VivoSense®

User Manual - LifeShirt Import Module

VivoSense® LifeShirt Import Version 3.1

Cautions and disclaimer

VivoSense® software is not a medical diagnostic tool and is intended for research and investigational purposes only. VivoSense® is not intended to be, or to replace, medical advice or review by a physician.

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1. Introduction

1.1. VivoSense® for LifeShirt

This manual describes the use of the LifeShirt® import module for VivoSense®. This module is specifically used to import and analyze data collected with the LifeShirt sensor system by VivoMetrics®.

1.2. System Requirements

The LifeShirt Import module is an add-on module to VivoSense® software. In addition to the VivoSense® requirements, the LifeShirt import module has the following system requirements:

- VivoLogic software must be installed on the same computer as VivoSense®
- CompactFlash memory card reader – To read files directly from device storage

2. Importing Data

Ambulatory physiological data recorded using the LifeShirt system is stored as a .W file on the LifeShirt recorder CompactFlash storage card. These files can be accessed or transferred to a PC using a standard CompactFlash card reader. Alternatively, if VivoLogic software has already been used to convert raw LifeShirt files to .viv files, these .viv files may be converted to VivoSense® files for further analysis.

2.1.   VL Batch Import

VivoSense® works in conjunction with the VivoLogic® application to extract data suitable for import to VivoSense®. After installing the LifeShirt Import Module, the VivoSense® File -> Import Hardware File menu will have the following two menu command options:

- LifeShirt raw file – Use this to import *.W, or *.waveform files
- LifeShirt data file – Use this to import *.viv files

LifeShirt raw file

LifeShirt raw data files contain only the original un-calibrated data recorded using the LifeShirt system. In order to import, ensure you are running VivoSense® as an administrator. VivoSense® will instruct VivoLogic to perform a QDC calibration before exporting respiratory data into VivoSense®. On import, VivoSense® will then perform two auto-calibrations. One calibration scales Vt and the other shifts accelerometer data (for details refer to the VivoSense® Core manual).

LifeShirt data file

LifeShirt data files (paired *.viv and *.vov files) contain all user annotations and calibrations performed by the user after the raw data was originally imported into VivoLogic and prior to import into VivoSense®. In this instance, auto-calibrations are performed to shift accelerometer data but not to scale Vt. In addition, both user and hardware annotations are imported to VivoSense®.

3. Processing Data Channels

Available data channels from LifeShirt devices fall in two categories: Raw data channels imported from the device and derived channels – as calculated by VivoSense®.

Raw data channels from LifeShirt are located in the Data Explorer under the "Raw" node. They include Waveforms data channels, as described in the following sections. All Raw LifeShirt data channels are labeled with the prefix LS_ in VivoSense® to indicate that their source is a LifeShirt system. For more information regarding these data channels, please consult the hardware documentation for the LifeShirt system.

The core VivoSense® manual contains a general description of the derived channels. Only the derived channels that are specific to the LifeShirt system are described here.

3.1.　Accelerometer Data Channels

The LifeShirt accelerometer measures acceleration along 3 axes denoted by CH7, CH8 and CHE. The raw data is measured in computer units (cu) with an arbitrary offset. The conversion to physical units is performed in the derivation of the core accelerometer channels (AccX, AccY and AccZ). This calibration is done automatically on import and assumes the subject is upright at least once during the course of the session. See the VivoSense® Core manual for information about axis definitions.

Raw Accelerometer Waveforms

LS_CH7

Acceleration, measured along the Vertical Axis (Source Channel of AccZ).

LS_CH8

Acceleration, measured along the Lateral Axis (Source Channel of AccY).

LS_CHE

Acceleration, measured along the Longitudinal Axis (Source Channel of AccX).

Please note that this channel is absent in LifeShirt Model 100 system. The LifeShirt Model 100 unit supports a two-channel accelerometer only.

3.2.　Electrocardiogram (ECG) Data Channels

The LifeShirt system provides a modified limb II electrocardiogram (EGC) measurement. VivoSense® will process this ECG and perform QRS detection to generate a set of R-wave markings

Raw Electrocardiogram Waveforms

LS_CH1

Primary raw ECG signal

3.3. Galvanic Skin Response (GSR) Data Channels

The LifeShirt system allows for the connection of an optional sensor for measuring Galvanic Skin Response (GSR). The source of this data may be from hardware port A or hardware port B. The following waveforms are included in VivoSense®:

LS_GSR~a

This is the raw GSR waveform if the GSR sensor was connected to the recorder port A.

