Webinar Q&A Report:

Maximizing Data Quality in Life Science Data Acquisition and Analysis

1. **Are there any resources available to find data acquisition settings that are correct for my animal model?**

   ADI's Basics of Data Acquisition manual is a good place to start. That will cover off the most common signal and animal model combinations.

2. **How can you be sure you are cleaning noise and not valuable information?**

   This is ultimately the choice that you'll need to investigate, and decide what is appropriate for your signal.

   One tip is to try to find an example signal that is free of noise. You can use this as a template for the morphology of the waveform (to qualitatively assess your filtering choices). In addition, you can look at the example signal in a spectrum tool, which will give you an indication of the component frequencies that make up a real signal, using that information for your filter settings.

3. **Can you give any tips to improve the quality of EEG signals?**

   Noise in an EEG is a common complaint. Here are the top suggestions.

   a. Be mindful of the quality of the connection of your electrodes. You can use an impedance meter like the MLE2002 Checktrode
   b. Properly shielding cables
   c. Relieve any tension on the electrodes and cables by attaching them to the subject in a place they are unlikely to move. By fixing the terminal end of the electrode wire in a location where it moves with the subject (no pulling or pushing), you can eliminate some sources of movement artifact.
   d. Instrumentation Grounding
   e. Reduce cable clutter

f. If your electrodes require it, use a high-quality electrode cream/paste. Additionally, preparing the area on the scalp where the electrode will be attached is a vital step to ensure good signal quality.

4. **Is there a need for another data acquisition device or interface from the amplifier for brain slice electrophysiology?**

Your data acquisition and amplifier instrumentation choices will depend on what you are interested in recording (what type of signal) from the brain slice. To directly answer the question, there isn't anything special about brain slice recording that requires anything more than a suitable amplifier, and a suitable data acquisition system. ADInstruments LabChart and PowerLab paired with a suitable amplifier work well for many brain slice applications, from field potentials to patch clamping.

5. **Can you use PowerLab for electrophysiological recording from brain slices?**

Yes, ADInstruments LabChart and PowerLab paired with a suitable amplifier work well for many brain slice applications, from field potentials to patch clamping.

6. **What is the best sampling rate to analyze HRV?**

The best sampling rate to analyze HRV will be relative to the heart rate of the subject (and the frequency characteristics of the signal). To be specific, the answer will be different for a human than for a mouse. For typical Human HRV studies, 2kHz is a good choice. This will provide a good balance between precise detection of the R-Wave and overloading your system with unnecessary data. Note: Because of the nature of HRV analysis the sample rate determines the step size of 'variation' that can be detected (i.e. at 1kHz 1ms is the step size). Lower sampling rates, therefore, result in 'banding' when looking closely at some of the HRV plots (i.e. the Poincare Plot).

7. **Do computers, for example running LabChart, make noise? Should we make it far from other instruments?**

Everything that has electricity running through it is a possible source of EM noise. The principles discussed in the webinar apply to everything in your lab that carries electricity. Your best option is to do an investigation, as suggested in the talk, by turning off everything you can and seeing what impact it has on your signal.

Of course, the computer isn't something you can turn off and still see a signal. In the case of this particular part of your setup, the most likely source of noise is the power supply. Simply avoiding power cables is a great place to start.

8. Can WiFi be a source of noise (PowerLab - PC)?

   WiFi is typically operating at a much higher frequency than we would typically see in laboratory instrumentation. While the short answer is yes, there are ways for WiFi to contribute to laboratory noise, most likely you will see other sources have a larger impact far before WiFi becomes a problem.

9. Does exercise or movement, for example in humans for metabolic research, produce noise in ECG or other signals measured simultaneously?

   Movement artifact is definitely something you should consider. For ECG specifically, the best thing you can do is eliminate the movement of the electrodes as much as possible. This can be accomplished by fixing electrode wires to the subject in a location that isn't likely to move relative to the terminal electrode. OR, by using a specialized device like the Equivital LifeMonitor, which has a very short travel, and eliminates most movement artifact with proper fit.

10. Can you post the arithmetic to correct the noise of ECG that you showed in the presentation?

    To remove ECG from the diaphragmatic EMG signal in the example I showed in the presentation, I used the following arithmetic expression in LabChart.

    abs(Threshold(SmoothSec(Window(Ch2,-0.001,0.00075),0.1),1)*Highpass(Ch1,10))

    Where Channel 1 is the Raw EMG (with artifact) and Channel 2 is the separate ECG signal I used for detection. The expression creates a square wave from the regular ECG signal and subtracts it from a high pass filtered version of the EMG signal.

