Application Note 26. Methodology and protocols of feedback-based EIS experiments in real time

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***Abstract*—This application note is devoted to distant experiments that provide visual or acoustic feedback from remote electrochemical impedance spectroscopy (EIS) sensors. It addresses automatic web experiments as well as experiments with manual evaluation of results, and explains underlying algorithms. Statistical evaluation based on three-sigma rule, probability of random occurrence and the Mann-Whitney U-test are proposed for the scoring system. Operators who only participate in *consciousness-device* or *device-device* experiments (the transmitter side) and who host such sensors (the receiver side) can find here recommendations for parameter settings, thermostabilization, selection of water or the difficulty level. This application note can be considered as step-by-step manual for participating, preparing and conducting such experiments also in neurocognitive way with EEG feedback, e.g. for operator training purposes.**

I. Introduction

This application note accompanies the following papers:

- 'Operator training for distant interactions with EEG and EIS based feedback' [1];
- 'Distant Monitoring of Entangled Macro-Objects' [2];
- 'Experimental Approach Towards Long-Range Interactions from 1.6 to 13798 km Distances in Bio-Hybrid Systems' [3];

and concentrates on technical and methodological sides of using EIS technology in distant *consciousness-device* or *device-device* experiments. Introductory parts, literature as well as overview of experimental results can be found in these works. It is also recommended to read the Application Note 18. 'Online system for automatic detection of remote interactions based on the CYBRES MU EIS impedance spectrometer' that represents the earlier web-based version of this system.

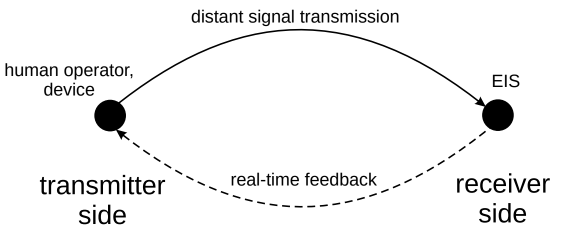

Fig. 1. General scheme of distant experiments with operators or devices on the transmitter side and EIS on the receiver side.

The 'distant experiment' means the following setup, see Fig. 1, where operators or devices on the *transmitter side* and EIS sensors on the *receiver side* are spatially separated. The terms 'impact', 'exposure', 'session' or 'influence' mean a long-distance signal transmission from transmitters to receivers, where we do not differentiate between human operators ('consciousness-device' experiments) or corresponding devices ('device-device' experiments) on the transmitter side, since both produce comparable results.

The distance between transmitters and receivers varies in a large range (the largest published result is about 13798km [3]). EIS devices can be used remotely (e.g. in internet via html plots) or locally (users have access to EIS devices). In case of remote usage, see Sec. II, all settings are already done and experiments can be started anytime. The remote setup corresponds to average complexity level[1].

In the local case, see Sec. III, users can additionally involve acoustic and EEG feedbacks for training (in individual or collective sessions), set up own complexity level, use plants as biosensors, analyze thermodynamic, statistic and environmental data from EIS device as well as perform other kinds of biophysical and neurocognitive training and measurements.

II. Conducting experiments on the transmitter side

There are many local and distant factors that affect both the receiving sensor and the transmitting operator/device. They can contribute to successful sessions, or represent a distorting factor. Therefore, it is important to repeat attempts several times. For operators, the ability to interact distantly is learnable, like many other skills. The more sessions performed, the easier it is to achieve positive, high-score results.

Dynamics of sensors data is divided into two phases: the phase B is a background recording (time prior to the session); the phase E represents the experiment (or session). Identification of impact is based on difference of EIS dynamics in B and E phases, see Fig. 2 – typically, the impact perturbs a trend of EIS dynamics in E phase. Perturbations are expressed as statistical values – standard deviations 'sigma' (σ); σ_B characterizes the background, σ_E characterizes the experiment (correspondingly μ_B and μ_E are mean values in B and E regions). The relationship

$$\Psi = k\frac{\sigma_E}{\sigma_B} \quad (1)$$

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[1]Examples of continuously running devices with streamed data over internet can be found on *AquaPsy.com* platform or *cybertronica.de.com/OnlineMeasurements*

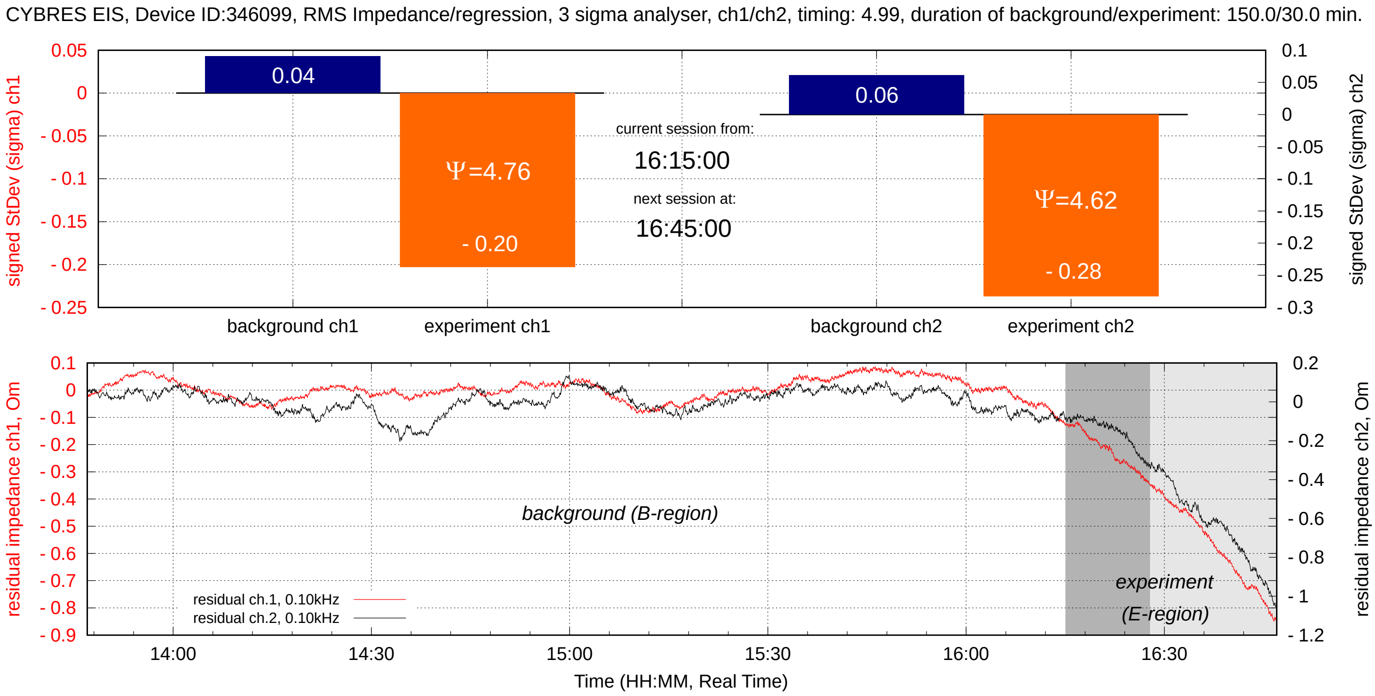


Fig. 2. Example of graphical output: (upper plot) bar diagrams represent standard deviations in background and experimental regions of channels 1/2 and '3 sigma rule' analyzer, corresponding experimental graph becomes orange at significant change $\Psi > 3$ and 'impact Ψ'>'averaged Ψ'; (lower plot) residual dynamics of both channels after regression analysis. Grey bar indicates progress of the session.

represents the final result – the more intensive are perturbations in the E region in regard to the B region, the higher are scores Ψ of the session. The coefficient k defines the sign of Ψ, $k = -1$ if $\mu_E < 0$ (the EIS dynamics in E region goes down) and $k = 1$ for $\mu_E \geq 0$ (the up trend of EIS dynamics).

Each Ψ value corresponds to the 'Probability of Random Occurrence (PRO)', calculated from past 24/48 hours. The higher is Ψ, the lower is the probability to obtain it randomly (i.e. the lower is its PRO). The impact is significant if it is over the average level of all sessions and $> 3\Psi$ (or $<\sim 0.25$ PRO). In this case the color of pie/bar chart of used channel becomes orange, see discussion in Sec. IV-C. Note that several positive attempts multiply probabilities – obtaining a few high-score results as random events has extremely low probability (jPRO value).

Each EIS sensor has 2 independent channels, both can be used for experiments. Results are represented in two different ways: as shown in Fig. 2, and with minimal complexity, where only Ψ are demonstrated as pie charts, see Fig. 3.

Each active or passive session (i.e. with or without distant impact) has a fixed time of 30 minutes. Sensors in web experiments provide about 1 sample in 1-10 sec.; to receive new data, press 'update' in your web browser. When the session is completed, the sensor is recalibrated, and a new session automatically begins. Timing of current and next sessions is shown in the graphs. Two following sessions after an active session are counted as 'post-effect sessions', they are required for evaluating the 'memory effect', see Sec. IV-E. After strong impacts, it is recommended to skip several sessions to give the sensors time to adapt (to use in this time another sensor/channel). For conducting experiments on the transmitter

Fig. 3. Example of the pie chart for representation of Ψ, the inner grey bar shows the progress of session. Red color indicates non-valid recording, blue color – normal values, orange color – significant result.

side follow these three steps:

1) Select the EIS channel with the most linear past dynamics. Due to regression analysis, all data are horizontally arranged along zero level of the Y axis. If the data have large variations, unstable dynamics, or well recognizable changes of trend, this channel is not suitable for experiments. Optimal conditions are provided if last 3-4 Ψ values in table of results are 'green', see Fig. 4 – such sensors are most sensitive. The parameter 'ready' indicates readiness of sensor for new session, select the channel with the largest value of 'ready'. To make the session 'active', press the button 'Start' (one click – the user 1, two clicks – the user 2 and so on).

2) To target a distant EIS sensor in *device-device* experiments, it is recommended to use so-called 'image keys' (e.g. 'QR code keys') placed on water containers, see more in [2].

Table of Results

last sessions

N	time (h:m)	ch1:Ψ	PRO	ch2:Ψ	PRO
1.	10:00:02	1.72	0.53	1.73	0.70
2.	09:30:12	-1.54	0.58	-0.71	0.90
3.	09:00:04	0.97	0.87	-2.43	0.46
4.	08:30:13	3.99	0.23	-0.81	0.86
5.	08:00:05	0.97	0.88	2.10	0.56
6.	07:30:14	-4.25	0.19	0.83	0.86
7.	07:00:06	-0.71	0.96	-1.30	0.67
8.	06:30:15	1.76	0.52	-1.93	0.65
9.	06:00:07	-5.47	0.06	-1.87	0.65
10.	05:30:17	-5.26	0.06	2.84	0.44
11.	05:00:08	-3.05	0.21	-0.55	0.98
12.	04:29:59	2.53	0.31	-2.81	0.44
13.	04:00:09	-0.58	1.00	-2.26	0.58
14.	03:30:00	-1.40	0.67	0.97	0.86
15.	03:00:10	-1.09	0.73	1.81	0.63
16.	02:30:01	-4.40	0.12	-1.82	0.60
17.	02:00:10	-0.93	0.88	-2.79	0.49
18.	01:30:01	-2.39	0.35	-0.82	0.84
19.	01:00:10	-3.91	0.19	3.21	0.35
20.	00:30:02	0.91	0.88	5.30	0.21
21.	00:00:13	5.46	0.06	-3.33	0.30
22.	23:30:04	-1.89	0.42	-5.34	0.19
23.	23:00:13	1.67	0.48	2.99	0.37
24.	22:30:03	1.54	0.54	2.39	0.49
25.	22:00:12	-2.95	0.23	-0.95	0.79
26.	21:30:04	0.90	0.83	-3.17	0.28
27.	21:00:13	-0.64	0.96	-2.65	0.40
28.	20:30:03	-2.35	0.31	2.83	0.38
29.	20:00:11	1.17	0.69	10.00	0.02
30.	19:30:01	1.32	0.62	10.00	0.02
unsigned mean Ψ		2.29		2.54	
ready for new sessions:		ch1=1.07		ch2=0.98	

results of active sessions

N	type	time (D-M h:m)	ch1:Ψ	PRO	ch2:Ψ	PRO
1.	1-post	28-Jun 09:00:11	2.09	0.42	9.55	0.02
2.	1-post	28-Jun 09:30:03	2.66	0.29	6.56	0.02
3.	1	06-Jun 08:30:00	-1.52	0.63	-6.11	0.04
4.	3	01-May 20:54:18	5.35	0.08	3.32	2.55
5.	2	23-Jun 23:23:54	-1.17	0.60	5.26	0.01
6.	1	24-Jun 20:00:16	-0.69	0.90	-5.25	0.07
7.	1-post	24-Jun 09:30:05	4.46	0.07	-4.62	0.09
8.	2	06-Jun 22:27:54	-2.52	0.26	-4.60	0.04
9.	1	29-May 08:30:01	4.21	0.06	2.77	0.37
10.	1-post	24-Jun 09:00:14	1.67	0.52	4.07	0.13
11.	1	01-Jul 08:30:13	3.99	0.23	-0.81	0.86
12.	3	10-May 08:30:01	-1.86	0.56	-3.94	0.21
13.	3	06-May 08:30:05	3.87	0.08	-1.18	0.16
14.	2	15-Jun 18:18:51	3.85	0.02	3.16	0.04
15.	2	05-Jun 22:35:15	2.75	0.09	3.75	0.09
16.	1-post	05-Jun 09:02:22	3.74	0.22	-2.27	0.41
17.	1	27-May 08:30:02	-2.00	0.22	-3.69	0.15
18.	1	07-May 08:30:06	2.36	0.30	3.55	0.20
19.	1-post	26-Jun 09:00:06	-1.64	0.54	3.36	0.28
20.	1	05-Jun 08:32:14	2.77	0.32	-3.29	0.26
21.	1-post	25-Jun 09:30:05	3.20	0.15	-2.39	0.33
22.	1	11-Jun 15:00:11	3.19	0.53	0.57	1.00
23.	1	25-Jun 08:30:06	0.53	1.00	3.14	0.19
24.	1-post	07-Jun 09:00:09	-0.81	0.68	3.01	0.18
25.	1	28-May 08:30:06	1.10	0.81	-2.94	0.40
26.	1	13-Jun 09:00:02	1.24	0.49	2.92	0.20
27.	1-post	07-Jun 09:30:01	1.59	0.39	-2.79	0.27
28.	1-post	13-Jun 09:30:12	-2.74	0.25	-2.63	0.24
29.	2-post	10-Jun 23:20:16	2.00	0.23	2.63	0.09
30.	1-post	13-Jun 10:00:04	2.58	0.26	2.19	0.32

A: mean Ψ of active sessions/mean Ψ of all sessions: 4.06/2.12=1.92, (1.96)
B: joint Probabil.Rand.Occur.(j-PRO): active ses./0.5 ses.: 4.12e-20
C: Mann-Whitney test (positive if < critical value): 12 (292 :1%, 338 :5%)

Fig. 4. Example of 'table of results' from web data. 'Last sessions' represent results of 30 past sessions, green values are estimated as $< \sqrt{\Psi_{mean}}$, Probability of Random Occurrence (PRO) is calculated based on last 24 hours. The 'result of active sessions' are calculated only for 'active' and 'post-effect' sessions, the system automatically calculates statistical and probabilistic evaluation (factors A, B, C) of active sessions.

In *consciousness-device* experiments, operators use graphics as such 'keys' – they concentrate attention on data plots. Typically, distant sessions have EEG dynamics that corresponds to 'active meditations' (with large alpha, delta and theta components), and differs from relaxation states, see more in [1]. The feedback provided by EIS sensors can be used in Mindfulness and Reiki practices, training of mental concentration (various types of meditations and Yoga), stress reduction therapy, different medical and psychiatric therapy programs. Sessions can be performed individually or collectively in small and medium size groups. Using additional feedbacks such as EEG, low-frequency acoustic (for inducing specific neurocognitive states), visual or other signals, is also possible.