LS_GSR~b

This is the raw GSR waveform if the GSR sensor was connected to the recorder port B.

GSR

This is the calibrated GSR waveform in µSiemens independent of which port the waveform was connected to.

3.4. Pulse Oximeter Data Channels

The LifeShirt system allows for the connection of an optional Pulse Oximeter sensor for measuring oxygen saturation. The following measures are included in VivoSense®:

LS_Sa02~s

This is the raw oxygen saturation measure imported directly from VivoLogic.

SaO2

This is a copy of the oxygen saturation measure where dropouts of less than 3 seconds are replaced with the previous good oxygen saturation value. A dropout is defined as a saturation value that is less than 70%. This helps to visualize the measure in the presence unwanted dropouts.

3.5. Respiration Data Channels

The LifeShirt system uses a dual band Respiratory Inductance Plethysmograph (RIP) technology to record raw channels of respiration.

Raw Respiration Waveforms

LS_CHA

This is the RIP band respiration waveform measured across the rib cage. Chest excursions are measured in uncalibrated computer units.

LS_CHB

This is the RIP band respiration waveform measured across the abdomen. Abdominal excursions are measured in uncalibrated computer units.

LS_Vt

This is the weighted sum of *LS_CHA* and *LS_CHB*. The value of the weighting coefficients are the result of the calibration. In the case of a .W file import, the calibration is performed automatically over the entire file

while in a *.viv* file import, no additional calibration is performed. Instead VivoSense® retains the same calibration settings that were stored the last time the *.viv* file was opened in VivoLogic.

4. Annotations

VivoLogic supports several types of annotations. The annotations entered via the LifeShirt recorder during a recording session are imported as *hardware annotations*. All other annotations, such as general user annotations, annotations which identify the location of the data used by a calibration calculation (such as QDC calibration, Fixed Volume calibration, posture calibration) or annotations identifying specific events such as apneas, hypopneas, alpha intrusions are imported as user annotations.

All annotations are user editable after import into VivoSense®. Please note, however, that any user modification will not result in changes to the output of an underlying algorithm.

5. Layouts

VivoSense® software provides a variety of Layouts specific to the LifeShirt Import module.

The following layouts are provided with the LifeShirt Import module:

Actigraphy

These Charts are suitable for evaluating the motion and/or activity of a subject. This layout contains channels for each calibrated accelerometer axis as well as derived posture and motion measures.

Breath Detection and Calibration

This is a specific set of Charts designed for adjusting the breath detection settings and calibrating the Vt waveform. All of the charts necessary for the examination of changes in breath detection are available. This layout also provides easy access to the Breath Detector channel (for adjusting breath detection settings) as well as the Calibration Volume channel (for performing a fixed volume calibration). Changing the Breath Detection settings will result in changes in respiratory measures and their corresponding trends

Cardiac

This is a set of Charts suitable for use in evaluating cardiac information from an electrocardiogram (ECG) sensor. This layout contains the filtered ECG waveform, R-wave markings resulting from QRS detection and subsequent derived R-R intervals. A trend of the heart rate is included along with accelerometer waveforms to be used for context interpretation and identification of artifact. If necessary this layout may be used for making changes to the R-wave picker settings.

Quality Control

This set of Charts is the most general and is suitable for evaluating the quality of recorded data. It contains waveforms and measures from the respiration, electrocardiogram and accelerometer data channels. It is not however a complete set of measurements from all channels.

Raw Waveforms

This is a set of Charts that contain all the raw (non-optional) data from the LifeShirt system. It is always important to visually examine raw data to account for possible sensor artifact. This layout does not contain charts for the optional pulse oximeter, EEG and GSR channels.

Respiration

This is a set of Charts suitable for evaluating respiratory data and contains several key respiratory measures and trends. The Vt waveform with breath detection markings, as well as respiration trend channels.

Sleep

This is a set of Charts suitable for use when evaluating sleep data and contains respiratory waveforms and measures, motion and posture data, as well as oxygen saturation data.