11. What would you recommend to analyze muscle fatigue through EMG spectrum analyses?

    The Spectrum tool in LabChart does a fantastic job with EMG fatigue analysis. You can either use the spectrum window itself (Window>Spectrum), or turn on a spectrum channel calculation in a LabChart channel.

12. Are there good tools to synchronize different signals with different sampling rates?

    There are two ways to answer this question. I'll try to address both.

    In a live recording session, this is typically handled fairly well by the data acquisition system. LabChart and PowerLab handle this elegantly while all the data is being sampled through the PowerLab.

If this is not the case, and you are interested in synchronizing data offline, after acquisition, potentially from different data acquisition systems, the problem becomes harder. The best advice, without knowing more detail, is to find a way to embed a timing signal into all of the systems while you are sampling. Using that information, you can try to uncover any issues with synchronization.

13. **Have you tried manually building a Faraday cage? Would it have to cover the electrodes & machine?**

Manually building a faraday cage is a great way to get one that works well with your particular preparation. Generally, it is a good idea to cover your instrumentation to the point at which you've amplified the signal to your liking. After most of your amplification is done, ambient noise has a far smaller impact on the signal.

The following is a good reference for a DIY faraday cage: https://youtu.be/KQyvyg30S1Q

14. **There is always a moderate amount of noise in my ECG recordings of rats. In our lab, we measure manually, but it can be difficult to see the exact start and stop of certain peaks. This can cause variation based on the individual doing the calculation. Is there any way to more accurately determine the lengths of these different ECG features?**

Unfortunately, if there is sufficient noise that your landmarks are obscured, there isn't much you'll be able to do about your measurement variability. You should first consider tackling the noise at the source using the practices described in the webinar. First and foremost, find the primary source and do what you can to isolate it from your experiment.

15. **In the artifact rejection settings, does it simply ignore the data when selected for datapad analysis?**

Tools like the classifier view will eliminate that event from the analysis. In the case of the ECG analysis module used in the webinar, that waveform is ignored (not removed completely) when analyzing ECG landmarks and averaging them for export.

16. **I am using Langendorff to give ischemia. In ischemia, the pressure signal drops to zero but in calculated parameters where I use heart rate, there is a lot of noise. How can I remove it?**

If you are using LabChart's Cyclic Measurements for your heart rate calculation, there are two ways to deal with this issue.

First, Cyclic Measurements has a feature in its advanced settings labeled "Peak Search Window" that will ignore any sections of data that have a gap in detected events longer than the search window specified.

Another way to eliminate this artifact is to add an arithmetic expression on top of the calculated heart rate. For example, if you know your heart rate ALWAYS between 200 and 800 bpm, you can use the following calculation (the heart rate is on Channel 1 in this example):

Window(eventinterp(ch1),200,800)*ch1

The Eventinterp function makes the cyclic measurements output ready for arithmetic to apply an additional function, while the window function returns a 1 while the original data is between our landmarks, and a 0 while it is outside. Multiplying that output by the original data gives us a result that is 0 when the original cyclic measurements result produces an artifact.

17. I am measuring cardiac physiology in an ex vivo working heart system. I want to sample multiple parameters during a 20-30 minute experiment, but I want to avoid periods where the heart rhythm is transiently abnormal. Is there a way that I can automate data capture from a file that avoids periods of arrhythmia?

For this question, I am going to suggest the same procedure described above. Add an arithmetic expression on top of the calculated heart rate. For example, if you know your heart rate should ALWAYS between 200 and 800 bpm, you can use the following calculation (the heart rate is on Channel 1 in this example):

Window(eventinterp(ch1),200,800)*ch1

The Eventinterp function makes the cyclic measurements output ready for arithmetic to apply an additional function, while the window function returns a 1 while the original data is between our landmarks, and a 0 while it is outside. Multiplying that output by the original data gives us a result that is 0 when the original cyclic measurements result produces an artifact.

If you cannot separate your artifact from your desired data in this manner, then you can use some other characteristic of the artifact (shape, amplitude) in a similar manner as described above with the heart rate and apply it with a similar result in mind.

If you have additional questions for ADInstruments regarding content from this webinar or wish to receive additional information about their instrumentation for invasive blood pressure measurement, please contact them by phone, or click here to make a general inquiry.

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