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BIOPAC WEBINAR Q&A

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Webinar: Recording Great Electrodermal Activity (EDA) Data: Pt.1 Recording the Data

Questions and Answers

1. Q: Is the adaptive scaling available in Biopac Student Lab?

   A: Yes.

2. Q: Why was median smoothing selected? How was the 50 setting selected?

   A: Median smoothing rejects outliers while mean smoothing averages them into the result. It will eliminate rap transient spikes from a slow moving signal such as electrodermal activity. 50 samples were selected because the sample rate was 50Hz. Usually, a smoothing window equal to the number of samples per second will remove most artifacts while not disturbing the physiological trends in the data. Remember to apply a 1Hz FIR LP afterwards, to smooth out the result. You can perform testing with these and other settings on clean data and compare to the original to see that the data are not significantly altered by the transformations. We recommend such testing steps before transforming data in general. See also this Application Note.

3. Q: you said fast SCL rise equals good data, is "fast drop of SCL" can be seen as a bad data (artifact)?

   A: What's important is to be aware that a SCR reaches the peak over 1-3 seconds while 50% decay may take anywhere from 2-10 seconds. So skin conductance data rises much faster than it drops. For instance, a very fast drop, for example a full 1 microSiemens over less than 2 seconds, is unlikely to be physiological in nature.

4. Q: For artifact correction: Should median smoothing be done before low-pass-filter or the other way around?

   A: The median smoothing should be performed first to remove any high frequency artifacts from the signal before low pass filtering it. Low pass filtering will smooth artifacts into the data, so they should be removed first.

5. Q: Can I just study using the raw EDA data? Or should I edit the data (e.g., smoothing?) beforehand?

   A: If the signal is clean, it can be used as is. But you can resample to 50 Hz (no less than 50 Hz) in order to speed up the performance of the analysis algorithms.

6. Q: I got some negative values for some participants. Could these be non-responders?

   A: This is a calibration issue. To fix existing data, contact us at support@biopac.com. For future recordings, make sure you perform the calibration with open circuit (electrodes not connected to the participant) at the start of the recording.

7. Q: Can you elaborate on how to identify electrical noise in the recording? As well as how to fix it when the participant is there or during the data cleaning stage?

   A: Electrical noise is 50Hz or 60Hz. You can use the Spectrum analyzer palette (Display->Show->Spectrum analyzer palette) in real-time as well as after the recording. A peak will be obvious at 50Hz/60Hz (depending on your region). This is an unusual problem to have with the EDA data as it is low-pass filtered at the amplifier. This means the source of noise is not related to the EDA, with the most likely culprit being third party equipment that is connected to our system without optical isolation. Dry electrodes or poor contact between the electrode and the subject will also exasperate this problem.

8. Q: Can an EMG headset be used to record wireless EDA data?

   A: No. EMG equipment records a biopotential voltage while EDA works by passing a current through the body and recoding conductance. We have the BN-PPGED module to accomplish wireless EDA recordings.

9. Q: What is the value of viewing the EDA response with a ball pushing a bar rather than viewing it as a graph/in the format it is being recorded?

   A: This example was a part of a biofeedback game that uses EDA and Acq*Knowledge*'s Network Data Transfer functionality to provide real-time access to the data for biofeedback. A sphere would materialize after every SCR (skin conductance response). If the goal is for the participant to relax, they try to keep their responses down or else the bar will be tipped over. In another version, the game can be played against a human or computer with the goal of generating more and larger responses than the opponent in order to knock down the bar first. The game adapts the size of the spheres to the max response of the participant so far, thus accounting for individual variability.

10. Q: Is there a way to salvage data that is messy because of substantial movement/messing with the electrodes? For example, in our study on SCR among anxious participants our most anxious participants were the ones who played with the electrodes the most making their data (which is of most interest) also the messiest.

