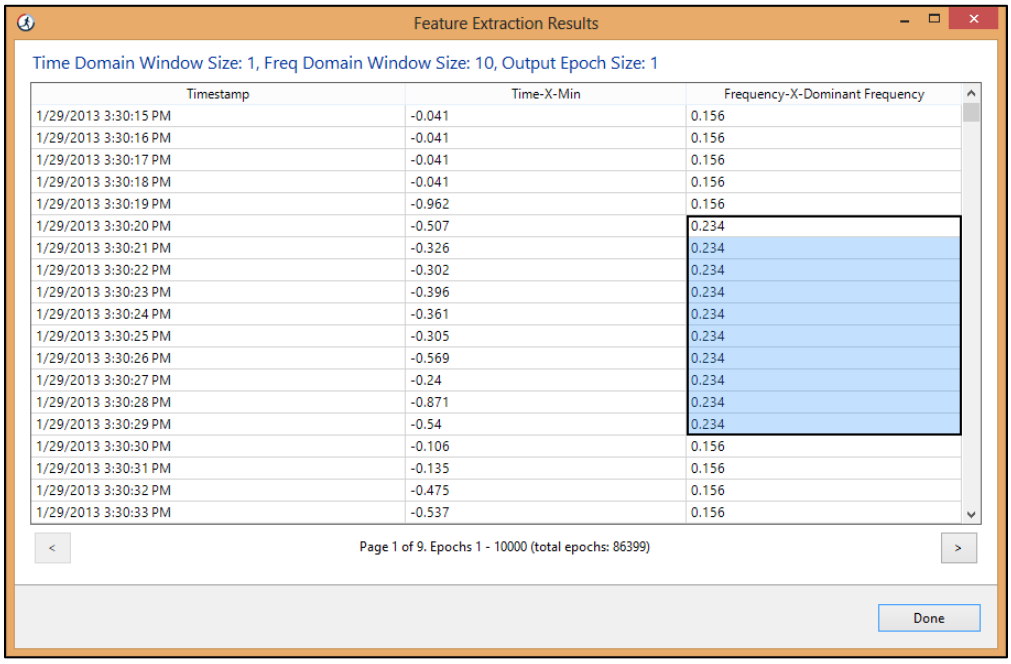

FIGURE 88B - FEATURE EXTRACTION RESULTS

The same output for all files can be exported in batch *csv using the "Export" button at the bottom of the main screen. A single *.csv file will be created for each file. The timestamp given in the *.csv export can be formatted to one-second resolution as desired using Excel.

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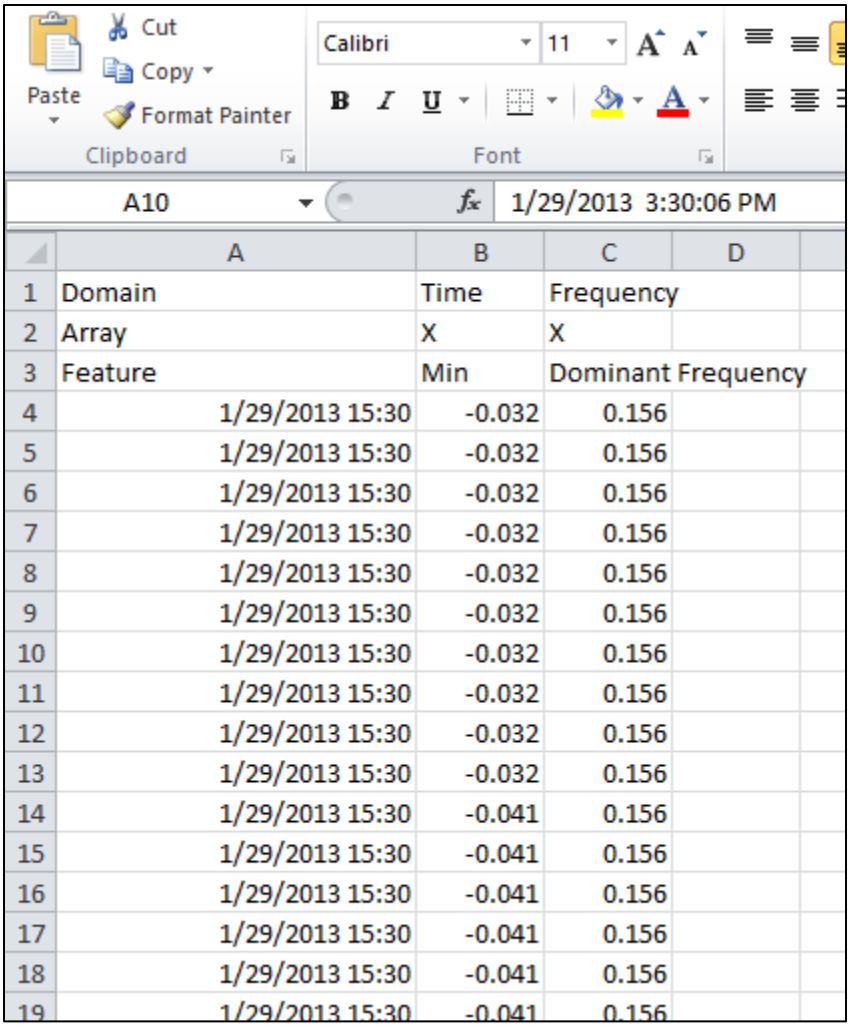