3) Reaction of EIS sensors on a distant influence occurs mostly on the targeted channel during active and post-effect sessions (less often – any/both of EIS channels indicate a reaction). The system automatically calculates Ψ and PRO for both channels. When the active session is finished, the final scores are inserted into the 'results of active sessions', see Fig.4. Scores in all active sessions are numerically and statistically evaluated – the factor A is mostly of interest for users (see Sec. IV-D). It varies from ∼1 to ∼2.5 and characterizes the 'distant interaction capability' of a user in different situations/conditions.

The values of Ψ_{mean} and $(\sigma_{mean})_B$ characterize the fluctuation of environment and can be used as environmental sensors, see more in Sec. V.

Important: if users during the session feel heaviness in the head, an increase of blood pressure, or any other unpleasant feeling, the session should be immediately stopped.

Operators, who perform experiments on the transmitter side, are suggested to consider the following methodological questions:

1) Does any altered state of consciousness contribute to achievement of positive results?

2) How the operator's results are improved by increasing the number of attempts (i.e. by training)?

3) Do multiple operators (collective session), synchronously concentrating on one target, increase intensity of impact?

4) Does the concentration on symbols (e.g. Reiki symbols) increase the intensity of impact?

5) Does the combination of operators and devices increase the intensity of impact?

6) How different macro-entanglement approaches (e.g. concentration on 'image key' or data plots) do contribute to achievement of positive results?

III. Preparing experiments on the receiver side

If operators have assess to EIS devices, they can perform experiments in neurocognitive way by using acoustic/EEG feedback, set up the difficulty level or perform measurements with plants as biosensors – these are important steps for successful operator training. First of all, it needs to parameterize experiments that includes selection of water/frequency, and using optical excitation/passive thermostabilization.

A. How to setup the receiver side

1) Required hardware and room. You need EIS MU3 system (or the M.I.N.D. system) with open or thermostated electrodes, and a windows-based PC/laptop (even low-cost and low-power mini-PC based on Intel Atom, see Fig. 5(b)). This PC should *continuously run (weeks)* to accumulate data and calculate statistical parameters. MU3 module is connected directly to such PC/laptop (or via USB hub), for remote connection of EIS devices use the USB device server Silex DS-520AN with WLAN/Ethernet connectivity, see Fig. 5(a). For transmitting html data in internet, it needs to set up the web server (e.g. windows handles it within Internet Information Services (IIS)), open ports in firewall and port forwarding in the router – all these issues are well described in multiple manuals. Local feedback-based experiments do not require outgoing internet connection.

Required room. Since these experiments are dealing with very weak signals, the measurement room should provide stable environmental conditions. It should not be illuminated by sun light and should provide stable temperature and no mechanical vibrations. It should be empty of human persons and electric devices generating strong EM fields. High frequency emitters (e.g. WiFi routers, mobile phones) should not be placed close to the measurement equipment. Typically, basement rooms satisfy these requirements.

2) Set up the system. Example of the setup (the M.I.N.D. system with thermostabilized container and thermal-compensation gel inside) is shown in Fig. 5. Install the passive thermostabilization setup and thermo filler, fill up the distilled water in 2x 15ml measurement containers, set up the frequency, filters as shown in Fig. 9, and enable optical excitation, see discussion in Sec.III-C.

Note 1. The system needs a thermo filler for thermal stabilization: 3-5 kg thermo-pack gel bags ('cool-warm' gel bags) or 3-5 liters of water inside of thermo box. The M.I.N.D. is delivered with 2x 1.5 liters empty water containers (fill up them with tap water, add a bit table salt [NaCl] for water preservation).

Note 2. Note that new electrodes can demonstrate unstable long-term EIS dynamics. To stabilize the dynamics, it is recommended to run continuous measurements with frequent water changes during first weeks of usage even if active sessions are not planed.

Note 3. We recommend first to use FIR 0.6 (or FIR 1) filter and after several days – to switch to IIR 0.005 filter that provides better scoring results, see Fig. 11.

Note 4. Default settings on the delivered mini PC – PC name: *mind*, account: *mind* and password: *mind*.

3) Start automated experiment. Automated experiments with statistical evaluation of data are so-called M.I.N.D. applications and are available for html output (web experiments) and for windows output (local experiments). For html, select 'web plot', 'timed nonlinear' regression, and 'MIND' see Fig.6; for windows, select 'plot 1x: RMS magnitude' and 'MIND', Fig. 11(a). Start background measurements (passive sessions) for 24/48 hours for self-calibration. Note, that the freshly filled water has unstable electrochemical dynamics up to 12 first hours (the best results are obtained a few days after the begin of measurements). Start experiment (active sessions) by pressing the 'Start' button. Note that each active session has two 'post-sessions', whose results are also considered within active sessions. The system can work a long time in such mode

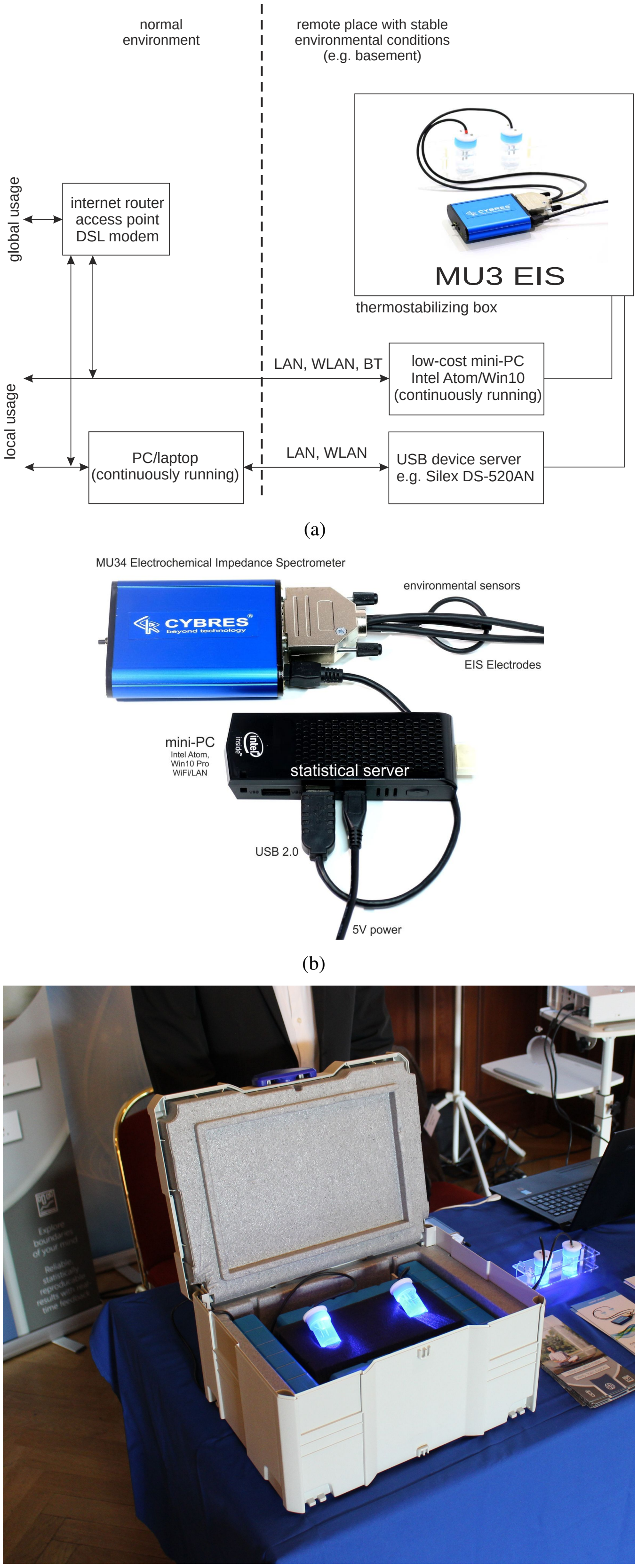


Fig. 5. **(a)** Two possibilities of connecting the EIS device for local or global usage. The connected PC/laptop (or via USB device server as e.g. Silex DS-520AN) should continuously run for accumulation of data and calculation of statistical parameters; **(b)** An example of a statistical server on micro-PC with the Intel Atom processor; **(c)** Example of the M.I.N.D. system with thermo insulating neopor container and thermo filler (salt water and thermo gel) inside.

(weeks) and is ready for new experiments at any time.

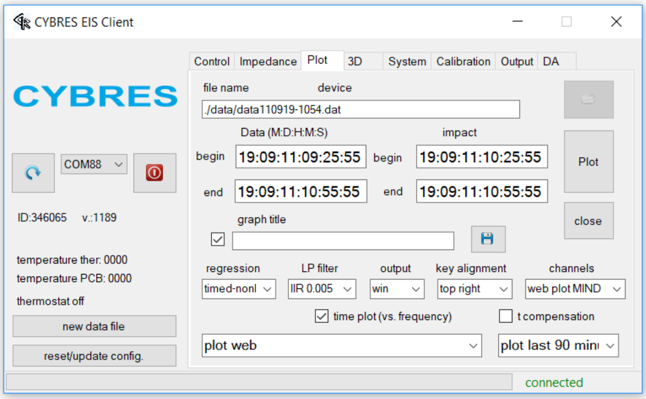


Fig. 6. Example of client settings for web output with plotting into html file.

B. Software settings

C. Discussion on the setup

1) Selection of water. Water represents the main sensor element and defines such properties as signal-to-noise ratio and sensitivity. The best signal-to-noise ratio is provided if the excitation and response signals occupy the full range of -1V..1V in the scope mode, see Fig. 7. Since the EIS device

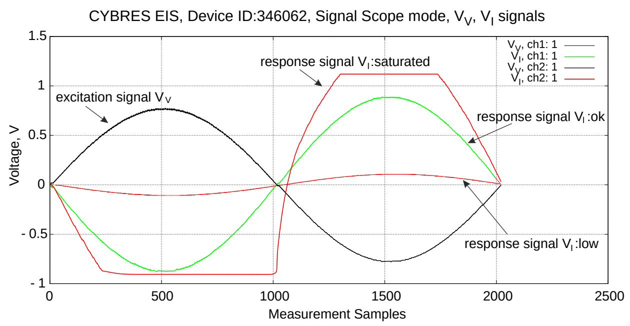


Fig. 7. Adapting EIS to new (unknown) water. Select 'signal scope' mode: if the response signal is saturated – decrease the amplification, if response signal is low – increase the amplification. The best signal-to-noise ratio is provided if the excitation and response signals occupy the full range of -1V..1V.

provides 4 amplification ranges, the full signal range is given 50k, 5k, 500 and 50 Ohm of impedance (corresponds to 20, 200, 2000 and 20000 μS/cm of conductivity). The water samples electrochemically degrade during measurements (impedance is decreasing, conductivity is increasing) and the best signal-to-noise period can be associated with the time intervals. For instance, if the initial conductivity of distilled water is 5-7 μS/cm, after 12 hours it is about 12-15 μS/cm, after 48 hours – 30-35μS/cm. Thus, the best time interval for experiments is a few days after begin of measurements for distilled water. *It is strongly recommended to perform one 'single scope' measurement before measuring in other modes.* Latest versions of firmware (v.1189 and later) support the option 'auto' that automatically adjusts the amplification, see Fig.9.

Tap vs distilled water. Generally, we did not observe a significant variation of sensitivity between tap and distilled water. Both types can be used for measurements and successful experiments have been conducted with both types. If the distilled water has initial conductivity $< 10\mu$S/cm in most cases, conductivity of tap water varies in a large range. This is explained by different ions in tap water and multiple electrochemical reactions. Moreover, tap water contains a large amount of dissolved gases and requires long-term degasation, otherwise it produces gas bubbles and spikes in EIS dynamics, see Fig. 8. Thus,

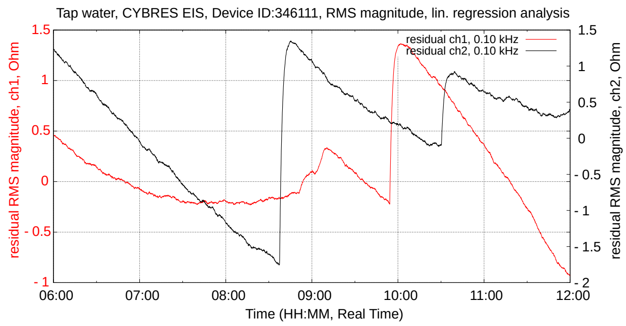


Fig. 8. Tap water with conductivity about 400μS/cm, demonstration of spikes in EIS dynamics due to gas bubbles and electrochemical processes.

commonly available distilled water with initial conductivity 1-10μS/cm provides more predictable behaviour and therefore is strongly recommended for conducting experiments. Do not use double distilled water with initial conductivity $< 0.5\mu$S/cm for such experiments.

New filled vs used water. Water that was used in one experiment can be further used in other experiments. However, such water behaves sometimes unpredictably and can from time to time decrease its sensitivity – this effect can be used for increasing difficulty level of training. Several web setups used the same water for a few months (only adapting the amplification range). Generally, we recommend changing water if the sensor loses its sensitivity or the large-amplitude noise (signal spikes) is significantly increased.

2) Selection of frequency range. Generally, lower frequencies have a higher response, i.e. higher sensitivity of sensor is achieved at lower frequencies. However, several electrochemical processes, such as polarization of electrodes or electrolyse, increase intensity at lower frequencies, i.e. nonlinearity of sensors is increased. DC current sensors, e.g. the Bobrov detectors [4] and the detector on deeply polarized electrodes [5] demonstrated very high sensitivity, however also require a long stabilization time (sometimes >12-24 hours). Thus, selection of frequencies represents a trade off between sensitivity and nonlinearity. In most experiments we use 450Hz as a compromise that also provides good signal-to-noise ratio, as alternative, 100Hz can be also used.

3) Optical excitation represents a new trend in electrochemistry and is largely unexplored up to now. Generally, all nonlocal effects are achievable without optical excitation as demonstrated by multiple experiments. However, optical excitation seems to facilitate such effects, see overview of macro-quantum experiments in [2]. Thus, if your EIS device

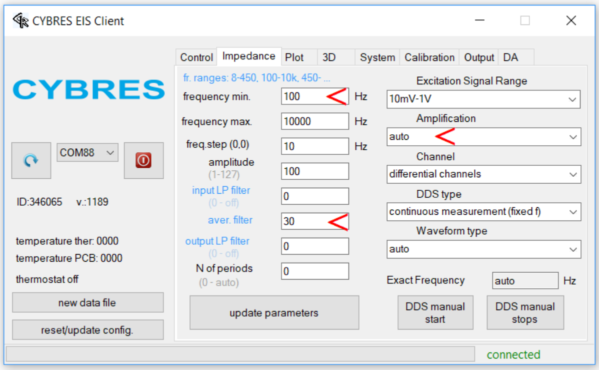


Fig. 9. Example of frequency and hardware filter settings.

allows using optical excitation, enable it for experiments, see Fig. 10. Note that IR excitation (940nm) produces considerable amount of heat and requires longer stabilization time (490nm is recommended).

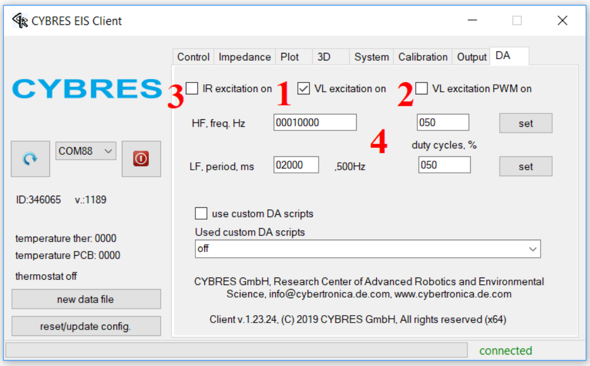


Fig. 10. Example of enabled optical excitation: 1 – 470nm continuous mode, 2 – 470nm pulsed mode, 3 – 940 nm excitation, 4 – parameters of modulation for pulsed mode.

4) Software filter selection is an important topic, since it influences the scoring system. The initial signal is of low dynamic range and possesses a lot of high frequency noise. The spectra of such noise changes during measurements. The system implements Finite Impulse Response (FIR), Infinite Impulse Response (IIR) and Averaging (AVR) filters with different parameters, see Fig. 11(a). The best results are obtained with FIR 0.6 and IIR 0.005 filters, however the IIR 0.005 provides better scoring due to better averaging of background region (4.26 vs 2.11, see Fig. 11(b,c)). The problem is that IIR 0.005 cannot be used from begin of measurement. Thus we recommend first to use FIR 0.6 (FIR 1) filter and after several days – to swtich to IIR 0.005 filter.