    A: There is a lot that can be done to recover the data. You can use the median smoothing, connect endpoints and filtering techniques that were discussed during the webinar and/or contact us at support@biopac.com so we can help with further suggestions. We have seen literally thousands of files with EDA and can usually help to extract some useable data. However, it makes sense for you to consider using alternative electrode locations where participants are less likely to play with the electrodes and leads.

11. Q: Can you look at batches of waveforms from different subjects in addition to batch analysis?

    A: Yes.

12. Q: Where can I find some instructions on how to automate (i.e. generate a script) artifact correction?

    A: That will be covered in the follow-up webinar.

13. Q: What would be the best measure to report for tonic EDA? Frequency, Amplitude or SD of NS-SCR?

    A: We refrain from advising on the best measure. We recommend that you consult the reference literature that was included in the presentation as well as the literature on the topic of EDA in general. The analysis routines in Acq*Knowledge* will provide you with a wide range of options to choose from and all of the frequently used and recommended measures.

14. Q: This was fantastic! Keep it coming. Want to make sure that you are fine with us sharing the recordings with our students.

    A: By all means, the goal of such events is to share our knowledge with researchers.

15. Q: Do you have any suggestions for removing artifact from mobile subjects?

    A: It's best to avoid artifact in the first place by using fresh electrodes and taping over the leads and electrodes. Experiment with placing electrodes in alternate locations that will not be influenced by movement that much but explore the literature beforehand. We have included one such reference in the presentation. If you are already done with the experiment, please refer to the answer of question 11. We are also working on new strategies for mobile applications that will help to prevent or minimize artifacts created during mobile recordings.

16. Q: What is the minimum time between events for event-related EDA analysis?

    A: This is a function of latency + rise time + recovery time. We would suggest no less than 8-10 seconds, but this decision is ultimately the researchers. There are also publications on how to deal with analyzing EDA data when events are spaced very closely together; there certainly are some interesting solutions. We recommend that you consult the literature if you have to cut down on the inter-stimulus interval.

17. Q: What type of stimuli/experiment was this last example for?

    A: The example which included two digital channels with markers involved auditory stimulation. Two categories of sounds were played to the participant: recordings of screams and recordings of hand claps. They had similar dB levels.

18. Q: Do we need to apply the gel also on the electrodes for one use? How much? Do we apply it on skin or on electrodes? Thanks.

    A: If the electrodes are fresh, you do not have to do anything. If they have dried out (you will know it, as they will feel dry to the touch and may even have a crust) then add gel as per the procedure that was described during the webinar.

19. Q: Will you be including MP36 systems?

    A: The analysis approaches apply equally to data recorded with the MP36 system. The MP36R system comes with the Acq*Knowledge* software, which was used for the presentation. The BSL software comes with the regular MP36 system (part of our educational BSL package) but has fewer features as it is designed for teaching purposes. Acq*Knowledge* can open files created with the BSL/MP36 system and, therefore, you can analyze BSL data using the more advanced research software, Acq*Knowledge*.

20. Q: What about recording EDA from the underside of toes with the TSD203-electrodes?

    A: The instep of the foot and the palmar surface of the hand have the highest concentration of sweat glands on the body and are thus ideal locations to record from.

21. Q: What is the process to put on the electrodes on the participants to get a good signal? Should I have them wash their hands? Use alcohol? Conductance gel?

    A: No alcohol should be used as it dries out the skin. If the participant must wash their hands, use just plain water. The disposable electrodes (EL507 and EL509 for MRI) are already pre-gelled, but if they are dry, GEL101 isotonic gel must be added. When using reusable electrodes, such as the TSD203, fill the cavity with GEL101.

22. Q: Can you record several videos simultaneously with Acq*Knowledge*?

    A: Using the CAMSYS4 and CAMSYS8, you can record and synchronize 4 or 8 videos respectively. Furthermore, using the OUT103 led as a sync marker, there is no limit for how many external video cameras you can synchronize with Acq*Knowledge* and later link the footage to the software. See here. In addition to the multi camera setups there is also a High Frame Rate option for recording fast events.