	A	B	C	D
1	Domain	Time	Frequency	
2	Array	X	X	
3	Feature	Min	Dominant Frequency	
4	1/29/2013 15:30	-0.032	0.156	
5	1/29/2013 15:30	-0.032	0.156	
6	1/29/2013 15:30	-0.032	0.156	
7	1/29/2013 15:30	-0.032	0.156	
8	1/29/2013 15:30	-0.032	0.156	
9	1/29/2013 15:30	-0.032	0.156	
10	1/29/2013 15:30	-0.032	0.156	
11	1/29/2013 15:30	-0.032	0.156	
12	1/29/2013 15:30	-0.032	0.156	
13	1/29/2013 15:30	-0.032	0.156	
14	1/29/2013 15:30	-0.041	0.156	
15	1/29/2013 15:30	-0.041	0.156	
16	1/29/2013 15:30	-0.041	0.156	
17	1/29/2013 15:30	-0.041	0.156	
18	1/29/2013 15:30	-0.041	0.156	
19	1/29/2013 15:30	-0.041	0.156	

FIGURE 88C - FEATURE EXTRACTION RESULTS

CentrePoint

The CentrePoint tab in ActiLife allows users to access subject data files that are stored in CentrePoint within the ActiLife software. This tab provides access to both raw and epoch files. The data file formats that can be exported from this tab include .GT3X, .AGD, .AGSD and .AGDC.

To access these files, users must have permission to view subject data in CentrePoint.

Getting Started

To begin, log in using your CentrePoint credentials.

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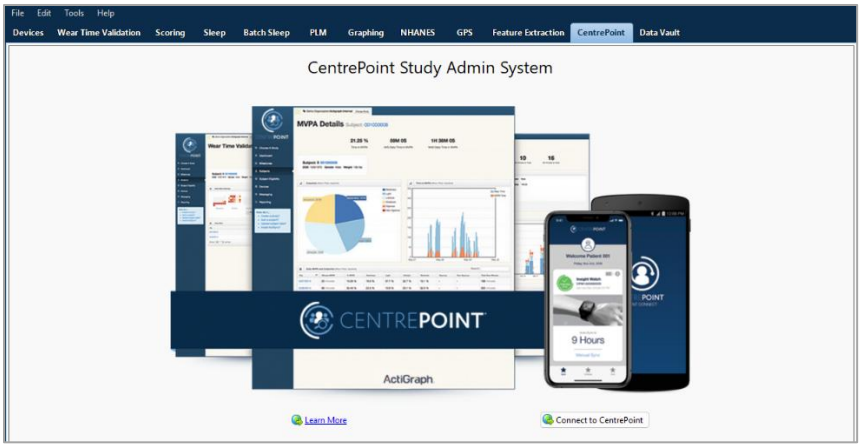

FIGURE CP1 – CP TAB UI

When selecting **"Connect to CentrePoint"**, a window will appear prompting the user to enter their CentrePoint credentials.

FIGURE CP2 – CP LOGIN UI

Once logged in to CentrePoint, the Dashboard will be displayed. The CentrePoint Dashboard includes a study menu, study information, subject information, a refresh tab, and a settings menu.

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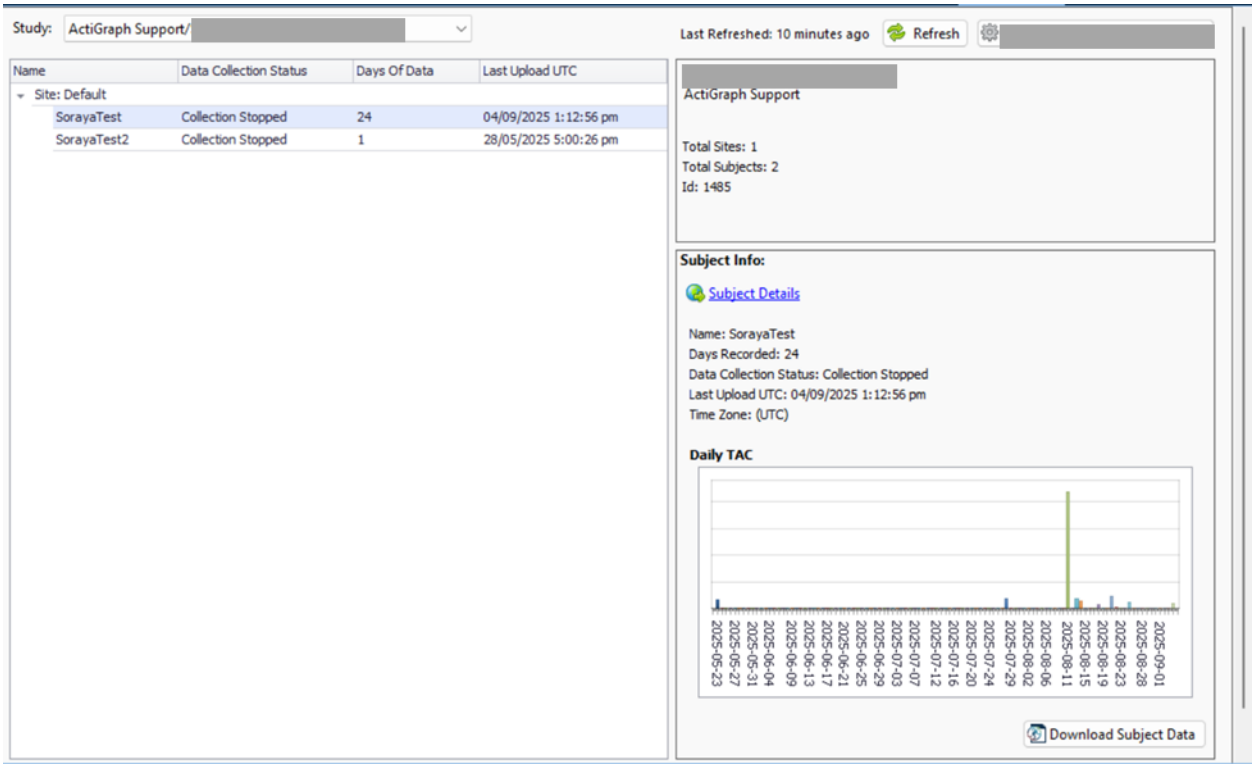