D. Temperature effects and passive thermostabilization

EIS devices allow active (with thermostat) and passive thermostabilization. Passive thermostabilization of water samples is more preferable for feedback-based experiments. One of reasons is the instability of EIS dynamics depending on temperature: the higher the temperature, the more unstable is the

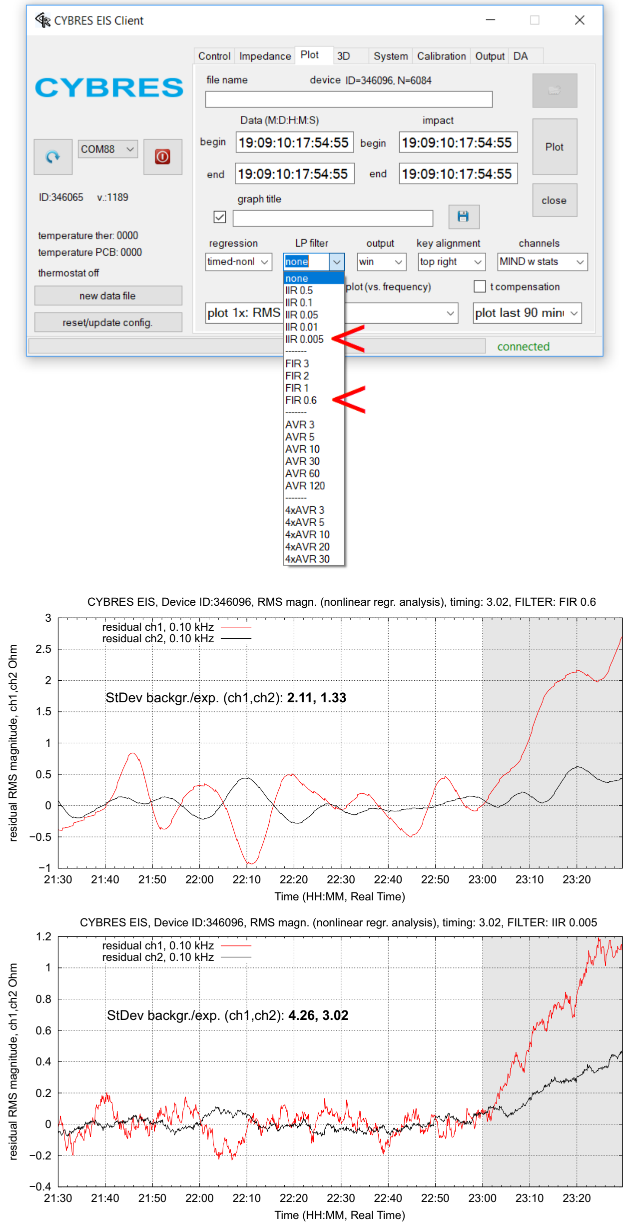


Fig. 11. **(a)** Software filter selection, Finite Impulse Response (FIR), Infinite Impulse Response (IIR) and Averaging (AVR) filters with different parameters. **(b,c)** The same data (from a real attempt) processed by FIR 0.6 and IIR 0.005 filters, both channels contain different noise. The scoring is better if using IIR 0.005 filter.

dynamics (active thermostats significantly increase the temperature of fluids). Thus, the important rule: *keep the temperature of water samples as low as possible*, e.g. do not install any additional heat sources close to water containers, in particular, do not insert the EIS measurement module into the thermostabilization box (at least with 5 cm wall thickness, it also depends on external temperature).

Regression analysis require stable trend of EIS dynamics that is impacted by variation of temperature. By following the relationship

$$EC_t = EC_{25}[1 + a(t_{25})], \qquad (2)$$

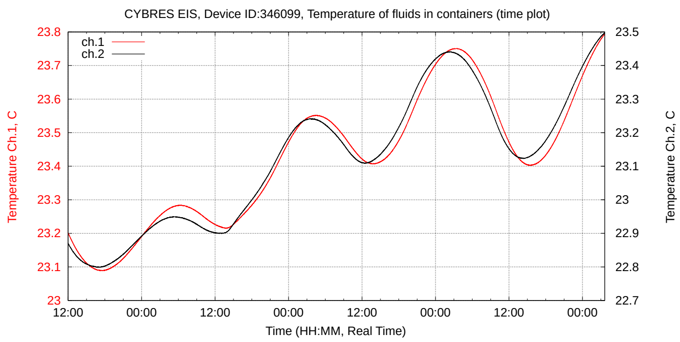
where a varies between 0.0191 and 0.025, EC_t is electrical conductivity at temperature t, EC_{25} is electrical conductivity at 25C [6], we recommend that variation of water temperature does not exceed 0.08-0.1C during 120 min experiment or 0.01-0.012C for 15 min. This corresponds to 10E-5% variation of conductivity close to 25C, for comparison – 15 min impact generates about 10E-4%–10E-3% changes, EIS device provides up to 10E-6% resolution (all for distilled water). Thereby important is a flat dynamics of temperature variation that can be compensated by regression (in contrast to step-like dynamics of distant impact).

Thus, the goal of passive thermostabilization is to facilitate a constant variation of temperature without rapid changes. This can be achieving by using neopor thermo insulating boxes with 3-5cm wall thickness (with multiple 3-5 kg thermo-pack gel bags or 3-5 liter salt water inside for increasing heat capacity and, thus, thermal inertia inside), see Fig. 12. Such

(a)

(b)

(c)



(d)

Fig. 12. **(a-c)** Examples of neopor thermoboxes with 3cm/5cm wall thickness for passive thermostabilization. Use multiple thermo-pack gel bags (or 3-5 liters of water) inside such boxes; **(d)** Example of fluid temperature during 3.5 days in a thermobox.

thermoboxes/gel bags can be easily ordered (<15 euro), and provide temperature variation about 0.04-0.08C for 120 min in normal room conditions. The room with the thermobox should not be illuminated by sun light and be empty of human personal during background recording and experiments (for remote connection of EIS devices without laptop/PC use the USB device server Silex DS-520AN with WLAN/Ethernet connectivity). IMPORTANT: Provide optical isolation (by covering water containers in non-transparent and non-metal material) between water containers inside the thermobox.

E. Setting up the difficulty level

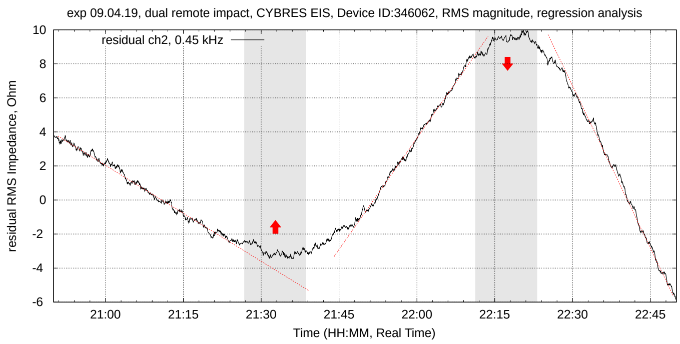
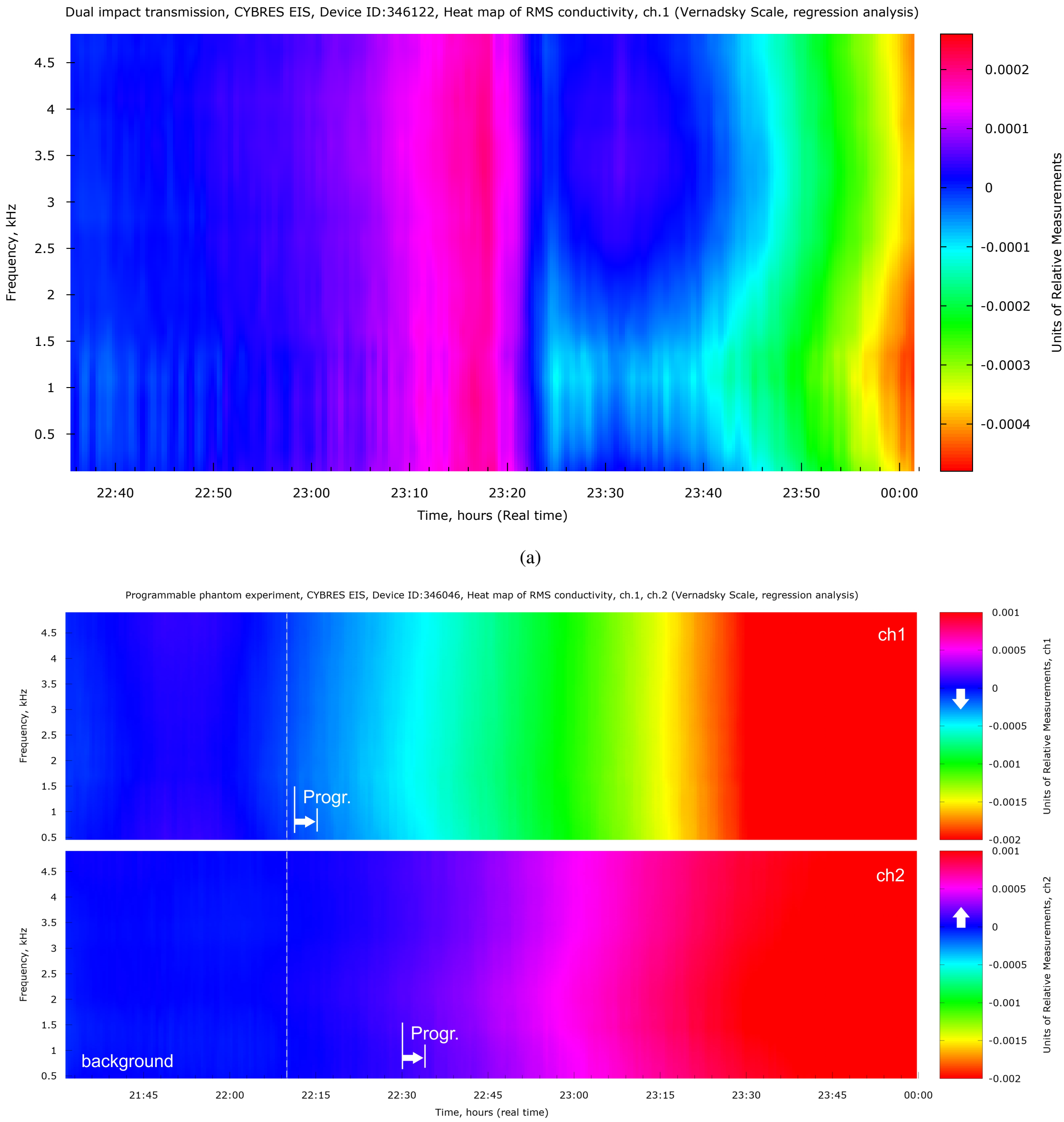


Fig. 13. Two distant impacts that inhibit and stimulate electrochemical degradation.

This section is mainly related to *consciousness-device* experiments. For operator training it is necessary to organize several tasks with increasing difficulty. Operators can select appropriate difficulty level and improve own skills before approaching the next, more complex, goal. From our experience, the difficulty levels can be organized along the *concentration*, *adressation* and *intentions* lines. The simplest level requires only concentration on the water, whereas the EIS device can be placed close to operator within his/her visibility range. Despite this setup produces a temperature impact (that can be compensated by passive thermostabilization and presence of operator in the room before the session for equalizing temperature), however its simplicity is important for creating a positive motivation on initial steps. On the advanced level the device is separated from operator by distance: from several meters (e.g. in the next room) up to several thousand km in another laboratory. This task trainers the capability of addressing dedicated remote target (with or without knowing its precise location). Some operators use 'mental imagination', whereas others only concentrate on real-time plots.

The high level task represents a 'remote transfer of intention'. Here operators not only perform a remote impact, but intentionally influence the target (these skills are important e.g. for remote healing). EIS device allows training this by transferring 'stimulation' and 'inhibition' intentions. This is reflected as increasing or decreasing intensity of ionic dynamics and is measurable as up or down trend after linear regression (after the background region). Successful fulfilment of this task depends on several factors, in particular, on the phantom effect, and can require several attempts. In the example on Fig. 13, operator undertook two 10 min. sessions, separated by 30 min. interval with ch2 as target. In the first session the '+' intention



(a)

(b)

Fig. 14. Examples of experiments with distant (several meters from different laboratories) effects leading to inhibition and stimulation of electrochemical degradation. **(a)** Dual impacts are transmitter on one channel one after another, bistable EIS dynamics manifest as switching between two trends; **(b)** Dual effects are conducted on two channels, channel 2 demonstrates the dynamics opposite to the natural electrochemical degradation, optical excitation is on.

was transferred (that increase electrochemical degradation and appears as up-trend), in the second session the '-' intention was transferred (that decrease electrochemical degradation and appears as down-trend), see Fig. 13. Such a dual intention transfer allows removing any doubts about influence of other impact factors – this dynamics is almost impossible to produce by choice (by any random process). Such an attempt can be performed also in 3D mode, see Fig.14 and 15.

F. Evaluating experiments in manual mode

For evaluating results of distant experiments in manual mode, the following parameters are important:

1) Changes of trend: enable the regression mode, this option should always be used with this kind of experiments. Enter the background/experiment time. First use linear regression and observe how linear is the background area and how much the trend changes during the course of experiment. Find a starting point during background recording that provides the most visible result (take care about B and E timing), see Fig. 19. If the EIS data has significant curvature, repeat this with the differential channel and/or nonlinear regression.

2) Timing: relationship between duration of background recording and experiment. It should be $\geq$ 2 (or even $\geq$ 3), at $<$2 the data are not reliable, see Sec. IV.

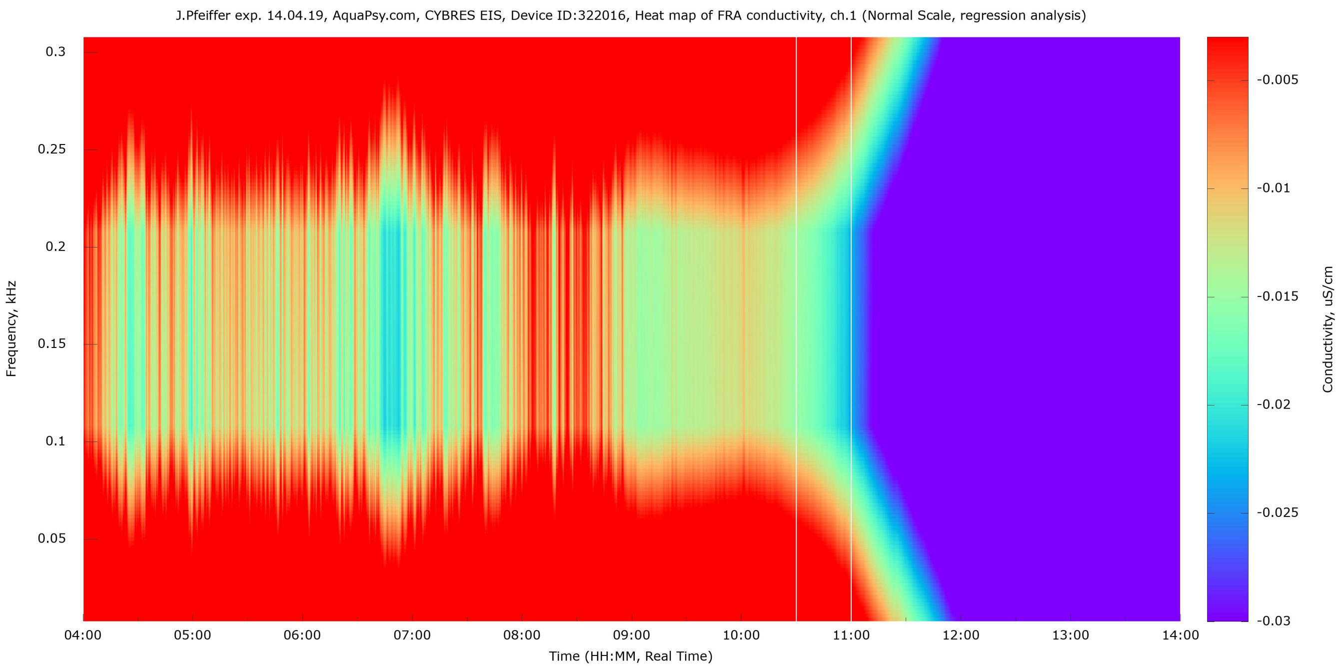


Fig. 15. Example of real remote session on the AquaPsy platform in 3D mode, white lines indicate the impact time performed by multiple operators around the world.