23. Q: Also, when I check the electrode setup with EL Check, I always get the red or orange light as a result - is this normal? If not, what can I do to get a better signal?

    A: Impedance checking is not necessary for EDA. Isotonic GEL101 for EDA recording is not as conductive as regular electrode gel, such as GEL100, and values will naturally be lower. If you are asking how to improve the impedance for biopotential recordings, such as EMG, EEG, etc. then the following will help:

    Abrading the skin using ELPAD

    Placing the electrodes 5-10 minutes in advance

And for a full list of recommendations, see here.

24. Q: Please explain the automated artifact removal scripting in detail or provide additional information for this feature! Thanks!

    A: This will be discussed in detail during the follow-up webinar.

25. Q: So should a ground electrode be used (in addition to the VIN-) if the EDA100C is the only amplifier being used?

    A: No, an additional ground electrode is not required when recording EDA. The subject is automatically grounded through the EDA electrodes. If you want to use an additional ground electrode, use the CBL205 in series with the ground cable of the other amplifier. This is not typically recommended when only recording EDA. Please read this application note.

Q: For attaching EDA to participants, what is best practice for washing hands. Use soap? Rubbing alcohol? Don't do it?

A: Please refer to question 22.

26. Q: Is there any downside (other than using up GEL101) to "reviving" electrodes that have not yet dried out? In other words, erring on the side of caution.

A: There is a downside. Since you are mixing the fresh gel with the dried gel, you are altering the salinity. Thus, the resulting gel mix will be more likely to saturate the sweat glands. Placing extra gel on the electrodes is a temporary solution until you can obtain new fresh electrodes.

27. Q: We also find that some participants have 0 microsiemen levels throughout the protocol, despite correct preparation of the skin (including using isotonic gel), and changing electrode placements

A: In our experience, about 10% of people are non-responders. If in doubt, you can always record some data from yourself when you encounter such a participant. If you use the same setup and same batch of electrodes and get responses yourself, but nothing from the participants, then you may have a non-responder. Also check the location where you are placing the electrodes for callused skin, cuts and abrasions because they will impact the quality of the signal.

28. Q: When will the automated artifact removal be covered

    A: In the next webinar.

29. Q: We sometimes get negative EDA vales -- is there a common reason for this?

    A: Please refer to question 7.

30. Q: How can I connect sound stimuli into BIOPAC and sync it with EDA recording?

A: Here are two ways (assuming you are using the MP150 system; there is a similar solution for the MP36R).

1. Split the audio output of the computer and feed it directly into the system as an analog channel via the HLT100C and INISO. This would ensure optical isolation.
2. If using stimulus presentation software, send markers over the parallel port to the STP100C module.

There are more solutions available and if you need further information, please contact us at support@biopac.com