FIGURE CP3 – CP STUDY DASHBOARD UI

Study Drop-Down Menu

The study drop-down menu allows users to navigate between the different studies they have access to in CP application. The tab will only display subjects located in the sites the user has permission to view. If the user has full study access, all sites and subjects within that study will be displayed. If subject data is hidden from the user in CentrePoint, the study will NOT BE displayed.

When a study is selected, a list of sites will be displayed. Under each site, users can view a list of subjects along with key details such as data collection status, number of days of data collected, and the last upload date and time (in UTC).

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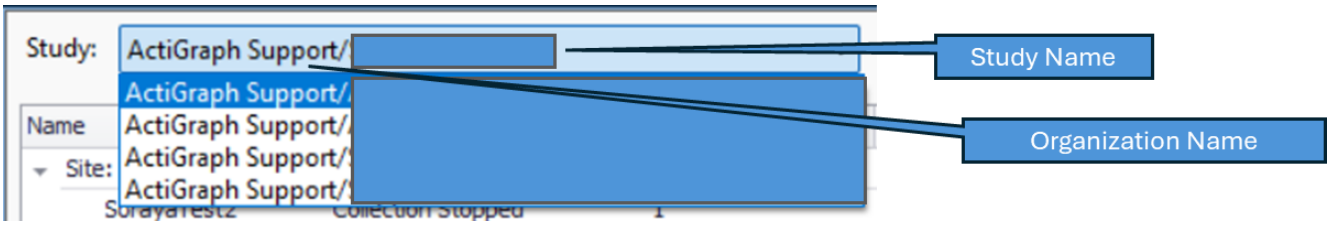

FIGURE CP4 – CP STUDY LIST

Study Information

The study information section will display the total number of sites, subjects, and the study's internal ID.

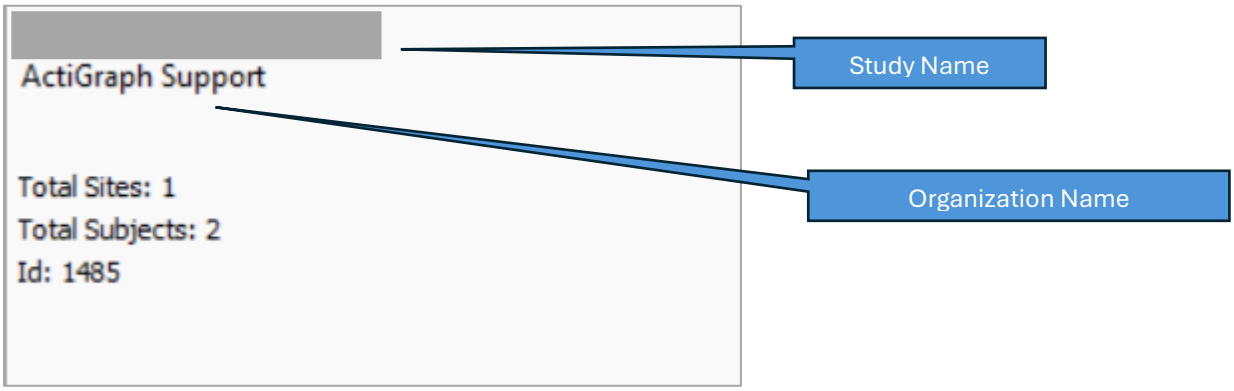

FIGURE CP5 – CP STUDY DETAILS

Subject Information

The *Subject Info* section provides detailed information on the selected subject. This includes:

- A quick link to the subject's page in CentrePoint
- The name of the study
- Number of days with recorded data
- Data collection status
- Last upload date and time (in UTC)
- A graph displaying total activity counts

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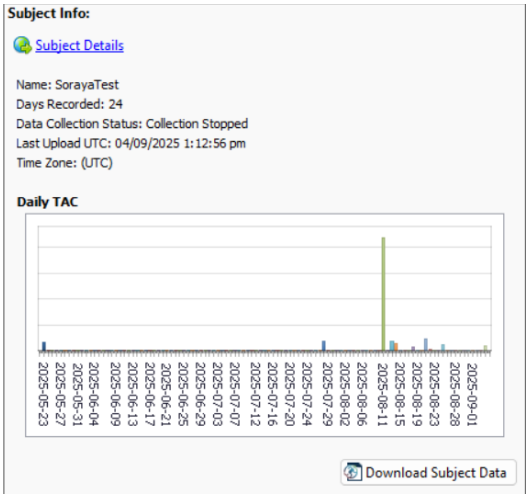

FIGURE CP6 – SUBJECT DETAILS

Download Subject Data

When using the CentrePoint tab in ActiLife, each subject must be downloaded individually. After selecting the desired subject and clicking the **Download Subject Data** tab, a subject detail page will be displayed. From there, users can choose to download either the **AGD file** (summary data) or the **raw data file**. The raw data files will be in .GT3X or .AGSD format depending on the device used in the study.