3) Follow '3 sigma rule' and/or 0.25 PRO: the Ψ score is calculated automatically (the M.I.N.D. system also calculates the values of PRO). This is an important parameter that indicates the impact intensity (it is significant at $\Psi > |3|$) and overstepping the background level at 'impact Ψ'>'averaged Ψ'. Sigma (standard deviation) of background region should be < 1.0 (or < 2.0 for high impedance values) – this guarantees that variation of signal in the experimental region is not caused by nonlinearity of signal itself (together with a long background recording time). Several setups, e.g. with a large variation of σ_B, do not generate $\Psi > |3|$, even if the impact was significant. In such cases the impact intensity can be also estimated from the PRO values, e.g. as PRO≤ 0.25.

4) Delay between begin of impact and begin of response of EIS dynamics. Note that a large delay (e.g. >20 min. and more) decreases probability of successful attempt and can be counted as failure of distant attempt.

5) Mismatch between impacted channel and responded channel and intended change of trend ('+' or '-') and real change of trend.

IV. Real-time data processing, statistical analysis and calculation of impact score

This section addresses advanced topics that explain underlying data processing algorithms. Data processing occurs at three levels: in the device (emdedded), at the level of single samples and at the session level with *'all sessions'* (basic statistical parameters and probabilities of the result are calculated as a random event) and *'active user sessions'* (cumulative probability of all results as chains of random events and non-parametric Mann-Whitney test), see Fig. 16. Data processing at the level of single samples can be carried out either by regression analysis and the StDev/mean analysis, or by statistical analysis of electrochemical noise. Here we consider the first method; details of the analysis of electrochemical noise can be found in [7].

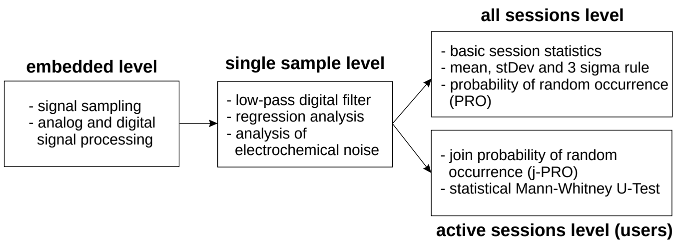


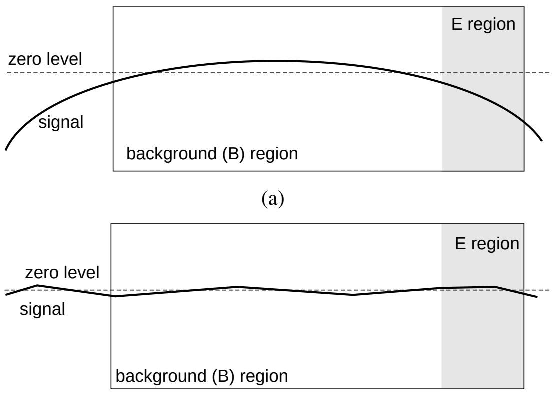
Fig. 16. Three levels of data processing: in the device (emdedded), at the level of single samples and at the session level with *'all sessions'* and *'active sessions with user participation'*.

A. Regression analysis

The main goal of regression analysis is to estimate the difference between the expected dynamics, approximated from past data, and observed dynamics, perturbed by current 'impact-factors'. If there is no differences, the 'impact-factors' are not present, otherwise deviations from expected EIS dynamics allow detecting these factors.

To understand the usage of regression analysis it needs to consider two fundamental types of EIS signals, see Fig. 17. The first, main type contains a small curvature due to variation of temperature and electrochemical degradation. The second type appears if the sensor undergoes perturbations caused by local or distant factors and becomes piecewise close-to-linear.

Any impact on EIS dynamics represents a point in such a piecewise function. The original sampled data $data(x)$ can be



(b)

Fig. 17. Two fundamental types of EIS signals: **a)** Example of signal curvature; b) Piecewise close-to-linear signal.

approximated by linear

$$fit_L(x) = a_l x + b_l, \quad (3)$$

or nonlinear functions

$$fit_N(x) = a_n x^5 + b_n x^4 + c_n x^3 + d_n x^2 + e_n x + f_n \quad (4)$$

with nonlinear least-squares Marquardt-Levenberg algorithm [8], where we are primarily interested in the residual curve

$$res(x) = fit_{L,N}(x) - data(x). \quad (5)$$

The function $res(x)$ is plotted in all diagrams with regression analysis. Generally, the $fit_N(x)$ function has better performance than $fit_L(x)$, and behaves sensitively to any even smallest perturbation. If the approximated signal in the B-area differs from the expected signal in the E-area, it produces the Δf signal, see Fig. 18. The value of Δf depends on the intensity of perturbation and can be calibrated for different sensors, time periods, environmental conditions or impacts. Thus, the averaged Ψ_{mean} from last 48/96 sessions, as shown in Table of results, see Fig. 4, represents a characteristic of the EIS sensor and current conditions. All impacts should be estimated in regard to the Ψ_{mean}.

In fact, Δf exists always in E-area and represents impact in the region E in relation to the region B. It slowly disappears as long as the 'old region E' is step-by-step shifted into background measurements. Since our main goals is to detect

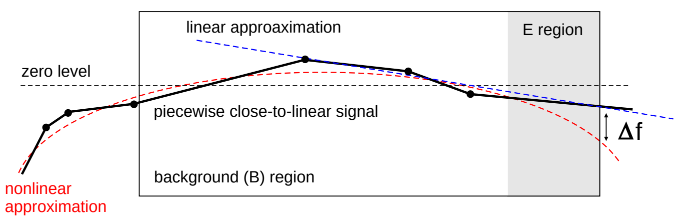
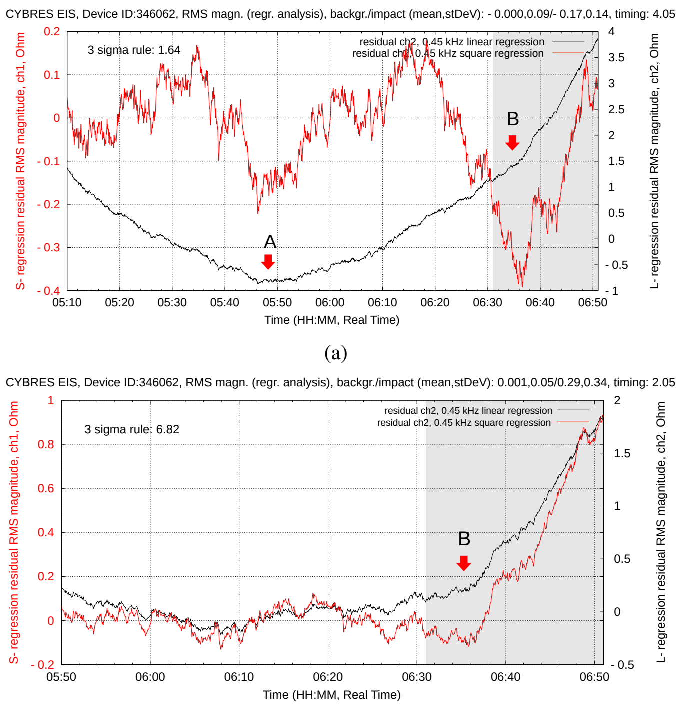


Fig. 18. The value of Δf produced by $fit_N(x)$ due to perturbations. Each point in such piecewise close-to-linear signal represent a new influence on the sensor.

new incoming influences (and to reject old influences), the impact can be detected faster if Δf is periodically resetted. It can be done by quick adopting the 'old region E' into background when the E-region is over. Is is achieved by setting a discrete time interval for sessions and calculating regression only inside this interval. After the session is over, a new session is allocated and the procedure is repeated again. Dark grey bar indicates a remaining duration of the session. The EIS system provide different options for online real-time experiments, see Table I. Optimal timing for regression is about 3x (background recording is 3x larger than experiment), shorter timing does not provide enough data samples for a good approximation of trend. Thus, 30 min of experiment requires about 90-120 min of background recording.

TABLE I
DIFFERENT TIMING OPTIONS PROVIDED BY THE ONLINE PLOT.

duration, time units	back-ground	experiment	conti-nuous	timed
60 sec	40	20	2	3
180 sec	120	60	2	3
300 sec	200	100	2	3
600 sec	400	200	2	3
30 min	20	10	2	3
45 min	30	15	2	3
60 min	40	20	2	3
90 min	60	30	2	3
120 min	90	30	3	4
180 min	150	30	5	6
240 min	210	30	7	8



(b)

Fig. 19. The value of Δf produced by $fit_S(x)$ due to perturbations.

Long background recording can accumulate multiple perturbations of signal, this makes regression less sensitive to new perturbations. This effect is shown in Fig. 19 that shows linear and nonlinear regressions of two events A and B. If the regressions approximate both events, see Fig. 19(a), $fit_L(x)$ and $fit_N(x)$ have a poor performance. Linear regression represents piecewise close-to-linear signal and fails in B and E regions. Nonlinear regression behaves well in the background region however due to large approximation fails in the experiment area with the B event. Only excluding the A event from the regressions, we are able to recognize the B event, as shown in Fig. 19(b). Here the nonlinear regression fits better zero level, but both $fit_L(x)$ and $fit_N(x)$ demonstrate a good performance. *Sessions that include strong perturbations in the background region should not be used in experiments.*

B. Statistical analysis

Since the long-range signal transmission and receiving sensors generate noised data, it needs to consider them as having probabilistic nature, and to evaluate results from statistical point of view by answering the following questions:

In terms of results: what is the probability that the operator/device on the transmitting side accidentally 'guessed' the sensor response on receiving side?

In term of the sensor: how likely is it that the experimenter misinterpreted the noise from the sensor as a response to the distant influence?

In terms of a process: how likely is it that a long-running random process will generate a noise (the null hypothesis), that will produce results similar to distant impacts?

These questions require a formalized procedure of how to differentiate a signal from noise and how to identify a positive result. We use the following approach. As considered in Sec. IV-A, the regression analysis provides two areas – the background recording B and the experiment E. The result is considered to be positive when the dynamics is *qualitatively different* in the areas B and E. Assessing the *qualitative difference* can be based on different principles, for automatic calculation we use statistical approach based on comparison of mean and standard deviation (μ and σ) of signal in B and E areas.

Analysis of stDev and 3 sigma rule. We assume that a signal noise has a normal distribution that is characteristic for noise histograms of used ADC. Mean and standard deviation are calculated separately for B and E regions as μ_B, σ_B and μ_E, σ_E; the averaged $(\sigma_B)_{mean}$ is calculated from last 48 or 96 values of σ_B. The Ψ is defined as

$$\Psi = k\frac{\sigma_E}{(\sigma_B)_{mean}}, \tag{6}$$

where k is the sign coefficient as discussed for the expression (1). Applying the '3 sigma rule', we say that B and E are *qualitative different* if

$$\sigma_E \geq 3\sigma_B, \ \ \Psi \geq 3. \tag{7}$$

Considering a significant Ψ as

$$\Psi > \Psi_{mean}, \tag{8}$$

where Ψ_{mean} is calculated based on 48/96 previous sessions, it makes sense to use

$$A = \frac{\Psi}{\Psi_{mean}}, \tag{9}$$

as it is shown in Sec. IV-D. The expression (9) in fact adapts evaluation of results to current situation (e.g. the noise level of EIS sensors). Expressions (6), (7) and (9) are used in algorithms for automatic score calculation.

The background recording is stable at

$$\sigma_B < 1, \tag{10}$$

sessions that violate the condition (10) are denoted as 'not valid'. The selection of critical value '1' is intended only to indicate the instability of EIS dynamics and can be replaced by other conditions, e.g. $\sigma_B < 10(\sigma_B)_{mean}$.

In calculation of σ, the 'sums of squares' algorithm was compared with the recurrent Welford's algorithm [9], [10], [11], both provide the same results, see Fig. 20. We implemented the Welford's algorithm for σ calculation as more stable one.

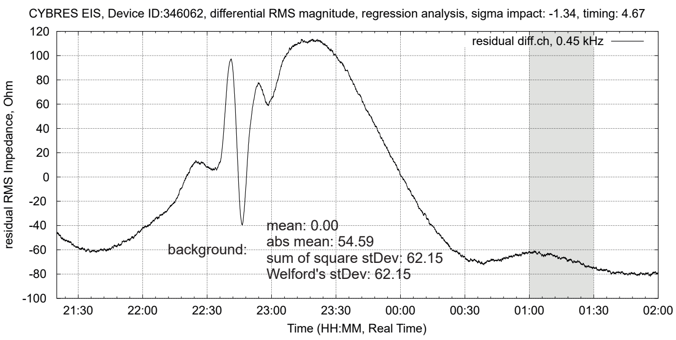


Fig. 20. Comparison of 'the sums of squares' and the Welford's algorithms as well as μ and μ^A for a background signal of complex form.

Analysis of means and one sample t test. Since the region B represents a residual curve $res(x)$, its expected mean μ_B is 0 even if the background signal has a curvature. Applying σ calculation for the E region, we see that μ_E=1/2 max. amplitude and 3σ rule in fact compares mean, see Fig. 21. Thus, the *qualitative difference* between B and E areas can be also estimated by compression of means. Let us introduce the absolute mean μ_B^{abs} for B area

$$\mu_B^{abs} = 1/N \sum |x_i|, \tag{11}$$

where x_i is the sampled signal. The region E is not covered by linear regression, its expected mean μ_E is not 0. The relation

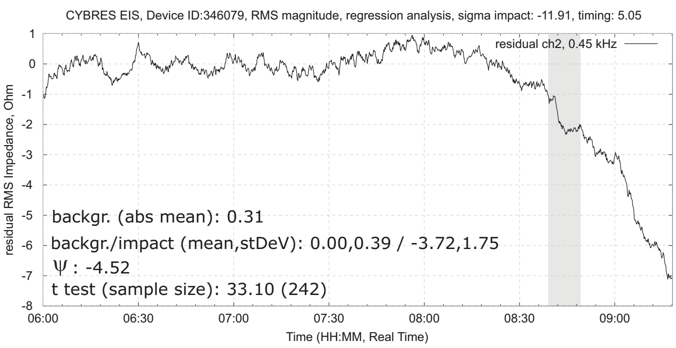


Fig. 21. Example of Ψ (3 sigma rule) calculated based on stDev and means.

$\Psi = \frac{\sigma_E}{\sigma_B}$ is to some extent equivalent to

$$\Psi_3^{abs} = \frac{\mu_E}{\mu_B^{abs}}, \quad (12)$$

which can be also used for assessment. Since the expression (12) compares means, it makes sense to use one sample t test, where the expected mean is μ_B (null hypothesis, $\mu_B = 0$) and the observed mean is μ_E

$$t = \frac{\mu_E - \mu_B}{\sigma_E/\sqrt{n_E}} = \frac{|\mu_E|}{\sigma_E/\sqrt{n_E}}, \quad (13)$$

where n_I is the number of samples in the E region. The critical values of t for p=0.001 and 250-350 sample size are 3.33-3.31, thus $t > 4$ can be generally used for rejecting the null hypothesis.

The problem of t test is its large value for all regression-based calculations. For instance, Fig.22 demonstrates results of one sample t tests for data without any impact, where it delivers a high score due to close-to-zero mean μ_B in the background region. Critical values for this type of t test should be redefined anew.