31. Q: What if your experiment required movement? How do you minimize motion artifacts?

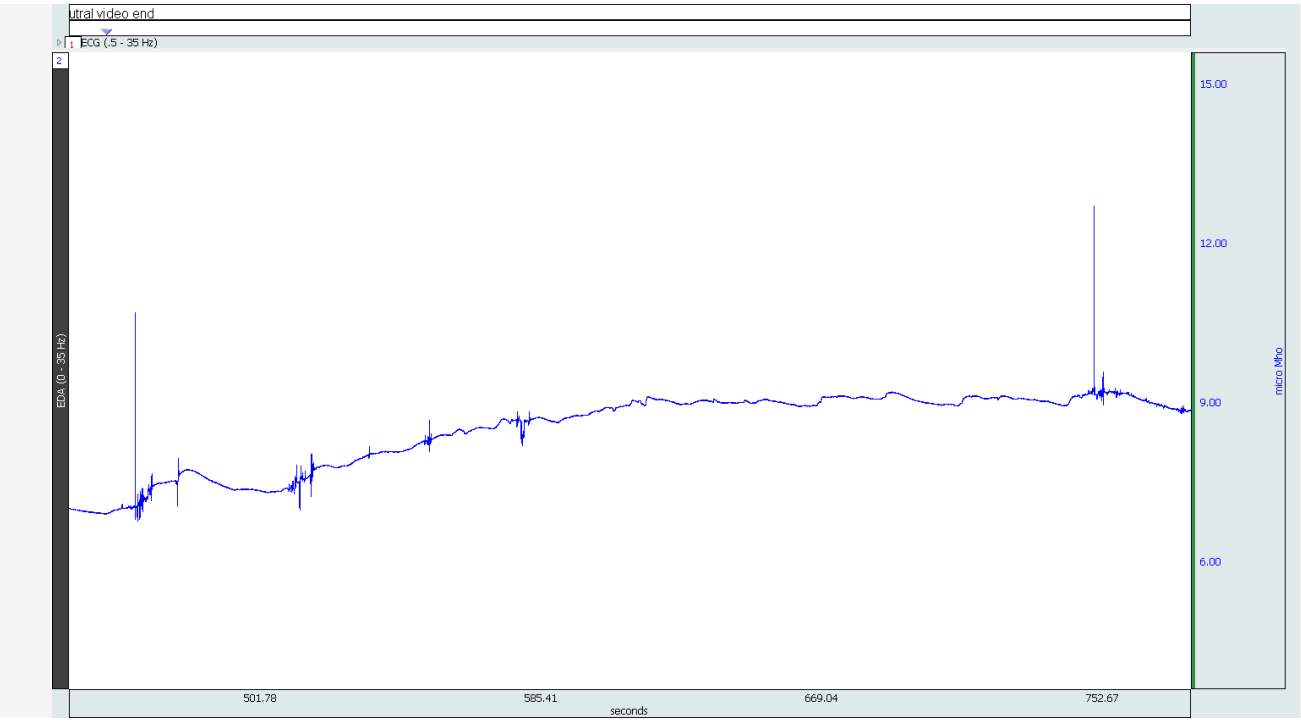
    A: Please refer to question 16.

32. Q: Parallel port support PCs is increasingly harder to find. Also presenting stimulus from laptops would be nice. Additionally 64 bit Windows is making software control of parallel ports increasingly difficult. Are you aware of any USB to parallel converter that would work for SENDING EVENT markers into BIOPAC?

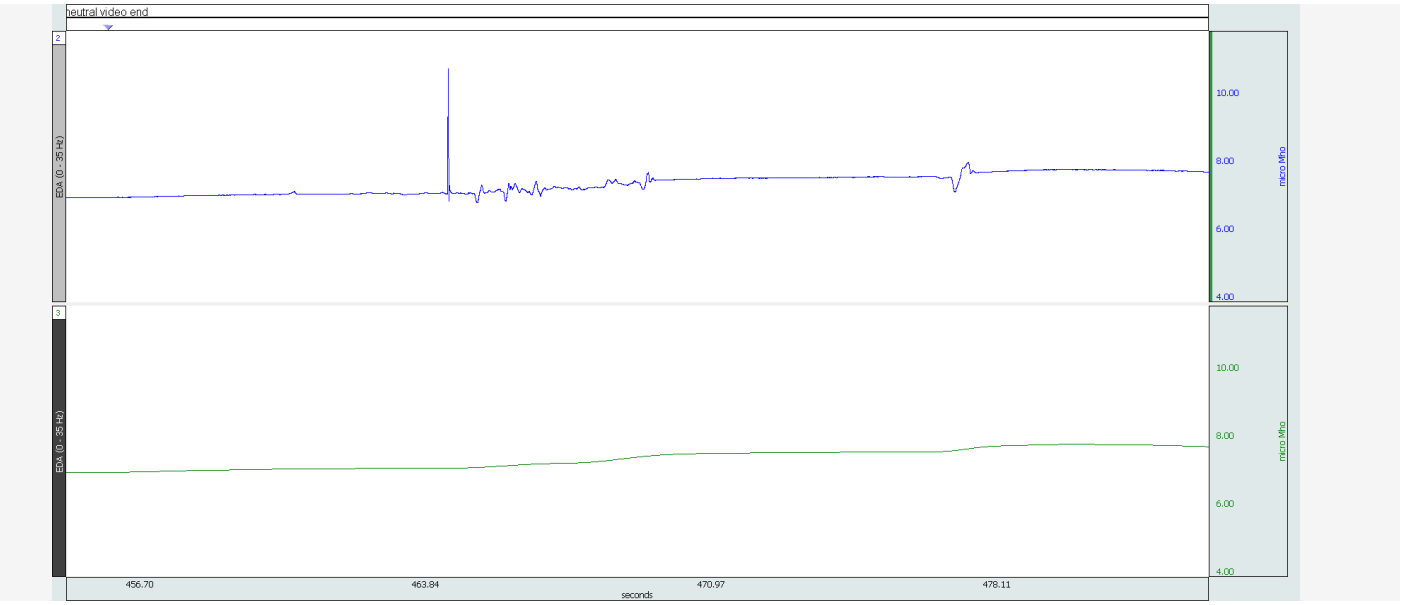
    A: Here is one solution.