Summary Data (AGD)

Selecting the summary data option allows users to download all the subject's data in a single file. This file can be processed and viewed directly in ActiLife. The summary data can be converted to a CSV file using the **Import/Export/Convert** (Epoch to Epoch) option located in the **File** menu in ActiLife. (Sleep scoring cannot be performed on files that contain over 90 days of data)

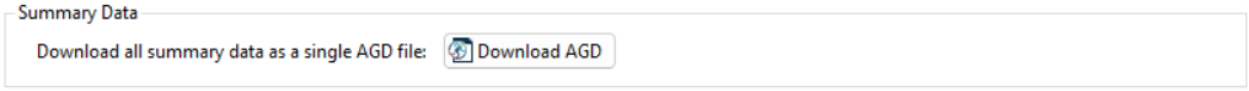

FIGURE CP7 – FILE DOWNLOAD OPTION

Raw Data (.GT3X, .AGSD & .AGDC)

Selecting the raw data option provides access to multiple raw data files, depending on how many uploads were performed by the subject. Each raw data file includes:

- Start and stop date
- File size

If sensor data is enabled in the study, .AGSD files will contain both raw sensor data and raw Accelerometer data *(this feature is exclusive to LEAP devices)*. To access this data, users must convert the .AGSD files to .CSV format using the **Import/Export/Convert (Raw to Raw**) option located in the **File** menu in ActiLife. The raw sensor data currently available for export are IMU, PPG and Skin Temperature. AGSD files can also be converted to AGD (summary data files) and processed in ActiLife.

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Raw Data Files

Download raw data files in .AGSD format

Filename	Start Of Data UTC	Stop Of Data UTC	File Size In MBs	Download
STM2D43230406_2025-05-28___11-47-47.agsd	05/23/2025 09:31:00	05/23/2025 10:55:53	1.920	download...

FIGURE CP8 – RAW DATA FILES LIST

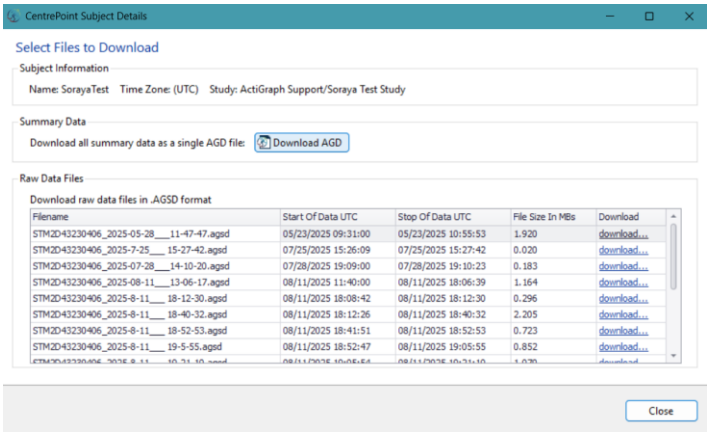

FIGURE CP9 – RAW DATA FILES LIST FOR LEAP STUDY

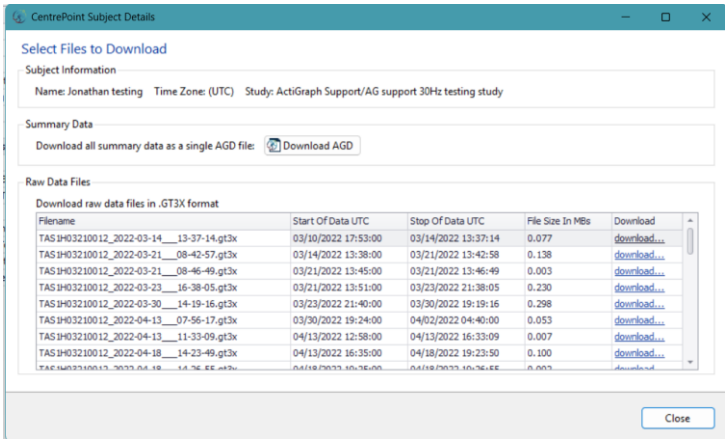

FIGURE CP10 – RAW DATA FILES LIST FOR GT3X STUDY

Please note:
For skin temperature raw data files, **ActiLife version 7.1.0** or latest version is required.
For IMU raw data files, **ActiLife version 7.2.0.0** or latest version is required.

Refresh Tab

The **Refresh** tab allows users to update the CentrePoint Dashboard. This action should be performed after new site or study access has been granted to the user, or when new subject data becomes available for download.

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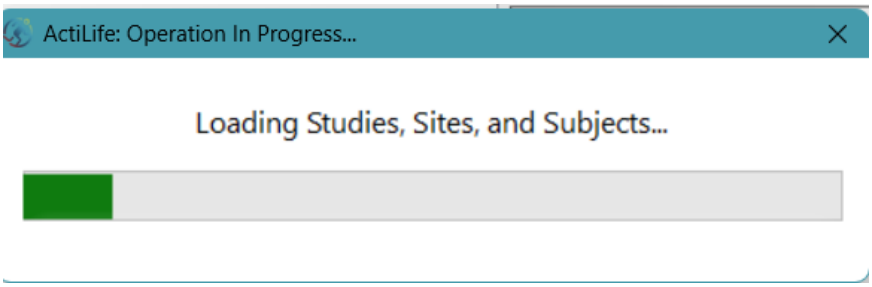

FIGURE CP11 – REFRESH DASHBOARD

Settings Tab

The **Settings** tab allows users to log out of their CentrePoint account. It also provides a direct link to the CentrePoint platform for quick access.