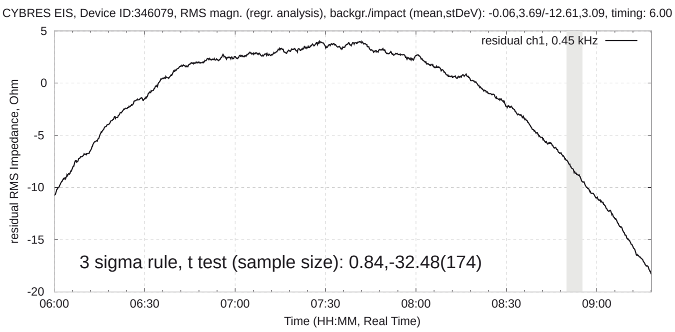


Fig. 22. Example of t test applied for linear regression. Despite curvature, mean of background region is close to zero and t value has a high score.

Thus, σ_3^{abs}, σ_3 and t can be potentially used as scores for assessing the signal changes in the area E. However, due to specific signal after regression analysis with μ_B close to zero, the analysis of mean with σ_3^{abs} and t contains large errors, further only Ψ with (6) and (9) based on stDev is used as a score.

Low-pass filters. EIS signals contain high frequency noise that affects the calculation of σ_B and σ_E. For removing the noise, the system offers several LP filters. Firstly, the hardware implements the averaging filter

$$y = 1/N \sum_{k=0}^{N-1} x[k], \quad (14)$$

where $x[k]$ are N original input samples that are averaged into one output sample y. Setting of this filter is shown in Fig. 9 with typical values of N between 20 and 30.

The client software implements the Finite Impulse Response (FIR) filter as the moving average filter

$$y[n] = 1/N \sum_{k=0}^{N-1} x[n-k], \quad (15)$$

where k is the length of moving window (offered are $N = 5$, 15, 30, 60 and 120). The filter (14) is also implemented in the multiple-pass form. With 4-pass it represents the Gaussian filter kernel.

We also use the first order IIR (Infinite Impulse Response) filter defined as

$$y[n] = (1-a)y[n-1] + ax[n] \quad (16)$$

where $y[n]$ is the output sample, $x[n]$ is the input sample, a is the coefficient. The system offers a between 0.5 and 0.0005 for manual adjustment.

Note that EIS signal has different characteristics of noise during long-term measurements. Typically, the number of high frequency components are increasing with the time and it requires adjustment of LP filters.

C. *Nonlinearity of regression and probabilistic nature of Ψ*

Fig. 19 demonstrates nonlinearity of regression. For instance, the events A and B in the background area can be identified based on linear regression. However, the nonlinear regression normalizes amplitudes of all perturbations in the background area, and identifying A and B is difficult. Similar effect is observed also in the experimental area, the regression-free part of the signal will have a large amplitude even it is only slightly differs from the approximated (expected) trend. Since EIS sensors, due to high sensitivity, measure always some small influences caused by different factors, the output Ψ always demonstrates non-zero values. Thus, it is important to evaluate and calibrate the impact-free amplitudes of Ψ.

For evaluation we use the observation from Fig. 19 – any influence on EIS sensor introduces additional point in piecewise close-to-linear signal that increases the value of σ_B. Performing nonlinear regression and comparing standard deviations from signals with and without such an additional point (potential impact), it is possible to estimate its statistical significance without nonlinear effects. In this case we calculate σ_{B1} for the background area without 'impact' and after this the σ_{B2} for the background area with the 'impact'. Since both σ_{B1} and σ_{B2} are covered by the regression, it removes nonlinear effects from Ψ. Moreover, the definition of

$$\Psi = \frac{\sigma_{B2}}{\sigma_{B1}} \quad (17)$$

corresponds more to classical meaning of '3 sigma rule' since σ_{B1} and σ_{B2} are estimated for signals with similar means. Since

$$\sigma_{B2} \geq \sigma_{B1} \quad (18)$$

is valid for most cases, the lower boundary of Ψ calculated by (17) is about 1. Fig. 23 compares the Ψ values obtained by (7) and (17).

We observe almost identical curves for both cases of $\frac{\sigma_{B2}}{\sigma_{B1}}$ and $\frac{\sigma_E}{\sigma_B}$, which differ only in their amplitude, i.e. Ψ calculated by (17) can be roughly converted into Ψ calculated by (7) by using a linear transforation. It means that Ψ, taking into account nonlinear effects, still provides acceptable results and requires only calibration of critical values.

For such a calibration we recorded a signal during 24 hours with Ψ calculated each 30 minutes, see Fig. 24. The values of

Ψ can be associated with probabilities of random occurrence (PRO), for example $\Psi > 6$ has occurrence 1/48=0.0208, $\Psi > 5$ – 5/48=0.1041, $\Psi > 3$ – 10/48=0.2083, $\Psi > \Psi_{average}$ – 13/48=0.2708. The performed experiment with real impact produces the score $\Psi = 6.97$ that falls under 0.0208 probability limit.

Thus, the experimental value of Ψ, which has a strong temporal correlation with duration of experiment, can be calibrated by PRO during background recording. This calibration is valid for specific sensor and time period and can be calculated based on last 24 or 48 hours. Values of Ψ_{mean} and $\sqrt{\Psi_{mean}}$ can be used for self-calibration purposes, for instance the values

$$\Psi < \sqrt{\Psi_{mean}} \tag{19}$$

for 3-4 past time periods can indicate a low background level of distortions and readiness for the next experiment.

D. Statistical processing of results at the level of all active sessions

The sensor constantly measures the 30-minutes-sessions to calculate statistics and for continuous calibration. It works all the time and current results are accumulated in the table of all sessions for the last 24 or 48 hours. However, they are entered into the table of results only when the user has made the current session active, i.e. he worked with the session her, see Fig. 25. This table contains the result of the session Ψ, the value of PRO

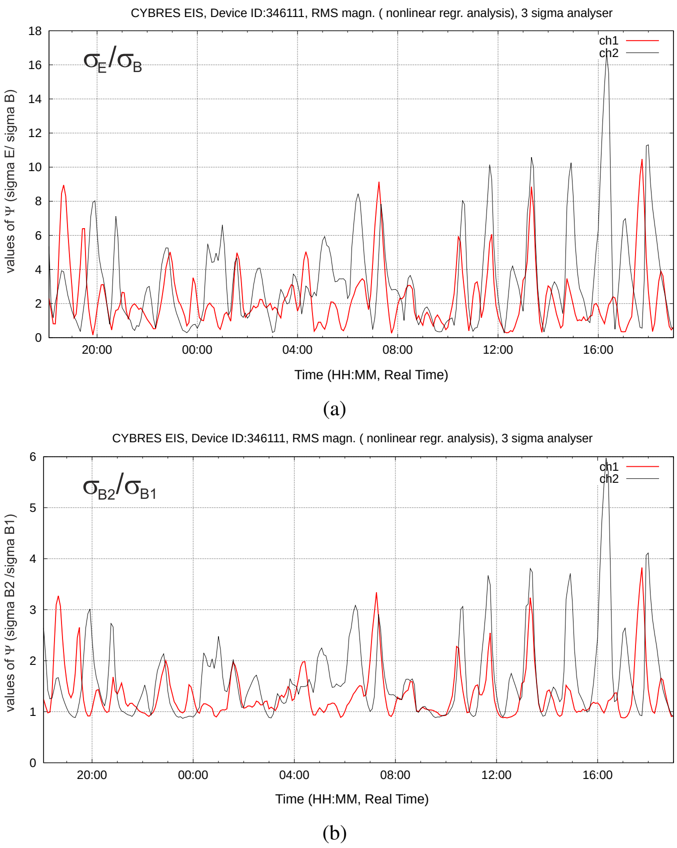


Fig. 23. Comparison of Ψ values obtained by (7) and (17). The values of Ψ are calculated by shifting initial 90/30 timing by 1 minute during 24 hours for both EIS channels.

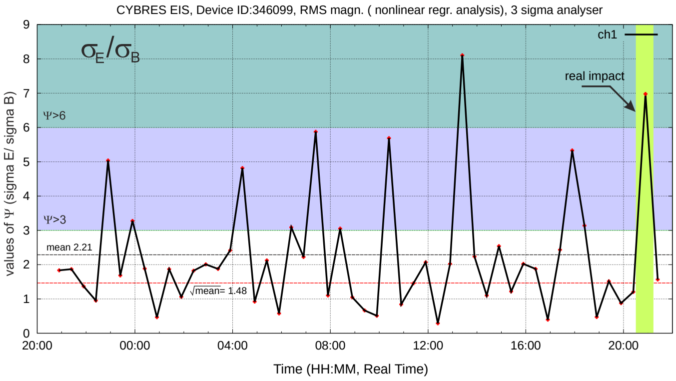


Fig. 24. Examples of Ψ calculated each 30 minutes during 24 hours without any experiments for estimating the probabilities of random occurrence (PRO). Two last results represent a real experiment. Values of Ψ_{mean} and $\sqrt{\Psi_{mean}}$ as well as the PRO, calculated based on last 24/48 hours, can be used for self-calibration purposes and indicate the statistical level of obtained results.

and the average of Ψ_{mean} for 24/48 hours. To analyze this data, the following three factors A, B and C are introduced (which give meaning to this aggregate data, like PRO for individual Ψ):

1. Factor A: overall assessment of user results. Since individual sessions take place in different operator states and environmental conditions, it is necessary to evaluate all active sessions for an overall assessment of the operator's results. The table of results has two data samples: one produced by the mean values of Ψ_{mean}, the second by Ψ in active sessions. If there are enough active sessions, the following value

$$A = \frac{\sum_N \Psi}{\sum_N \Psi_{mean}}, \tag{20}$$

where N is the number of active sessions, gives the general characteristic of the user. The larger the value of A, the more 'active' the user. The A factor can alternatively be calculated as

$$A = \frac{1}{N} \sum_N \left(\Psi_i / (\Psi_{mean})_i \right). \tag{21}$$

Using of (21) is more preferable if Ψ_i and $(\Psi_{mean})_i$ significantly vary across active sessions (e.g. they was obtained from different devices).

2. B factor: Joint probability of results as random events (jPRO). The joint probability jPRO of independent events can be calculated as a multiplication of PRO from active sessions. For example, if $PRO_1 = 0.2$ and $PRO_2 = 0.1$, their product is

$$jPRO = PRO_1 * PRO_2 = 0.02, \tag{22}$$

i.e. the lower is the PRO of sessions, the lower is their joint probability jPRO. In other words, performing several positive experiments can significantly improve the probabilistic estimates of experimental sessions. To obtain an estimate of the factor B (jPRO), it is necessary to compare an active session with a 'standard random' sequence – a session with $PRO = 0.5$

$$B = \frac{\prod_N PRO}{\prod_N 0.5}. \tag{23}$$

Selection of $PRO = 0.5$ is motivated by the average Ψ. If active sessions are close to mean (random) values, then the factor is $B \geq 1$. The smaller the B factor, the more strongly active sessions differ from random ones in terms of the joint probability of independent events.

3. C factor: Estimation of the statistical difference between active and random sessions. In the B factor, the difference in the joint probability of active and random sessions is estimated, but it does not give a clear formalized criterion about the statistical difference between active and average session samples. For this, the non-parametric U-test Mann-Whitney is used, where the 'null hypothesis' – active sessions are random and no mental effect exists. The null hypothesis is rejected if the test result is below the critical (with 1% and 5% error). The calculation uses the rank sums of all Ψ and Ψ_{mean}

$$C = N^2 + \frac{N(N+1)}{2} - T, \qquad (24)$$

where T is the largest of the rank sums (Ψ or Ψ_{mean}).

The results of the factors B and C (jPRO and U-test) are defined for $N > 5$ and allow estimating the randomness of active sessions (statistically significant number of active sessions $N = 30$). The factors A and B are important for users – they show the level of his/her abilities and progress in training.

In assessing the applicability of the A, B, and C criteria, we calculated their parameters for two boundary cases: **random** – when the algorithm uses data of a random number generator instead of a real EIS device and **maximum** – when using a real device, where the table of active sessions contains 30 maximal values obtained from all sessions within 3 days. Real user data will be between the 'random' and 'maximum' cases.

Fig. 25 and Table II show the data for these cases – the factor A varies between 1 and 2.4, the factor B – between 10^4 and 10^{-26}. The Mann-Whitney test in the first case did not reject the null hypothesis (i.e-, the result was random), in the second case the null hypothesis was rejected.

TABLE II
ASSESSMENT OF A, B, C FOR TWO BOUNDARY CASES: **RANDOM** (FROM RNG) **MAXIMAL** (SEE DESCRIPTION IN TEXT), AND FOR TWO REAL CASES: FROM EIS DEVICES WITHOUT ACTIVE SESSIONS (DATA FROM LAST SESSIONS ARE COPIED TO ACTIVE SESSIONS), SEE FIG. 26 AND WITH 30 ACTIVE SESSIONS, SEE FIG. 4.

factor	simulated random (RNG)	maximal EIS data	real random (EIS)	real 30 active sessions
A	1.04	2.36	1.04	1.96
B	2.64^{4}	2.82^{-26}	9.55^{-2}	4.12^{-20}
C	445	0	422	12

An example of real passive sessions (random EIS data) (24-July 2019) is shown in Fig.26. Passive sessions of publicly available EIS with ID 346079 are copied to active sessions and statistically evaluated. In Table IIthis represents the case 'real random (EIS)'.

An example of real active sessions (May-June 2019) is shown in Fig. 4. We observe the factors $C = 1.96$ and $B = 10^{-20}$ in Table II. The Mann-Whitney U test rejects the null hypothesis about the random nature of results. In other words, these data unambiguously confirm the effect of the operators remote influence on EIS sensors, both in terms of the ratio between Ψ and Ψ_{mean}, as well as their statistical and probabilistic parameters.

E. Post-effect (the memory effect)

The memory effect is manifested in the influence of previous experiments on current measurements. The physical nature of this effect is unclear, it is also known as the 'phantom effect', 'post-effect', etc., and has been demonstrated in various systems and experiments [12], [13], [2]. This effect is also sometimes manifested in the M.I.N.D. system as shown in Fig. 27. After the active session 17 was finished, perturbations continue further during several subsequent sessions. The values of Ψ in the post-effect sessions (2.20, 2.59, 2.89) are even higher than in the active session (1.89).

last sessions

N	time (h:m)	ch1:Ψ	PRO	ch2:Ψ	PRO
1.	06:21:52	-1.72	0.34	0.59	0.96
2.	05:51:15	0.65	0.91	0.39	1.00
3.	05:20:38	-1.71	0.34	-1.52	0.40
4.	04:50:01	3.97	0.02	1.18	0.68
5.	04:19:25	-1.25	0.47	1.05	0.68
6.	03:48:48	1.27	0.47	1.49	0.40
7.	03:18:11	-1.13	0.57	-0.60	0.98
8.	02:47:35	-1.35	0.47	-1.53	0.43
9.	02:16:58	0.73	0.91	-1.47	0.40
10.	01:46:21	-1.63	0.30	3.46	0.06
11.	01:15:44	-1.07	0.55	-2.58	0.13
12.	00:45:08	-1.38	0.49	-0.42	0.98
13.	00:14:31	-2.89	0.09	-0.71	0.94
14.	23:43:54	1.52	0.34	0.88	0.81
15.	23:13:18	2.57	0.13	1.19	0.70
16.	22:42:41	-2.20	0.24	1.25	0.54
17.	22:12:04	-1.89	0.28	-1.25	0.54
18.	21:27:51	0.88	0.70	-1.11	0.68
19.	20:57:14	1.70	0.30	2.12	0.21
20.	20:26:38	-0.68	0.89	-1.26	0.53
21.	19:56:01	0.70	0.89	1.12	0.64
22.	19:25:24	-0.62	0.87	-1.41	0.43
23.	18:54:48	-1.10	0.57	-0.96	0.77
24.	18:24:11	2.15	0.23	1.47	0.45
25.	17:53:34	-0.80	0.87	0.68	0.89
26.	17:22:58	-2.10	0.21	-1.96	0.28
27.	16:52:21	0.89	0.70	0.82	0.79
28.	16:21:44	2.10	0.19	2.14	0.23
29.	15:51:08	-3.18	0.06	-2.93	0.09
30.	15:20:31	1.82	0.21	1.58	0.40
unsigned mean Ψ		1.39		1.30	
ready for new sessions:		ch1=0.87		ch2=1.37	

Fig. 27. Example of post-effect ('memory effect', 'phantom effect'). After removing influence, the perturbation of sensors continues further during several subsequent sessions.