33. Q: My question is, how do I recognize and remove artifacts created by movement?

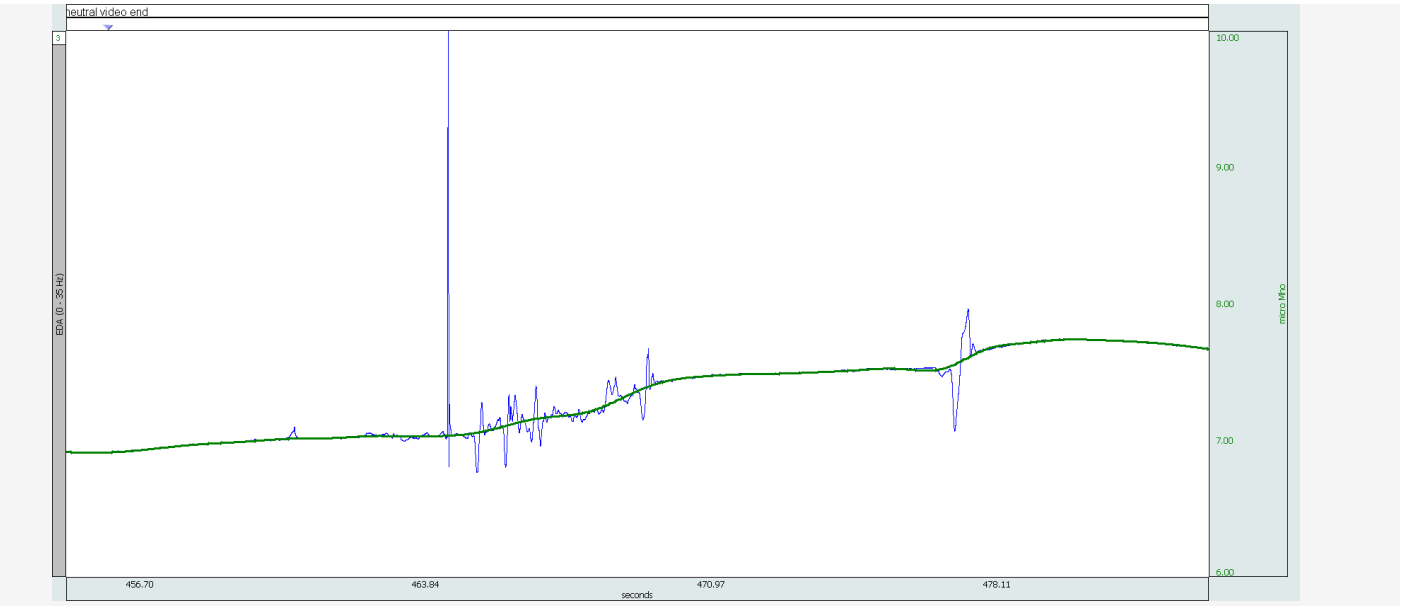
    A: These are changes in skin conductance that do not make sense given physiological expectations. Typically this means the EDA goes up or down at a very fast rate. Such artifacts are very fast. Here is an example:



Next, we have resampled the data to 50Hz and applied a 50-sample median smoothing filter (Transform->Smoothing) and then 1 Hz FIR low pass filter (Transform->Digital filters->FIR filter->Low pass). We have zoomed in and the original data is seen on top with the transformed result on the bottom. The artifacts are completely eliminated:



This is even better illustrated by showing the waveform in scope mode, with the green waveform representing the clean result:



This is an example of the most typical type of artifact and method of correction. However, we will release an EDA troubleshooting guide in the future that will include Acq*Knowledge* sample files of various types of issues so you can learn how to handle the data yourself.

The follow-up webinar will address artifact removal automation techniques.

34. Q: I have a question about safe grounding. We often collect ECG and ground the subject with three lead set up that way. We don't ground on any of our other channels. But your slide suggested that we need to have a separate filter to place in between the lead and the EDA amplifier for safety. Please elaborate in the Q/A document.

A: When using EDA, you are already grounded via the VIN- connection of the EDA100C/GSR100C amplifier. Thus, no other ground is necessary, not even an ECG ground. However, you can certainly use

other grounds, just make sure to use a CBL205 cable at the ground lead connection for any additional grounds you may want to use.

A second ground can be very useful when recording EEG or EMG (because the quality of the ground connection at the finger with isotonic gel is not the best possible and for these sensitive signals it's nice to have a separate ground) or in the event that the EDA lead gets disconnected through movement artifact, etc.

35. Q: In your experience, are non-responders non-responsive from all recording locations? Or would it be useful to try a different recording location if your subject seems to be a non-responder?

    A: We have not experimented with this sufficiently. We recommend consulting with the literature.

36. Q: Is there an expected difference in reliability of the data between recording EDA in the lab with a MP150 and with a mobile device. We have compared the devices at the same time point and the data doesn't really look the same.

    A: Data recorded from the same electrodes will look identical with one exception: the wireless system uses 12-bit A/D conversion before broadcasting the data, while the wired system uses 16-bit A/D conversion. This means you can detect much smaller changes in skin conductance with the wired system. The minimum resolution with the wireless system is 0.012 µS, while with the EDA100C amplifier it is several orders of magnitude smaller (because you can also change the gain and zero offset of the amplifier). For practical purposes, the resolution of the wireless system will be enough, but this is something to keep in mind if extremely sensitive measurements are necessary.

    Q: are there any sources you can provide for how to run statistical tests using the data obtained from BIOPAC

    A: We would like to refrain from making recommendations on how to run statistical tests.