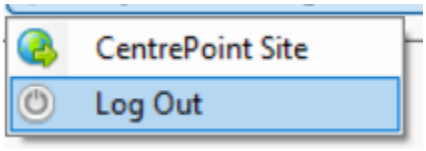

FIGURE CP12 – LOGOUT FROM CP

Data Vault

The Data Vault tool is a secure, cloud-based storage system integrated into the ActiLife program that allows users to quickly and securely save files into their own personal cloud to share with others. There are many immediate benefits to the Data Vault system including:

- Simplified Data Sharing
- Reduced IT costs
- Built-in data backup and retention
- Fast storage

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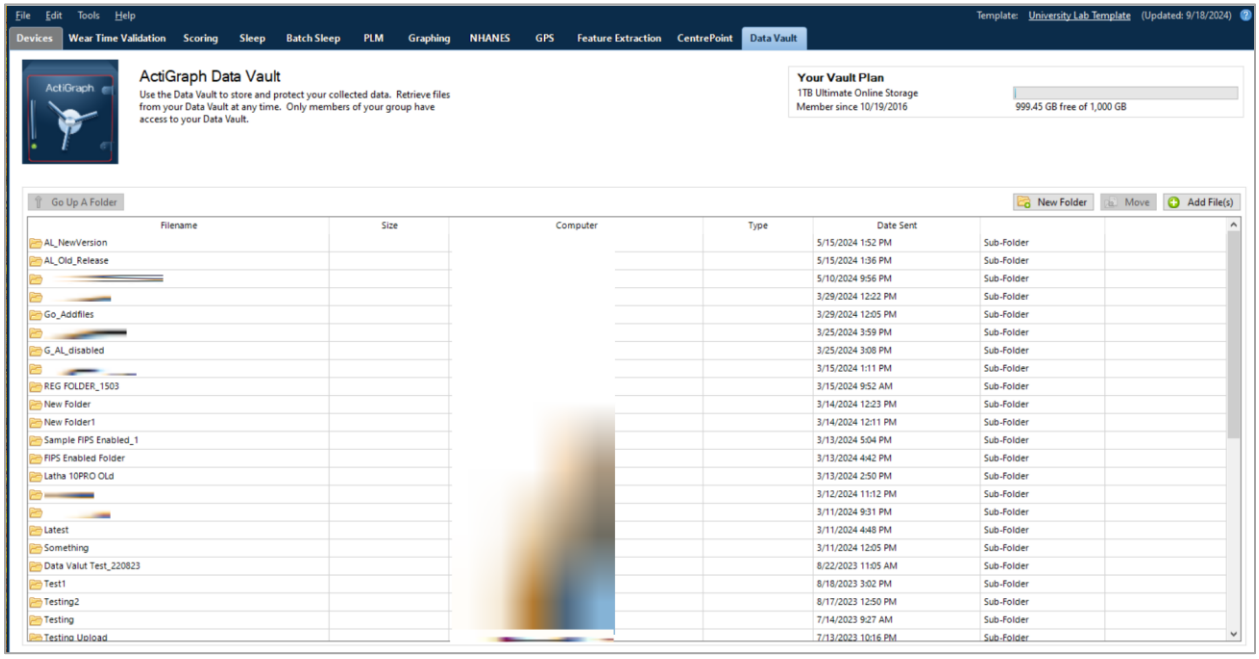

FIGURE 89 - ACTILIFE DATA VAULT

Limitations on the Data Vault

Data Vault is not FIPS compliant and it is not possible to upload to Data Vault from a FIPS enabled machine.

Adding Files to the Data Vault

ActiLife 7 users receive 4GB of free space. To add files to the Data Vault, navigate to the Data Vault tab and click the “Add File(s)” button. Browse to the file location and select the files you wish to upload. Multiple files may be added by holding the “Shift” key on the keyboard while selecting files. Click “Open” to start the upload process.

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Sub Folders

Sub folder organization in the Data Vault is available in ActiLife version 6.0 and later. To add sub-folders, click the "New Folder" button in the Data Vault view. Users who share license groups between ActiLife 5 and ActiLife 6 should be aware that ActiLife 5 users can only upload to the root directory and cannot see or utilize any subfolders that were created by ActiLife 6 users.

Sharing Data with Colleagues – License Grouping

License grouping allows dispersed Data Vault users to share their valuable data quickly and easily. ActiLife Full and Lite licenses are automatically grouped together. A Lite user who uploads files using their Data Vault tab will automatically see any files that a Full user uploads, and vice versa. This ensures centralization of important actigraphy data when that data is being collected across multiple study sites.

Institutions and Universities can also be grouped together under a single License Group for collaboration on studies. For information on License Grouping, contact Ametris support at support@Ametris.com

Multipart Uploads

The ActiLife Data Vault takes advantage of a technology known as multipart uploads. This technique delineates the files into multiple parts and uploads each part to the Data Vault. This technique results in much faster uploads over slow connections and increases reliability, since failed uploads can be restarted where they left off. For this reason, the Data Vault tool is superior to other methods of file sharing such as FTP, email, and network sharing.

Viewing Upload Progress

To view the upload progress for the queued files, click on the hyperlink below the progress indicator. This will open the Data Vault Transfers window. From there, file transfers can be cancelled, and status information can be viewed.