To explain the post-effect, we can also consider two alternative options. Firstly, the regression can generate an oscillating behavior with periodically changing sign after a strong impact. However this version does not explain why post-effect sessions have a higher amplitude than the active session. Secondly, in *device-device* experiments with non-local signal transmission, we sometimes observed two pulses – when the remote generator was turned on and off. It can be assumed that a similar effect is also occurred in *operator-device* experiments.

Since the post-effect is created by the operator, it must also be taken into account in evaluation of results. To register this effect, two sessions after active one are considered as 'secondary active' (post-effect sessions). If the Ψ in post-effect sessions

Table of Results

last sessions						results of active sessions					
N	time (h:m)	ch1:Ψ	PRO	ch2:Ψ	PRO	N	time (D-M h:m)	ch1:Ψ	PRO	ch2:Ψ	PRO
1.	20:16:22	0.97	1.00	1.07	0.75	1.	07-Jun 19:49:17	1.23	0.06	2.43	0.02
2.	20:12:59	0.96	1.00	1.08	0.75	2.	07-Jun 18:41:35	1.04	0.75	1.12	0.83
3.	20:09:36	0.99	1.00	0.98	1.00	3.	07-Jun 19:28:59	1.05	0.65	1.10	0.77
4.	20:06:13	1.01	0.60	1.05	0.77	4.	07-Jun 19:42:31	0.97	1.00	1.09	0.75
5.	20:02:50	0.95	1.00	1.00	0.77	5.	07-Jun 20:12:59	0.96	1.00	1.08	0.75
6.	19:59:27	1.07	0.60	1.01	0.77	6.	07-Jun 19:18:49	0.97	1.00	1.07	0.79
7.	19:56:04	0.96	1.00	1.01	0.75	7.	07-Jun 20:16:22	0.97	1.00	1.07	0.75
8.	19:52:40	0.97	1.00	1.04	0.73	8.	07-Jun 19:59:27	1.07	0.60	1.01	0.77
9.	19:49:17	1.23	0.06	2.43	0.02	9.	07-Jun 18:51:44	1.07	0.77	1.03	0.83
10.	19:45:54	1.01	0.62	0.98	1.00	10.	07-Jun 19:22:12	1.07	0.67	1.05	0.79
11.	19:42:31	0.97	1.00	1.09	0.75	11.	07-Jun 18:55:07	0.99	1.00	1.06	0.83
12.	19:39:08	0.98	1.00	0.99	1.00	12.	07-Jun 19:32:22	1.06	0.67	1.01	0.77
13.	19:35:45	0.94	1.00	0.96	1.00	13.	07-Jun 18:34:48	1.05	0.77	1.06	0.83
14.	19:32:22	1.06	0.67	1.01	0.77	14.	07-Jun 20:06:13	1.01	0.60	1.05	0.77
15.	19:28:59	1.05	0.65	1.10	0.77	15.	07-Jun 18:44:58	0.97	1.00	1.04	0.85
16.	19:25:35	0.95	1.00	0.97	1.00	16.	07-Jun 19:12:03	0.94	1.00	1.04	0.81
17.	19:22:12	1.07	0.67	1.05	0.79	17.	07-Jun 19:05:17	0.99	1.00	1.04	0.83
18.	19:18:49	0.97	1.00	1.07	0.79	18.	07-Jun 19:52:40	0.97	1.00	1.04	0.73
19.	19:15:26	0.95	1.00	-0.98	1.00	19.	07-Jun 19:01:53	-0.99	1.00	1.03	0.83
20.	19:12:03	0.94	1.00	1.04	0.81	20.	07-Jun 18:38:11	0.94	1.00	1.03	0.83
21.	19:08:40	1.01	0.73	0.98	1.00	21.	07-Jun 18:48:21	1.03	0.77	0.98	1.00
22.	19:05:17	0.99	1.00	1.04	0.83	22.	07-Jun 18:58:30	0.99	1.00	1.02	0.83
23.	19:01:53	-0.99	1.00	1.03	0.83	23.	07-Jun 19:45:54	1.01	0.62	0.98	1.00
24.	18:58:30	0.99	1.00	1.02	0.83	24.	07-Jun 19:08:40	1.01	0.73	0.98	1.00
25.	18:55:07	0.99	1.00	1.06	0.83	25.	07-Jun 19:56:04	0.96	1.00	1.01	0.75
26.	18:51:44	1.07	0.77	1.03	0.83	26.	07-Jun 20:02:50	0.95	1.00	1.00	0.77
27.	18:48:21	1.03	0.77	0.98	1.00	27.	07-Jun 19:39:08	0.98	1.00	0.99	1.00
28.	18:44:58	0.97	1.00	1.04	0.85	28.	07-Jun 20:09:36	0.99	1.00	0.98	1.00
29.	18:41:35	1.04	0.75	1.12	0.83	29.	07-Jun 19:15:26	0.95	1.00	-0.98	1.00
30.	18:38:11	0.94	1.00	1.03	0.83	30.	07-Jun 19:25:35	0.95	1.00	0.97	1.00
unsigned mean Ψ		1.05		1.06							
ready for new sessions:		ch1=1.05		ch2=0.99							

A: mean Ψ of active sessions/mean Ψ of all sessions: 1.09/1.05=1.04
B: joint Probabil.Rand.Occur.(j-PRO): active ses./0.5 ses.: 2.64e+04
C: Mann-Whitney test (positive if < critical value): 445 (292 :1%, 338 :5%)

psi1=0.98, psi2=1.02, fluid temp: tf1=0.000, tf2=0.009, ext. temp: te=0.003, imped.: im1=0.0000, im2=0.0000, pro1=1.000, pro2=0.750, last psi: psi-l1=0.97, psi-l2=1.07, ready1=1.05, ready2=0.99, pro-l1=1.00, pro-l2=0.75

(a)

Table of Results

last sessions						results of active sessions					
N	time (h:m)	ch1:Ψ	PRO	ch2:Ψ	PRO	N	time (D-M h:m)	ch1:Ψ	PRO	ch2:Ψ	PRO
1.	07:35:53	0.83	0.92	-1.31	0.75	1.	03-Jun 08:22:23	2.49	0.36	10.00	0.02
2.	07:05:44	0.75	0.96	-4.47	0.10	2.	05-Jun 03:34:46	-10.00	0.02	-0.53	0.98
3.	06:35:35	-2.26	0.46	-2.39	0.42	3.	04-Jun 12:00:29	4.70	0.17	9.12	0.02
4.	06:05:26	-3.23	0.27	1.96	0.56	4.	02-Jun 21:18:35	2.03	0.50	8.23	0.05
5.	05:35:17	-1.03	0.83	-0.27	1.00	5.	03-Jun 04:51:11	-8.11	0.03	-0.98	0.83
6.	05:05:14	-1.43	0.73	-3.65	0.21	6.	03-Jun 17:55:18	-6.80	0.04	2.50	0.40
7.	04:35:04	0.43	0.98	4.04	0.15	7.	05-Jun 02:34:28	-0.91	0.88	-6.39	0.04
8.	04:04:55	1.59	0.71	-1.71	0.65	8.	03-Jun 15:54:42	-5.94	0.04	1.55	0.57
9.	03:34:46	-10.00	0.02	-0.53	0.98	9.	04-Jun 11:00:11	5.79	0.06	-0.82	0.94
10.	03:04:38	0.91	0.88	-1.81	0.58	10.	03-Jun 10:23:03	5.69	0.04	1.66	0.59
11.	02:34:28	-0.91	0.88	-6.39	0.04	11.	03-Jun 18:25:27	-1.63	0.67	-5.61	0.06
12.	02:04:19	-3.68	0.21	2.57	0.44	12.	03-Jun 23:26:58	-5.54	0.12	-4.86	0.12
13.	01:34:12	1.01	0.83	5.20	0.04	13.	03-Jun 08:52:34	1.00	0.91	-5.54	0.07
14.	01:04:04	-1.68	0.62	-2.99	0.38	14.	04-Jun 05:58:46	-5.53	0.12	-2.89	0.35
15.	00:33:56	1.05	0.83	-1.73	0.58	15.	03-Jun 21:56:31	-5.42	0.10	-2.65	0.33
16.	00:03:49	3.90	0.19	-2.48	0.42	16.	04-Jun 21:03:00	-5.40	0.10	0.68	0.98
17.	23:33:41	0.60	0.94	0.84	0.90	17.	03-Jun 14:54:24	5.24	0.06	-4.38	0.17
18.	23:03:32	-5.21	0.10	0.93	0.90	18.	04-Jun 23:03:32	-5.21	0.10	0.93	0.90
19.	22:33:25	2.07	0.52	3.24	0.29	19.	05-Jun 01:34:12	1.01	0.83	5.20	0.04
20.	22:03:17	1.54	0.73	-1.73	0.60	20.	03-Jun 11:53:31	0.77	0.98	5.11	0.09
21.	21:33:08	-2.93	0.35	-1.76	0.60	21.	03-Jun 12:23:40	3.33	0.15	5.04	0.11
22.	21:03:00	-5.40	0.10	0.68	0.98	22.	04-Jun 14:31:13	3.79	0.31	4.75	0.08
23.	20:32:52	2.59	0.44	0.91	0.88	23.	03-Jun 03:20:41	-4.57	0.03	-1.79	0.62
24.	20:02:44	1.62	0.67	-1.90	0.62	24.	03-Jun 15:24:33	4.54	0.11	1.84	0.47
25.	19:32:36	-0.38	1.00	3.48	0.21	25.	05-Jun 07:05:44	0.75	0.96	-4.47	0.10
26.	19:02:27	-2.60	0.48	-0.75	0.96	26.	04-Jun 01:27:32	-4.32	0.23	-2.84	0.29
27.	18:32:19	2.48	0.48	0.39	1.00	27.	03-Jun 09:52:54	-0.68	0.96	4.24	0.11
28.	18:02:11	1.66	0.69	3.69	0.21	28.	04-Jun 05:28:39	1.50	0.69	4.24	0.21
29.	17:32:02	-1.61	0.69	-1.89	0.62	29.	04-Jun 04:58:31	0.55	1.00	-4.23	0.19
30.	17:01:54	2.35	0.52	-3.21	0.25	30.	03-Jun 18:55:36	4.22	0.17	1.24	0.75
unsigned mean Ψ		2.43		2.34							
ready for new sessions:		ch1=1.22		ch2=0.56							

A: mean Ψ of active sessions/mean Ψ of all sessions: 5.82/2.46=2.36
B: joint Probabil.Rand.Occur.(j-PRO): active ses./0.5 ses.: 2.82e-26
C: Mann-Whitney test (positive if < critical value): 0 (292 :1%, 338 :5%)

psi1=-1.09, psi2=2.81, fluid temp: tf1=26.885, tf2=26.892, ext. temp: te=27.969, imped.: im1=18.2374, im2=21.5906, pro1=0.833, pro2=0.333, last psi: psi-l1=0.83, psi-l2=-1.31, ready1=1.22, ready2=0.56, pro-l1=0.92, pro-l2=0.75

(b)

Fig. 25. Evaluation of the factors A, B, and C for two boundary cases: **(a) random** – with input data from a random number generator; **(b) maximum** – when using a real device, where the table of active sessions contains 30 maximal values from all sessions within 3 days.

are higher than in the active one, these values are entered into the table of active sessions and labeled as 'post', i.e. one active session can generate multiple results. Attempts to erase the 'phantoms' (or the memory effect) have not yet succeeded, but such 'phantoms' dissolve within the 2–3 subsequent sessions.

V. Environmental monitoring

Continuously running sensors record environmental fluctuations that can correlate with some astronomic and other events. For example, Fig. 28 demonstrates the standard deviation in B-area, averaged in a sliding window of 24 hours, for June 2019. Two peaks on these graphs on both EIS channels coincide with the full moon and the summer solstice on June 17 and June 21.

Example of measuring local fluctuations is shown in Fig. 29. A person entered in a room at 16:38 (no mobile phones, no mechanical distortions). EIS sensors are protected in the thermo-insulating box, the distance between sensors and person is about 2-3 meters. We observe a first variation of temperature of measurement fluids inside a thermo box about 17:03. However, the reaction of EIS sensors started immediately at 16:38 (25 minutes prior to temperature reaction).

Relationship between variations of temperature and electrical

last sessions — **Table of Results** — **results of active sessions**

N	time (h:m)	ch1:Ψ	PRO	ch2:Ψ	PRO	N	type	time (D-M h:m)	ch1:Ψ	PRO	ch2:Ψ	PRO
1.	12:00	1.30	0.61	0.46	0.97	1.	0	25-Jul 12:00	1.30	0.61	0.46	0.97
2.	11:30	2.67	0.10	2.60	0.23	2.	0	25-Jul 11:30	2.67	0.10	2.60	0.23
3.	11:00	0.97	0.76	-0.78	0.93	3.	0	25-Jul 11:00	0.97	0.76	-0.78	0.93
4.	10:30	-1.31	0.61	0.80	0.93	4.	0	25-Jul 10:30	-1.31	0.61	0.80	0.93
5.	10:00	1.67	0.37	0.70	0.93	5.	0	25-Jul 10:00	1.67	0.37	0.70	0.93
6.	09:30	-0.96	0.73	-1.63	0.46	6.	0	25-Jul 09:30	-0.96	0.73	-1.63	0.46
7.	09:00	2.61	0.08	3.03	0.16	7.	0	25-Jul 09:00	2.61	0.08	3.03	0.16
8.	08:51	-0.21	1.00	-0.32	1.00	8.	0	25-Jul 08:51	-0.21	1.00	-0.32	1.00
9.	08:21	0.54	1.00	-1.12	0.74	9.	0	25-Jul 08:21	0.54	1.00	-1.12	0.74
10.	07:50	1.81	0.27	1.27	0.59	10.	0	25-Jul 07:50	1.81	0.27	1.27	0.59
11.	07:20	-2.44	0.10	-1.58	0.57	11.	0	25-Jul 07:20	-2.44	0.10	-1.58	0.57
12.	06:50	-0.66	0.95	-0.69	0.95	12.	0	25-Jul 06:50	-0.66	0.95	-0.69	0.95
13.	06:19	-1.40	0.63	2.78	0.26	13.	0	25-Jul 06:19	-1.40	0.63	2.78	0.26
14.	05:49	1.33	0.61	1.07	0.72	14.	0	25-Jul 05:49	1.33	0.61	1.07	0.72
15.	05:18	-0.67	0.94	-0.80	0.94	15.	0	25-Jul 05:18	-0.67	0.94	-0.80	0.94
16.	04:48	0.88	0.81	-0.62	0.94	16.	0	25-Jul 04:48	0.88	0.81	-0.62	0.94
17.	04:18	-0.74	0.93	1.98	0.60	17.	0	25-Jul 04:18	-0.74	0.93	1.98	0.60
18.	03:47	-0.91	0.86	-0.86	0.86	18.	0	25-Jul 03:47	-0.91	0.86	-0.86	0.86
19.	03:17	-0.67	0.92	-3.30	0.15	19.	0	25-Jul 03:17	-0.67	0.92	-3.30	0.15
20.	02:46	1.41	0.58	2.26	0.42	20.	0	25-Jul 02:46	1.41	0.58	2.26	0.42
21.	02:16	1.27	0.82	-0.54	1.00	21.	0	25-Jul 02:16	1.27	0.82	-0.54	1.00
22.	01:46	-1.23	0.80	-2.50	0.40	22.	0	25-Jul 01:46	-1.23	0.80	-2.50	0.40
23.	01:15	-1.89	0.44	-1.09	0.89	23.	0	25-Jul 01:15	-1.89	0.44	-1.09	0.89
24.	00:45	2.64	0.12	3.11	0.25	24.	0	25-Jul 00:45	2.64	0.12	3.11	0.25
25.	00:15	-0.54	1.00	1.01	0.86	25.	0	25-Jul 00:15	-0.54	1.00	1.01	0.86
26.	23:44	0.90	1.00	-0.66	1.00	26.	0	24-Jul 23:44	0.90	1.00	-0.66	1.00
27.	23:14	2.04	0.40	3.75	0.20	27.	0	24-Jul 23:14	2.04	0.40	3.75	0.20
28.	22:43	-1.70	0.75	-1.91	0.75	28.	0	24-Jul 22:43	-1.70	0.75	-1.91	0.75
29.	22:13	2.03	0.33	-1.82	0.67	29.	0	24-Jul 22:13	2.03	0.33	-1.82	0.67
30.	21:43	-1.24	1.00	1.45	1.00	30.	0	24-Jul 21:43	-1.24	1.00	1.45	1.00

unsigned mean Ψ 1.36 1.60
ready for new sessions: ch1=0.71 ch2=0.99

A: mean Ψ of active sessions/mean Ψ of all sessions: 1.77/1.69=1.05, (1.04)
B: joint Probabil.Rand.Occur.(j-PRO): active ses./0.5 ses.: 9.55e-02
C: Mann-Whitney test (positive if < critical value): 422 (292 :1%, 338 :5%)

Fig. 26. Evaluation of the factors A, B, and C for test case of real data from EIS device without active sessions: data from last sessions are copied to active sessions and statistically evaluated.