37. Q: I want say how I can stimulate the rats

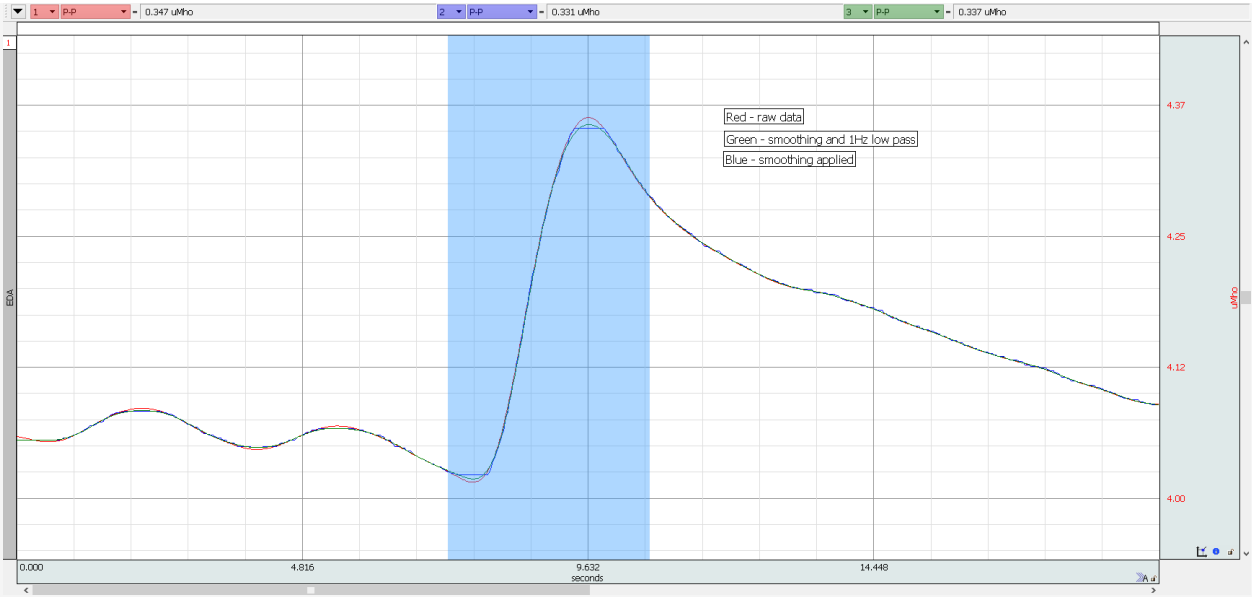
    A: We can deliver a wide range of voltage or current stimulation, including even tDCS stimulation. It is best to contact us at support@biopac.com since there are many details to consider when designing an experiment with electrical stimulation.

38. Q: Can the analysis (as shown at this moment) be applied to multiple participants without having to do it manually for each participant?

    A: Yes, and this will be covered in the follow-up webinar.

39. Q: Will using smoothing on a signal remove some information that might otherwise be useful, such as skin conductance responses or altering the SCL?

    A: No, median smoothing will not impact the signal if it is applied correctly and it is easy to determine whether you have altered the signal by overlapping the raw and smoothed waveforms. If the filter becomes too aggressive (if you use too many samples for the window), then it will also transform the underlying trends in the signal. For data sampled at N samples per second, a median smoothing filter with window size N will result in a slight reduction of observed P-P changes in responses:



You have to define the limits for an acceptable transformation. In this example, the peak-to-peak measurement after smoothing and low-pass filtering at 1Hz differs by about 3% from the raw data (0.337 vs 0.347). But a filter this aggressive will eliminate most fast motion artifacts. If this trade-off is acceptable it's the researcher's decision and we recommend to always perform testing on both clean and noisy data before choosing a strategy to remove artifacts.

40. Q: How can I generate event markers from the network/ other software?

A: With the MP150 system and the STP100C module you can receive data from the parallel port or the StimTracker (and similar device) from any computer. You can send markers to Acq*Knowledge* using NDT over the network: http://www.biopac.com/product/network-data-transfer-licenses/

For virtual reality experiments we can provide sample code for how to send markers from Vizard to Acq*Knowledge*, as well as how to stream physiological data to the virtual reality computer in real-time.

41. Q: Electrode placement table - what's the paper title?

A: Emotional sweating across the body: Comparing 16 different skin conductance measurement locations, Physiology & Behavior 106 (2012) 298–304

42. Q: Isn't it important to control the area of contact? If gel covers a larger surface area, conductance levels will be higher.

A: With both disposable and re-usable electrodes, the surface area remains quite consistent between participants. For example, the glue of the EL507 and EL509 electrodes is quite strong so the gel cannot really spread beyond the contact area of the electrode once you apply it to the skin and the sponge pad helps to keep the gel in place.

43. Q: Is it possible to get access to graphs/pictures of what the EDA signal will look like when different issues arise (e.g., how does EDA look when electrodes have expired, when the wrong gel is used, when the participants are moving a lot, when there is momentary decoupling, etc.)

