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QuSpin Neuro-1 Data File Format Description

This document provides a detailed description of the format for data files generated by QuSpin's Neuro-1 OPM magnetometer system. The data files contain measurements from triaxial sensors, triggers, analog signals, and sensor and system level data.

File Format Overview

When data is saved using the Neuro-1 system, two files are generated–one file that contains sensor measurements, and one file containing sensor and system level data.

Sensor Measurement Data

Sensor measurement data is saved in a Labview Measurement File or ".lvm" format. These files are plain text, making them easy to read and modify manually if needed. They can be opened in any text editor, such as Notepad or Excel.

The file starts with a header section containing metadata about the data acquisition, such as the version of LabVIEW used, the date and time of the measurement, the operator's name, and other relevant settings. This header provides context for the data and helps in understanding how the data was collected.

The files contain channel header information such as the number of channels, date and start time of measurement, units of measurement, and time interval.

The data is organized into rows and columns, where each column represents a different measurement channel, sensor, or signal (such as time, sensor axis data, triggers, and analog signals).

Naming format: *User Specified Name_time stamp_array #.lvm* , where "array #" refers to the physical array of sensors, to distinguish between multi array systems. Currently, with one DAQ, up to 2 arrays can be used. Therefore, "#" can either take the value 1 or 2.

Data Columns

The main data section includes multiple columns containing measurements, and digital and

analog signals. The row above the first data (above t = 0 sec) contains identifiers for the columns. These are:

- Column 1, X_Value: refers to the time of the measurement
- Columns 2 - 193: Sensor axis data where
    - Columns 2-65, X axis data for sensors 1-64
    - Columns 66-129, Y axis data for sensors 1-64
    - Columns 130-193, Z axis data for sensors 1-64
    - Columns 194 - 204, digital trigger data denoted by “T#”
    - Columns 205 - 220, analog trigger data denoted by “A#”
- Column 221 -222: “MUX” counters referring to the FPGA module on either array 1 or array 2. These values are 16 bit numbers (resetting to 0 after 65533) incrementing by 1 when the sample rate is 1500 Hz, 2 when sample rate is 750 Hz, and 4 when the sampling rate is 375 Hz. These columns are useful to identify if and when a data packet was dropped.
- Column 223: “DAQ_Counter1” refers to a DAQ level counter (32 bit number) that increments by 1 every 0.04 seconds. Useful for identifying if and when a transmitted data packet was dropped
- Columns 224-225: “Data_Valid1” and “Data_Valid2” are columns that indicate whether a data packet was dropped. Values are 0 when no data was dropped, and 1 when data was dropped.
- Column 226: Comments on the particular row

Sensor and System Level Measurement Data

Sensor and System Level Measurement Data is saved as a text file. The file consists of columns that correspond to individual sensors and rows corresponding to specific sensor settings. For binary settings, “0” refers to “off” and “1” refers to “on”.

Naming format: *User Specified Name_time stamp_array #_calibrations.txt*, where “array #” refers to the physical array of sensors, to distinguish between multi array systems. Currently, with one DAQ, up to 2 arrays can be used. Therefore, “#” can either take the value 1 or 2.

Data Columns

- Column 1: sensor parameter name.
- Columns 2-65: Sensor ID with the format “Alpha-numeric[#]” where the alpha-numeric refers to the physical slot and the [#] refers to the sensor number on the array. Arrays can have a maximum of 64 sensors. For example A5[5] refers to the 5th sensor in the array that is located on slot A5.

Data Rows

- Row 1: Column headers identifying the sensor

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- Rows 2-7: Calculated field overlap values used to correct measurements made from non-orthogonal axes. These values are calculated during the calibration and then applied to during measurements. For example, “YX” refers to how much of the Y axis overlaps with the X axis. Ideally, this number is 0, but is rarely that in practice due to misalignments from the manufacturing process

- Rows 8-10: Calibration values for each axis calculated during the orthogonalization process. Once the axes are orthogonalized using the overlap values, these calibration values normalize the axis to ensure accurate absolute field measurements. Ideally, these are 1.

- Rows 11-36: On/Off settings for various parameters.

- Rows 37-50: Blank rows reserved for future parameters if needed.

- Rows 51-61: Various values of sensor control data which can be useful for troubleshooting.

- Row 62: System level data such as power supply voltages, firmware versions, etc…