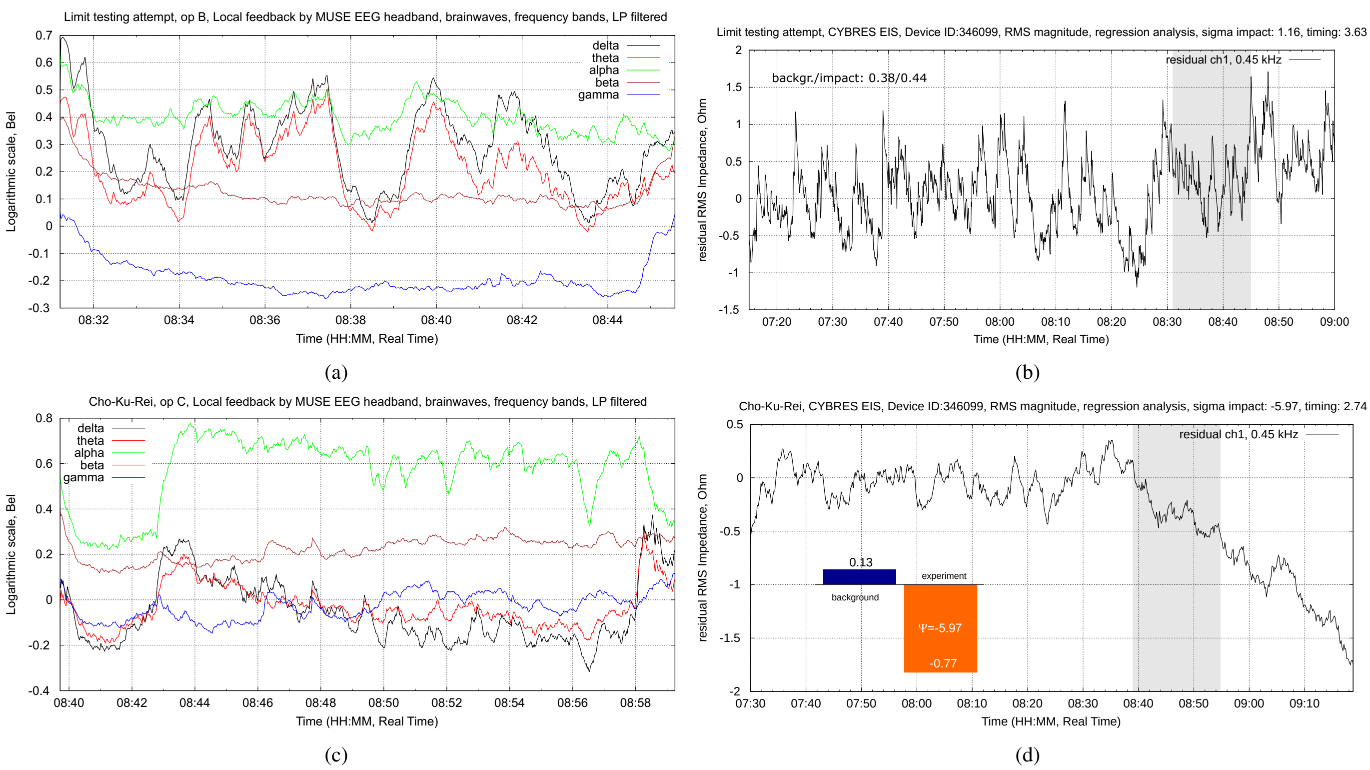


Fig. 30. Experiment with 'mind-independent mechanisms' with Reiki. **(a, b)** Session with a negative result ($\Psi = 1.16$), EEG and EIS graphs; **(c, d)** session with a positive result ($\Psi = 5.97$) when using Reiki (the Cho-Ku-Rei symbol), EEG and EIS graphs are shown, see explanations in text.

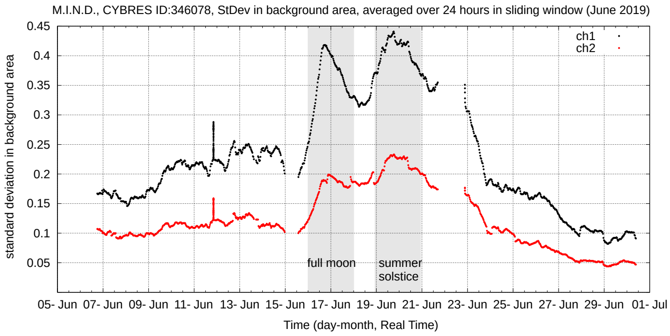


Fig. 28. MIND sensor without public access, June 2019, shown is the standard deviation in background region, averaged in a sliding window of 24 hours. The first peak coincides with the full moon on June 17 and the second peak on June 21 – with the summer solstice.

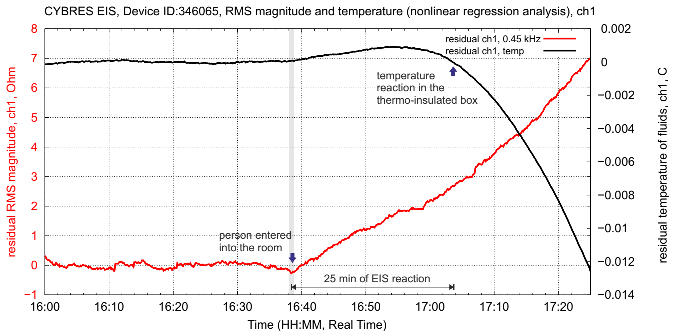


Fig. 29. Reaction of EIS sensors in thermo-insulating box on a human person 25 minutes prior to temperature reaction.

conductivity is described by

$$EC_t = EC_{25}[1 + a(t_{25})], \tag{25}$$

where a varies between 0.0191 and 0.025, EC_t is electrical conductivity at temperature t, EC_{25} is electrical conductivity at 25C [6]. We can roughly estimate that variation of $\Delta t = 10^{-3}C$ can produce a variation of conductivity at $10^{-5}EC_{25}$, i.e. increase of impedance in Fig. 29 cannot be explained even by a variation of temperature. It was also noted that reaction of EIS sensors depends on a person and thus can underline some dedicated measurement approach.

Despite a physical way that transfers such local or global influences is fully unclear, monitoring environmental dynamics represents the 'natural background of Ψ' and can be of interest for further analysis.

VI. Data files generated by M.I.N.D.

The system generates several files in the directory 'log'. Descriptions of data fields are provided within these files.

MIND_logfile.log – log file of all results/sessions and internal variables.

MIND_pro.log – current dependency between values of Ψ and PRO.

MIND_tableOfActiveSessions.log – the table of 30 active sessions sorted by the value of Ψ.

MIND_tableOfLastSessions.log – the table of 48 past session (both passive and active).

Note that M.I.N.D. reads values from these files before starting the system – to reset the system you need to delete these files.

VII. Using additional EEG and acoustic feedback

EIS data plots represent a visual and information feedback that is provided to the transmitter side in real time. They use only impedance data channels from EIS devices based on regression analysis. There are several ways to involve other data channels (e.g. thermodynamic data or electrochemical noise) or other kinds of feedback, e.g. EEG and acoustic feedback. They use the DA scripts, whereas EEG is provided by external device (e.g. commercially available MUSE, EMOTIV, or NeuroSky), the acoustic signal is generated by client program based EIS data. Main results of these approaches are represented in [1], more details on using this kind of feedback will be published in this section in next releases of this AppNote.

VIII. Conclusion

This application note[2] provides practical recommendations for preparation and conducting feedback-based distant experiments. It addresses operators on transmitter and receivers sides and introduces several detailed theoretical explanations on underlying algorithms.

IX. Disclaimer

This application note means an open-science approach of experimental nature. When using this approach and corresponding implementations in CYBRES MU devices – considered as a service from CYBRES GmbH – its experimental character in relation to methodology, equipment or accuracy should be always considered. Remember, a single measurement has a probabilistic nature. Before drawing any conclusions, a statistically significant number of independent attempts (>30) should be undertaken. CYBRES GmbH does not assume any liability arising out of the application or use of any part of this service, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages of any kind. CYBRES GmbH especially disclaims all liability for any health problems that stem from the use of such devices or services. CYBRES GmbH can any time change this service, add/remove diverse functionality. CYBRES GmbH follows the data protection rules, any requests/data exchange remain confidential as long as other agreements with corresponding partners are not achieved. Graphical images are allowed to copy when the word 'CYBRES' remains on caption to these images. Any citations or references on graphical/technical material should include links to CYBRES GmbH.

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APPENDIX

A. FOUR SIMPLE STEPS TO RUN EIS IN REAL-TIME FEEDBACK MODE

1. Make sure, that a room for your experiments satisfies requirements, as described in Sec. III-A. If the measurement room has unstable temperature (e.g. illuminated by sun light or heated by electrical/IR radiators with thermostat), or human persons have access to this room – measurements will contain artefacts. Keep temperature in the room possibly low (EIS dynamics is more stable at a low temperature).

2. Connect the system as shown in Fig. 5. Fill up large 1.5L containers with tap water (add table salt for conservation), install them inside the thermo-stabilizing neopor container. Fill up small measurement 15 ml containers with distilled water (with conductivity about 1-10μS/cm), do not use double distilled water. Make sure that the PC, used as a statistical server, can run continuously (switch off automatic restart for updates, switch off all energy optimization options in Win10).

3. Make sure that software and drivers are installed as described in the user manual, the Section 5.1. Start MU-EIS-Client.exe. Make sure that the following options are set.

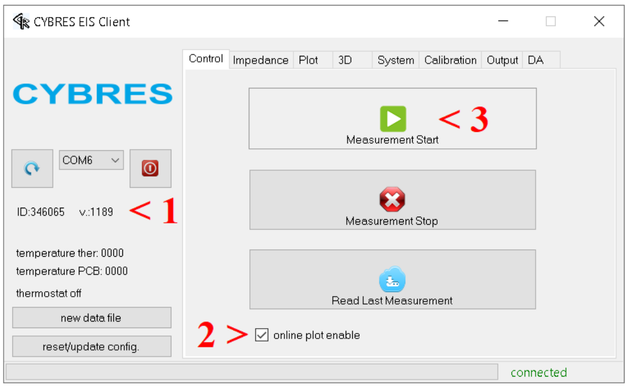

Fig. 31. Explanations: 1 – the system is connected, you see hardware and firmware IDs; 2 – plot is enabled (it writes data into the file and plot them); 3 – press 'start' to start measurements.

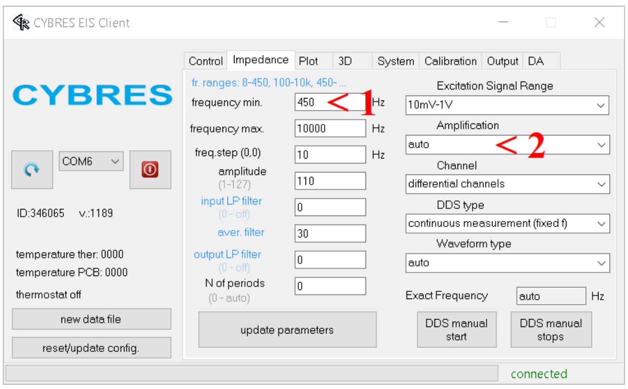

Fig. 32. Explanations: 1 – the frequency of electrical excitation, see the section III-C for explanations, use 450Hz or 100Hz; 2 – use 'auto', in some systems 'auto' is not available, use amplification first as 50000 and after a few days 5000.

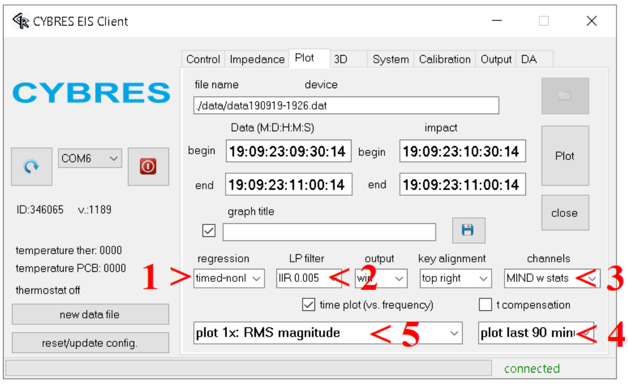

Fig. 33. Explanations: 1 – select regression as 'timed-nonlinear'; 2 – LP filter - IIR0.01, after a few days IIR0.005, see the section III-C for explanations; 3,4,5 – select as shown. **The output will be done into a Win10 App 'gnuplot'.**

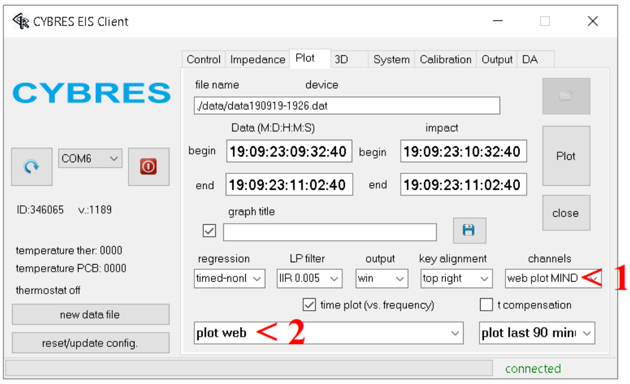

Fig. 34. Explanations: 1,2 – select as shown. **The output will be done into a html file (/web/index.html)**.

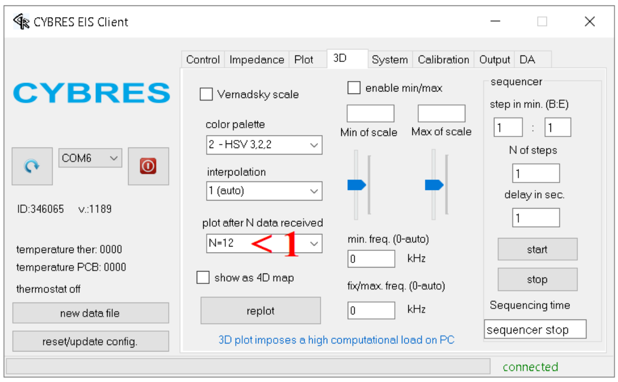

Fig. 35. Explanations: 1 – it controls the computational load, use N=12 (one plot is performed after 12 data samples) for mini PC based on Intel Atom; use N=3 for a PC with Intel I3/I5 processors.

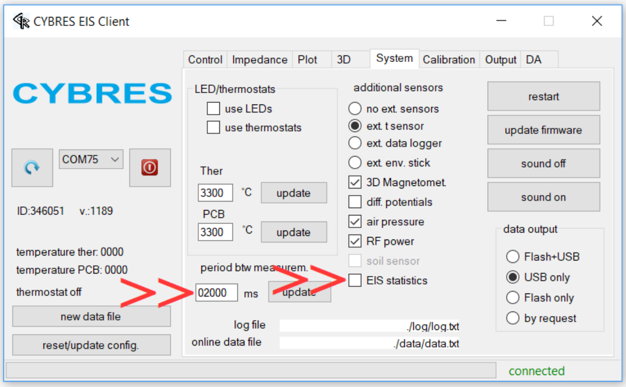

Fig. 36. Explanations: make sure that all parameters are set as shown in this image. Disable 'EIS statistics' and set 2 sec. period between measurements.