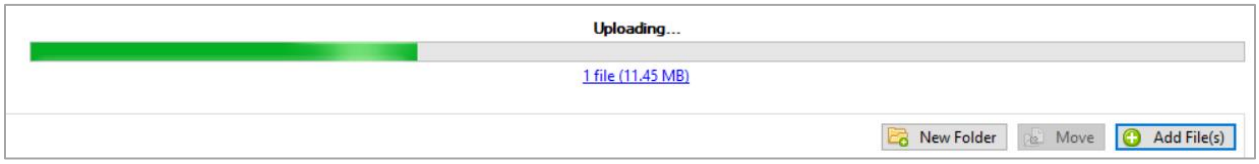

FIGURE 90 - DATA VAULT TRANSFERS WINDOW

File Types

Any type of file can be uploaded to Data Vault. Simply change the file type to "All Files" in the File Upload dialog as shown in Figure 91.

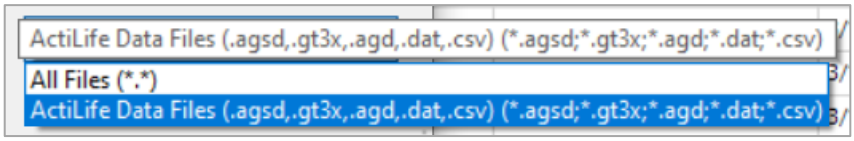

FIGURE 91 - CHANGING THE DATA VAULT FILE TYPE

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Downloading Files from the Data Vault

To download files stored in the Data Vault, simply click the 'Download' link to the right of the file you wish to download. Multi-file downloads are not supported as of version 6.1 but are coming soon.

Purchasing More Space

Various data plans are available for a monthly or yearly fee. Contact Ametris sales to inquire about more space for your organization at sales@Ametris.com or 1-877-497-6996.

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Appendix A - File Types in ActiLife

Comparison of GT3X+ and GT3X Devices

Before explaining the difference between the *.gt3x and *.agd files, it would be useful to explain the paradigm differences between the GT3X and GT3X+ device platforms. GT3X devices sample accelerometer data 30Hz (only). This data is then filtered and accumulated into user-selected epoch sizes (60s, for instance) inside of the device. Because this data is being processed and accumulated into epoch-size chunks, on-board storage requirements are relatively small. Whenever ActiLife downloads data from these devices, it produces an *.agd file (epoch-level file) which can then be processed inside of ActiLife.

GT3X+ platform devices are different in that the user selects the rate at which raw data is sampled from the accelerometer (the user can choose any frequency between 30-100Hz in 10Hz increments). The GT3X+ then stores every sample, making the data storage requirement for this device type much greater. Upon download, the GT3X+ device produces a *.gt3x file (raw data). The ActiLife software can then be used to band pass filter and accumulate that raw data into epoch-level data, thus producing an *.agd file that is equivalent to the one produced from the GT3X device as described above. The benefit of the GT3X+ device is that the user can produce any epoch-level output from the raw data. In addition, the raw data is available to perform other analyses outside of the scope of this discussion.

Figure 92 graphically explains the difference between the GT3X and GT3X+ devices.

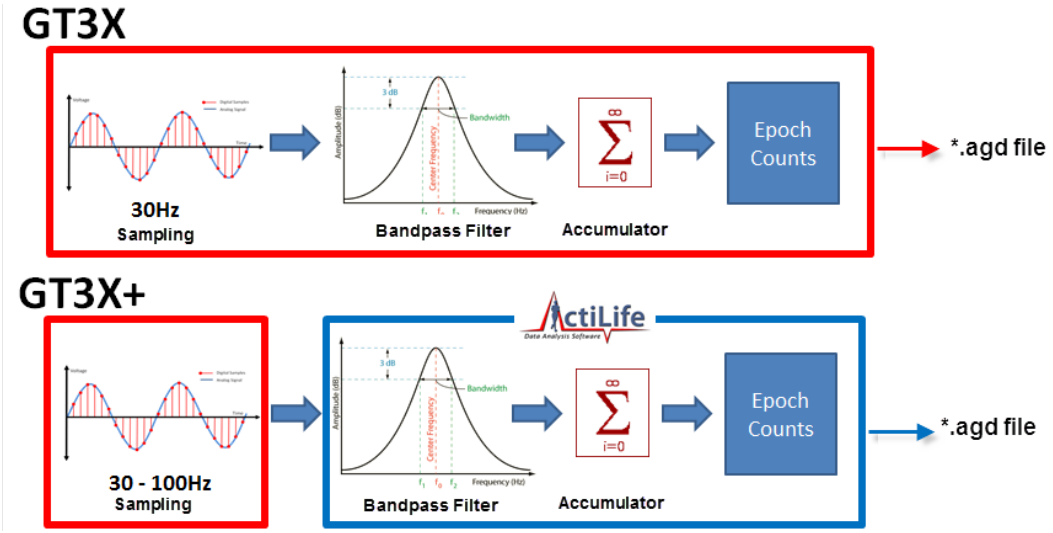

FIGURE 92 - COMPARISON OF THE GT3X AND GT3X+ DEVICES (AND ACTILIFE'S ROLE)

*.gt3x File Format

wGT3X-BT devices produce an interim compressed file with file extension *.gt3x. This is a compressed file and must be extracted to a usable format using ActiLife's import/export tool which is accessible from the File menu in ActiLife. The file can be exported to *.agd format for processing in ActiLife or *.csv/*.dat format for processing using third party tools. The *.gt3x file can also be exported directly to *.agd format during the download process by checking "Create AGD File" from the download prompt (see Downloading wGT3X-BT Devices for more information).