A: A separate troubleshooting guide is being prepared and it will contain actual data, not just pictures. We should focus on good data - show what the signal should look like and not worry about what bad data looks like. I do not like this approach...there are just too many potential issues

44. Q: Are there stimuli every second or so?

    A: Such a frequency of stimulation would be too much given the time it takes for responses to reach their peak and decay.

45. Q: You selected "Smoothing Baseline Removal". If I want to compare the data of baseline (before sound stimuli) and data of sound exposure, should I still choose that?

    A: Smoothing baseline removal was used during the webinar as a method to obtain the phasic EDA signal, the signal that represents changes in EDA. If you want to compare the participant's responses during two different blocks of the experiment (such as when sound stimuli are presented vs baseline), please refer to the section of the webinar that covered the block analysis.

46. Q: What are the ideal locations for the FPS (startle) electrodes?

    A: It is best to refer to the Committee report on Guidelines for human startle eyeblink electromyographic studies

47. Q: Why resample? Is there a problem with having it at the 2000Hz rate of data collection?

    A: Reducing the sample rate lessens the computational load for the analysis.

48. Q: Hi, I was just wondering how the hardware setup changes if you are using the TEL100C system?

    A: Just like with the EDA100C/GSR100C amplifiers, make sure you are in DC mode. You should also make sure the gain you are using is appropriate. Please contact us at support@biopac.com if you have specific questions.

49. Q: Where can I find interesting articles and reports about BIOPAC and EDA?

    A: Visit our website or conduct a Google scholar search for BIOPAC + GSR or BIOPAC + EDA. The search will return over a thousand results.

50. Q: What about electrode placement on thenar and hypothenar

    A: The Committee report on Publication recommendations for electrodermal measurements, just like the Handbook of Physiology, refers to this and the volar phalanges placement as recommended. It does not compare the two, however, so I recommend reviewing the literature to see if there is an indication which placement is the best - thenar and hypothenar or volar phalanges. It is hard for us to make a recommendation.

51. Q: Is it possible to use ECG electrodes at the palm of the hand?

    A: ECG electrodes should not be used to record EDA because the gel is not isotonic.

52. Q: Is it possible to do deconvolution analysis with Acq*Knowledge*?

    A: Not at the moment. We are constantly reviewing feature requests.

53. Q: We find that while we are able to get a good EDA signal initially, the signal turns into noise within 20 minutes of the protocol. Can you offer any insights?

    A: It is best to send over a data sample to support@biopac.com. We would need to see the data to provide useful advice. Please send the raw .acq file. However, I would start by looking at the electrode to subject connection and make sure that everything is good there. Check the quality of the electrodes and ensure they are making good contact with the subject. When you send a file make sure that you include a full description of your equipment and participant setup including any tasks the subject is performing.

54. Q: is it just the reusable electrodes that dry out, or do the SSL3 electrodes dry out as well?

A: The SS3L electrodes are filled with gel at the start of the study. Then they are cleaned and stored away. Disposable electrodes are pre-gelled and if they are not stored properly or they are past the expiration date, the gel may be dry.

55. Q: How about some participants who have cold hands? Does their temperature of hands influence recording EDA data?

A: Yes, we have observed that cold hands will negatively impact the quality of EDA data, reducing the SCR size in some participants. This subject is also discussed in detail in the Handbook of Psychophysiology.

Q: What was the deal with Channels 8-15? Are those the channels you may only use for physiological data collection? I'm a bit confused by that part in the presentation.

A: Digital channels 8-15 can be used to record markers from stimulus presentation software such as E-Prime, Presentation and Experiment Center.

56. Q: What do you recommend if the participant is sweating (and some people sweat more than others) over the course of activity for which we are collecting EDA for?

A: The hands are not a principal site for thermoregulatory sweating so the impact on recorded EDA should be minimal.