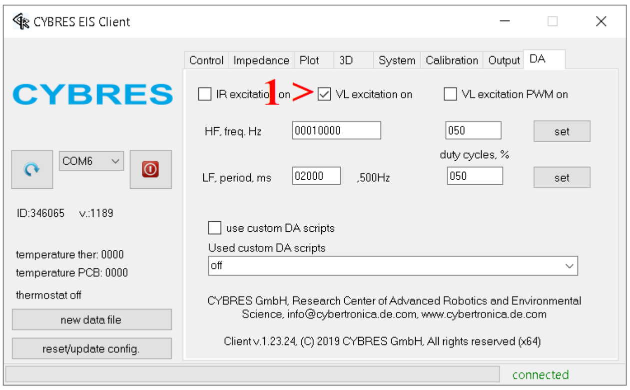

Fig. 37. Explanations: 1 – optical excitation, see the section III-C for explanations; it is suggested first to enable it.

4. Press 'Start Measurements', you should see a green line indicating sampling. After some initial time (typically a few minutes) you will see either the gnuplot window or the html output (it depends on setting in Fig. 33, Fig. 34). Note, that fresh water has unstable electrochemical dynamics, see Sec. III-A. Run the system a few days for stabilization/self-calibrations before starting measurements of ultra weak impact factors. Observe the values of Ψ_{mean} – they should be < 2 with enabled optical excitation, large values of Ψ_{mean} or multiple values of $\Psi = 10.0$ indicate artefacts during measurements.

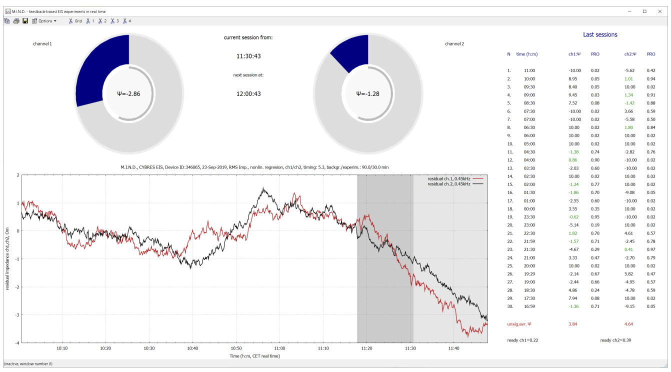

Fig. 38. Example of gnuplot output.

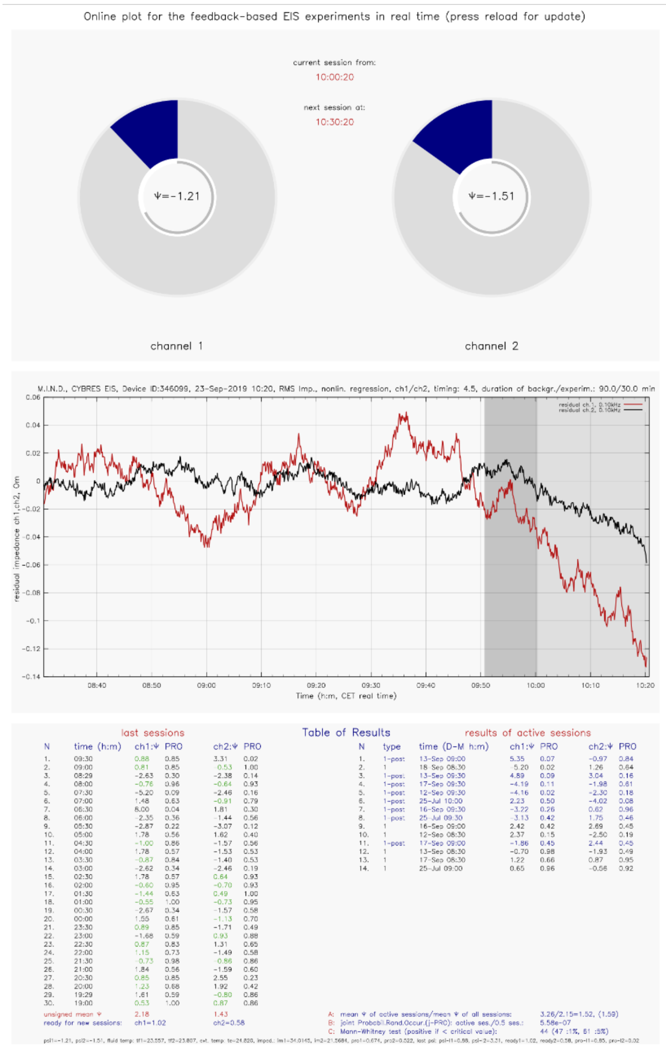

Fig. 39. Example of html output.

B. FAQ

1. How to start an active session?

Press 'Start Measurement'. Note, that continuous measurements should be running all the time, by pressing 'Start Measurement' during running measurements you make a current session 'active' (in other words – do not press 'Stop Measurement' at all in this kind of measurements). Generally, 49 different types of sessions and post-sessions (e.g. different users or specific conditions) are possible. By pressing the button 'Start Measurement' 2 times, the active session of type 2 is enabled, 3 times – type 3, and so on (up to 10 different types are possible in this way).

2. Which EIS channel is best for remote experiments?

EIS channels with strong variation of signals are usually more sensitive, however they accumulate also a lot of high amplitude perturbations in the background region. EIS channels with low perturbations are also less sensitive, but contain less noise in the background region. We suggest **to start first with less stable channel** and then with a stable channel and to collect experience with both. Consider also the '*ready*' value: the larger the '*ready*' is – the more larger Ψ values are possible on this channel (however 'ready' does not say anything about sensitivity of the channel). Generally, do not use such EIS channels, that undergo large perturbations (variation of signals is so large that noise components are not visible any more).

3. What are the Ψ values 10.0 and 9.90?

Strong perturbations that occur in passive sessions are limited by $\Psi = 10.0$. Typically they are generated by some external perturbation or unstable EIS dynamics. These values are ignored in statistical calculations. Strong Ψ values generated during active sessions and post-sessions are limited by $\Psi = 9.90$ and are considered in statistical calculations.

4. The system time is not synchronized with the time on plots. How to fix it?

Press the button 'Measurement Stop', and close the client program. Open it again and connect to the EIS device. The windows' system time and internal time in the device will be synchronized automatically.

5. LP filer affects my Ψ values. How to select the optimal LP filter?

Unfortunately, an optimal selection of LP (low-pass) filter cannot be done automatically. Generally, we recommend to use the IIR filter, starting with the coefficient 0.1. The EIS dynamics should contain a small amount of low-amplitude noise. If the curves have no noise or periodical saw-like pulses, the filter is not optical (go back to larger coefficient). Typically, after 3-4 days of measurements the dynamics is stabilized so that IIR 0.005 can be applied. Perform all major experiments with LP IIR 0.005 filter setting (and distilled water).

6. Where can I find the MIND algorithms?

Algorithms for MIND data processing are in files script/printMIND.dat and script/printWebMIND.dat.

7. How to remove the EIS measurement module from the thermostabilization box (Pro-version)?

Temperature mode of EIS is related to environmental temperature. To give an example: at 23C-24C of measurement fluids, the EIS dynamics is stable during several days, whereas at 30C-32C EIS dynamics demonstrates a lot of high-amplitude spikes within a few hours. Pro-version has 3 cm wall thickness and at 24-25C of environmental temperature provides an acceptable thermal mode for EIS measurements. At higher environmental temperature it is recommended to turn off optical excitation in the Pro-version (it reduces t of fluids on 1C-2C).

8. I see MIND' diagrams, however sessions do not start.

Select in the regression 'timed-nonlinear' instead of 'nonlinear'.

9. I used tap water for small measurement containers. Is this a wrong setup?

You can use tap water as a measurement fluid. Make sure that a correct amplification factors is set (run a measurement in scope mode to see the signals, or use 'auto' in amplification). However tap water has unstable EIS dynamics due to ongoing electrochemical reactions. Your table of results will contain many artefacts and recognition of 'weak impact factors' is difficult. Use distilled water (not double distilled), e.g. for technical purposes (can be found in any supermarket, price about 0.5-0.75 Euro per litre).

10. WiFi connections to my mini PC is periodically broken, the mini PC is sometimes rebooted.

We strongly recommend to use wired Ethernet connection for mini PC (generally to statistical servers connected to MIND/EIS systems), and to use WiFi only in exceptional cases. In mini PC turn off automatic updates and reboot after updates as well as all energy optimizing options.

11. My Ψ and PRO values are low in active session. What I'm doing wrong?

First of all, observe post-sessions. It can happen, that you work against EIS trend in the active session and the result will appear only in post-sessions. Secondly, try to avoid several specific time moments: when the MIND system has a freshly filled water, some astronomic events (like a full moon and similar events) and when the system has strong ongoing perturbations (environmental influences), see Sec. V. More generally, distant phenomena have a probabilistic character, before making any conclusions, try to collect results from 30 active sessions and to compare the values of factors A, B, and C with the published ones, see [1]. Finally, frequently perform the sessions – such skills can be improved by systematic training.

12. Significant change of Ψ starts 10-15 minutes after the begin of a session. Is this a normal dynamics of Ψ?

Yes, typically, the dynamics of Ψ responds with some delay, we assume that this delay characterizes the operator, its capabilities of concentration and keeping mental focus. If the delay takes more than 10 minutes, the active session can have a low score, thus, we recommend in this case to extend the active session to the next one (press once again the button 'Measurement Start' during the next session), i.e. to keep the concentration attempt next 30 minutes.

13. Why you do not use active thermostat for thermostabilization of samples?

In fact, we have a version of EIS spectrometer with active thermostat and it is also used for such experiments. Active thermostabilization of electrochemical dynamics has advantages for short-term measurements, however we experienced many disadvantages for long-term measurements (on the level of weeks). First of all, the thermostat should be set at 4C-5C higher than the environmental temperature + self-heating of optical excitation system. In most cases it leads to 29C-33C of fluid samples, which significantly increases a probability of high-amplitude spikes (as assumed, the proton tunnelling effect). Higher temperature requires degassing of fluids and leads to artefacts created by micro-bubbles. Combination of these two factors makes the EIS dynamics very unstable and less useful for measurements of ultra-weak influences. Passive thermostabilitation in neopor boxes with 3-5 cm wall thickness and with 3-5 kg of water/gel inside provide 0.04-0.08C of thermal instability for 120 min in normal room conditions, which is enough for a stable regression analysis, see more in Sec. III-D.

14. I'm a healer and practitioner of Reiki. How can I use the system?

Generally, MIND provides an objective feedback from different kinds of distant mind-matter experiments. In application to Reiki it can be used e.g. to test a self-attunement, on the second and third degree – to train with Reiki symbols, especially their distant application. Frequent sessions with Reiki allow collecting more experience about remote interactions with water-containing systems, learning more about effectiveness of sessions in dependency on own psycho-physiological state and external (e.g. astronomic) events. Here it is also important to perform at least 30 sessions – that addresses such issues as mental discipline, following 5 rules of Reiki and similar topics.

15. Sampling rate at mini PC is about 1 update in 15-20 sec. Is this still a real-time measurement?

One sample of EIS dynamics takes about 150ms. Sampling of other sensors can slow down the total hardware sampling time up to 400-500ms. This is the update rate from EIS device. Statistical and numerical data processing on PC depends on several parameters such as used analytical tools or the time window (how many data are included into analysis). For typical applications (e.g. with enabled additional sensors and statistical calculations) and PC with Intel i3/i5 CPU, the update rate is about 1 sample/sec. However, the electrochemical dynamics for 'treatment-during-measurement' approach is slow, in fact one sample in 20-30 sec. produces enough data for regression analysis within 90-120 min. sessions. This allows using a low-computational-power, non-expensive mini-PC for data processing. Faster sampling does not make any advantages for the MIND application, but it can be achieved by using a faster PC and setting 'time btw measurements' to 1 sec. and 'plot after N data received' to N=1.

16. Can I use MIND in a 'normal home environment'?

Figure 40 shows images of 7 days of measurements from a M.I.N.D. system, installed in a living/home environment – we are testing the worst case – small closed/separate room inside a large (four floors) house with many WiFi, temperature changes, people etc. About 4-5 WiFi routers are within 10 meters (+ large number of smart phones).

As far as we can see, there is no obvious correlation with WiFi (most intensive using of WiFi is about 17.00-22.00 every day). As long as temperature varies about 0.1-0.2C for 24 hours (0.004-0.008 C per hour), it does not influence the sensor. Critical are power supply and mechanical vibrations (due to movement of people + elevator). Unstable values of the sensor can be also explained by a 'geopathogenic zone' (but it is difficult to validate) and ongoing electrochemical reactions (due to some impurity in water).

Performed sessions with such setup demonstrate results that are a bit weaker than in more stable conditions and contain more noise but they are still valid and of interest (and significantly differ from random results). Thus, answering this question – yes, the sensor can be used in a home environment if at least some degree of isolation (separate closed room) is provided and some noise in results can be accepted.

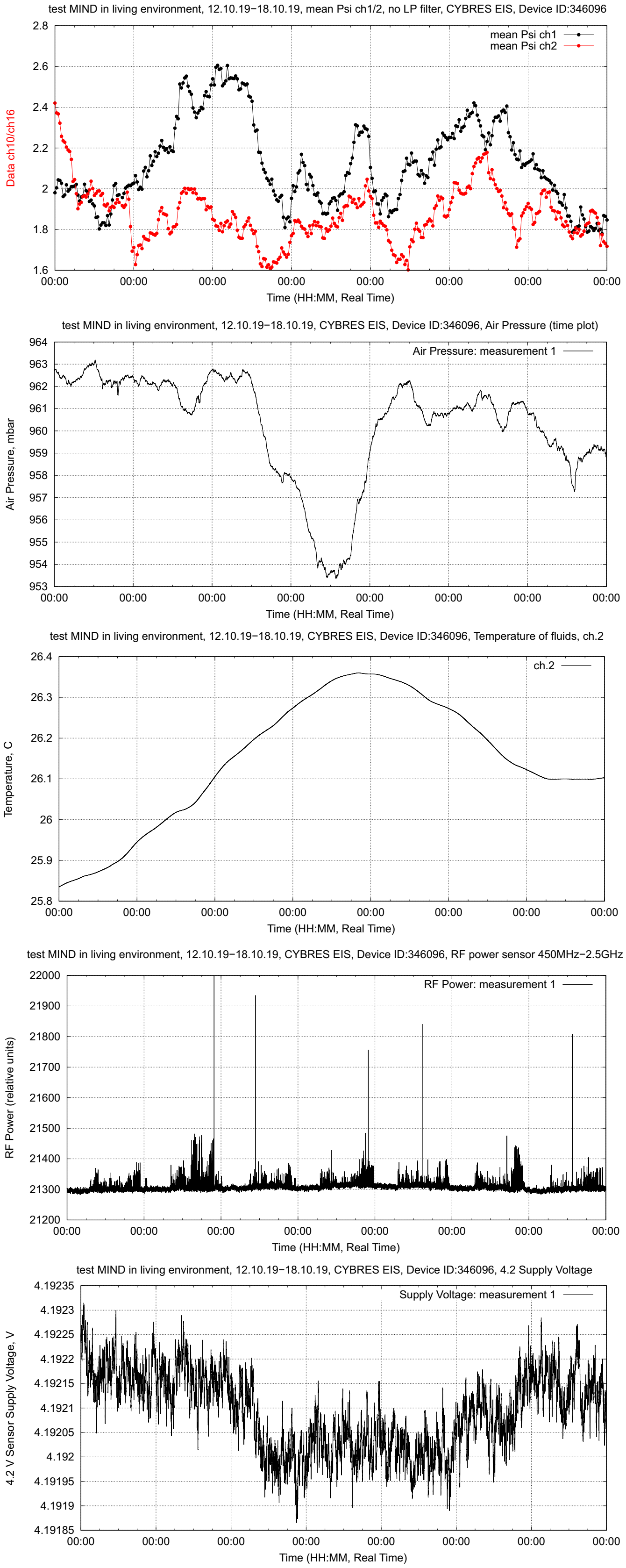

Fig. 40. Test of M.I.N.D. system in a living/home environment.