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*.AGSD File Format

LEAP devices produce an interim compressed file with file extension *.agsd. This is a compressed file and must be extracted to a usable format using ActiLife's import/export tool which is accessible from the File menu in ActiLife. The file can be exported to *.agd format for processing in ActiLife or *.csv/*.dat format for processing using third party tools. The *.asd file can also be exported directly to *.agd format during the download process by checking "Create AGD File" from the download prompt.

This file format can contain data from other sensors which cannot be processed in ActiLife.

*.AGDC File Format

CPIW devices produce an interim compressed file with file extension *.agdc. This is a compressed file and must be extracted to a usable format using ActiLife's import/export tool which is accessible from the File menu in ActiLife. The file can be exported to *.agd format for processing in ActiLife or *.csv/*.dat format for processing using third party tools. The *.asd file can also be exported directly to *.agd format during the download process by checking "Create AGD File" from the download prompt.

*.agd File Format

The *.agd file format is ActiLife's native file format and is the desired file type for all ActiLife operations and tools such as Wear Time Validation, Data Scoring, Sleep Scoring, and Graphing. These *.agd files are database files formatted for use with the popular SQLite architecture (www.sqlite.org). These files can be viewed in the ActiLife AGD viewer (available from the File menu). Alternatively, the SQLite browser (publically available on the SQLite website) can be used to browse the details of the *.agd files. A file schema is provided in Figure 93.

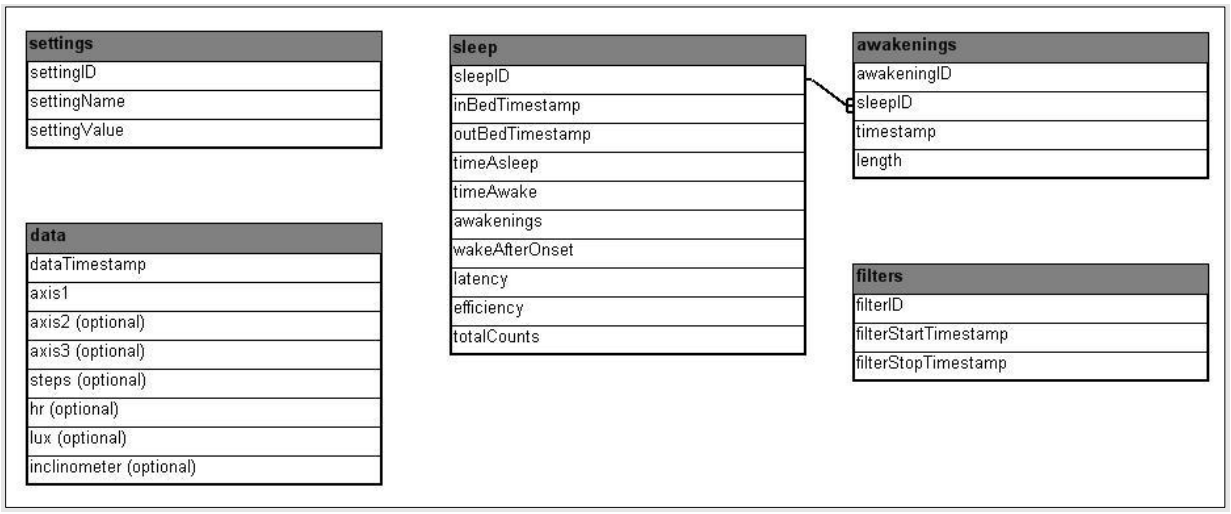

FIGURE 93 - *.AGD FILE SCHEMA

*.agd files are created in ActiLife immediately when data from a device is downloaded through the "Devices" tab. These *.agd files typically contain post-filtered and accumulated data as this is the only type of data that ActiLife can properly handle. The rows in the database represent whole-number epoch summations (1s, 5s, 10s, 30s, 60s, etc.). However, at the time of this writing all GT1M, GT3X, ActiTrainer, CPIW, LEAP and ASM products that have been initialized to collect raw data (12Hz or 30Hz) will produce an *.agd file on

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download. Although the file cannot be processed in ActiLife, the *.agd format can be exported to *.csv or *.dat through ActiLife's import/export tool or AGD viewer tool, both accessible from the File menu.

wGT3X-BT devices produce a *.gt3x file on download (see *.gt3x File Format). In order to process in ActiLife, the file must be exported to *.agd format. This can be done at the time of download by checking "Create AGD File" from the download dialog box or by using ActiLife's built-in import/export tool available from the File menu.

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q*.agd Data Table Format

The data table in the *agd database consists of the following parameters. Their calculations are explained.

dataTimeStamp – a measure of total Ticks. A single tick represents one hundred nanoseconds or one ten-millionth of a second. There are 10,000 ticks in a millisecond. The value of this property represents the number of 100-nanosecond intervals that have elapsed since 12:00:00 midnight, January 1, 0001. More information available at http://msdn.microsoft.com/en-us/library/system.datetime.ticks.aspx

axis 1 – Post filtered and accumulated per-epoch **vertical** activity data

axis 2 (optional) – Post filtered and accumulated per-epoch **horizontal** activity data

axis 3 (optional) – Post filtered and accumulated per-epoch **perpendicular** activity data

steps (optional) – Total steps per epoch

hr (optional) – Heart beats-per-epoch. This data is only gathered by ActiTrainer devices when those devices are initialized to collect heart rate data AND when the Polar® Heart Monitor (wireless heart strap) is worn by the user.

Lux (optional) – Ambient light sampled once per second (on wGT3X-BT and ASM devices only) and averaged over the length of the selected epoch. (e.g., for 60s epochs, this would be the light values summed once per second and divided by 60).

Inclinometer (optional) – Device orientation information. This is calculated by sampling the angle of the device over the entire length of the epoch (30 times per second) and selecting the predominant angle; i.e., the angle "range" that appeared the majority of the time over the epoch. For details about inclinometer functionality, see the Inclinometer Whitepaper.

*.dat File Format

Older versions of ActiLife produced *.dat files when downloading data from devices. These files consist of ten (10) lines of header data (meta information about the content) followed by epoch accumulated/filtered data. This "DAT" file stores all of the activity (1 to 3 axis), pedometer, Inclinometer, and/or heart rate data in ASCII format. This file also contains the Serial Number, Start Time, Start Date, Epoch Period, Download Time, Download Date, Current Memory Address Pointer, Current Battery Voltage, **Mode** and **First Start Time** (used to build the DAT file) as part of its ten (10) line header information. The file can be viewed with any standard text editor such as MS Notepad. The Mode value given in the header of the DAT file outlines which features were active during data collection for the file. Table outlines the values of the Mode variable.

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Mode	Mode in binary	Activity	Dual Activity	3rd Axis	Steps	Heart Rate	Lux	Incline	Total Parameters
0	000000	X							1
1	000001	X			X				2
2	000010	X				X			2
3	000011	X			X	X			3
4	000100	X	X						2
5	000101	X	X		X				3
6	000110	X	X			X			3
7	000111	X	X		X	X			4
8	001000	X		X					2
9	001001	X		X	X				3
10	001010	X		X		X			3
11	001011	X		X	X	X			4
12	001100	X	X	X					3
13	001101	X	X	X	X				4
14	001110	X	X	X		X			4
15	001111	X	X	X	X	X			5
16	010000	X					X		2
17	010001	X			X		X		3
18	010010	X				X	X		3
19	010011	X			X	X	X		4
20	010100	X	X				X		3
21	010101	X	X		X		X		4
22	010110	X	X			X	X		4
23	010111	X	X		X	X	X		5
24	011000	X		X			X		3
25	011001	X		X	X		X		4
26	011010	X		X		X	X		4
27	011011	X		X	X	X	X		5
28	011100	X	X	X			X		4
29	011101	X	X	X	X		X		5
30	011110	X	X	X		X	X		5
31	011111	X	X	X	X	X	X		6
32	100000	X						X	2
33	100001	X			X			X	3
34	100010	X				X		X	3
35	100011	X			X	X		X	4
36	100100	X	X					X	3
37	100101	X	X		X			X	4
38	100110	X	X			X		X	4
39	100111	X	X		X	X		X	5
40	101000	X		X				X	3
41	101001	X		X	X			X	4
42	101010	X		X		X		X	4
43	101011	X		X	X	X		X	5
44	101100	X	X	X				X	4
45	101101	X	X	X	X			X	5
46	101110	X	X	X		X		X	5
47	101111	X	X	X	X	X		X	6
48	110000	X					X	X	3
49	110001	X			X		X	X	4
50	110010	X				X	X	X	4
51	110011	X			X	X	X	X	5
52	110100	X	X				X	X	4
53	110101	X	X		X		X	X	5
54	110110	X	X			X	X	X	5
55	110111	X	X		X	X	X	X	6
56	111000	X		X			X	X	4
57	111001	X		X	X		X	X	5
58	111010	X		X		X	X	X	5
59	111011	X		X	X	X	X	X	6
60	111100	X	X	X			X	X	5
61	111101	X	X	X	X		X	X	6
62	111110	X	X	X		X	X	X	6
63	111111	X	X	X	X	X	X	X	7

TABLE 7 - MODE WORD DEFINITIONS

Appendix B – Vector Magnitude

The term Vector Magnitude is used frequently throughout this manual and often when working with Ametris devices. Vector Magnitude refers to the magnitude of the resulting vector that forms when combining the sampled acceleration from all three axes on any device. Figure 94 illustrates the axes orientation for all Ametris devices.

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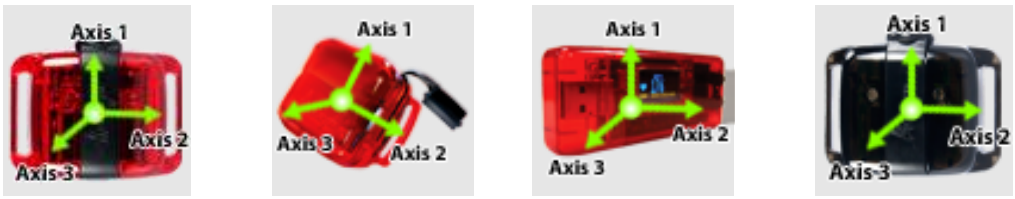

FIGURE 94 - AXIS DEFINITIONS FOR AMETRIS DEVICES

When looking at epoch level data (post filtered and accumulated data), the Vector Magnitude (or VM) can be defined as

$$Vector\ Magnitude = VM = \sqrt{(Axis\ 1)^2 + (Axis\ 2)^2 + (Axis\ 3)^2}$$

This value can be calculated on a per-epoch basis or as a sum for all axes over time.

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Additional resources:

Support Knowledge Base: HTTPS://ACTIGRAPHCORP.MY.SITE.COM/SUPPORT/S/

Tutorials: HTTPS://AMETRIS.COM/TUTORIALS

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