Dobrovolsky Yu., Prokhorov H., Diachenko L., Zukow W., Babelyuk V, Popovych I. Correlation investigation of the brightness of GDE-grams using the methods of computer graphics and direct measurements. Journal of Education, Health and Sport. 2022;12(7):366-372. eISSN 2391-8306. DOI http://dx.doi.org/10.12775/JEHS.2022.12.07.035
https://apcz.umk.pl/JEHS/article/view/JEHS.2022.12.07.035
https://zenodo.org/record/6806836

The journal has had 40 points in Ministry of Education and Science of Poland parametric evaluation. Annex to the announcement of the Minister of Education and Science of December 21, 2021. No. The journal has had 40 points in Ministry of Education and Science of Poland parametric evaluation. Annex to the announcement of the Minister of Education and Science of December 21, 2021. No. 32343.
Has a Journal's Unique Identifier: 201159. Scientific disciplines assigned: Physical Culture Sciences (Field of Medical sciences and health sciences); Health Sciences (Field of Medical Sciences and Health Sciences).

Punkty Ministerialne z 2019 - aktualny rok 40 punktów. Załącznik do komunikatu Ministra Edukacji i Nauki z dnia 21 grudnia 2021 r. Lp. 32343. Posiada Unikatowy Identyfikator Czasopisma: 201159.
Przypisane dyscypliny naukowe: Nauki o kulturze fizycznej (Dziedzina nauk medycznych i nauk o zdrowiu); Nauki o zdrowiu (Dziedzina nauk medycznych i nauk o zdrowiu).

Received: 20.06.2022. Revised: 20.06.2022. Accepted: 07.07.2022.

Correlation investigation of the brightness of GDE-grams using the methods of computer graphics and direct measurements

[1]Dobrovolsky Yu., [1]Prokhorov H., [1]Diachenko L., [2]Zukow W., [3]Babelyuk V., [4]Popovych I.

[1]Yuriy Fedkovych Chernivtsi National University, Ukraine
[2]Nicolaus Copernicus University, Torun', Poland
[3]Vivat Hotel and Health Complex, Morshyn, Ukraine
[4]Bohomolets' Institute of Physiology of NAS, Kyiv, Ukraine

UDC 004.921: 004.9: 535.23:628.98

Abstract

There are two methods of measuring the glow of a liquid under the conditions of gas-discharge imaging. This is a investigation of the brightness of GD-grams - a digital image of streamers created under these conditions, and a direct measurement of brightness using a luminometer, which is carried out during the formation of a streamer during a gas discharge. In the first case, the digital image is analyzed using computer graphics methods and certain software. In the second, the results of direct measurement are analyzed. We have analyzed these two methods using the example of the glow of water under the conditions of gas-discharge visualization. It is shown that with direct measurements the brightness values are higher than when investigating the brightness of a digital image of the same streamer obtained in the same time period. Namely 1.5 cd/m^2 and 1.7 cd/m^2. The difference is 13% and significantly exceeds the measurement error of the brightness meter (± 7%). According to the results of our research, we suggest that, at the very least, when calibrating the devices that create the GDV-grams, use direct measurements of the glow of the liquid in photometric units. For example, in brightness units.

Keywords: Gas-discharge visualization, computer graphics, brightness, streamer, digital image

Introduction.

One of the methods of investigationing liquid objects is the investigation of fractal images of these objects, which are obtained under the conditions of gas discharge visualization (GDV). At the same time, a GDV-gram is formed - a single image of a gas discharge recorded at any moment of exposure to an electromagnetic field in the area of the object [1]. To date, a number of studies have been performed with the use of GDV-image of general-purpose objects, which have in common a complex biophysical approach to data storage based on the analysis of fractal images [2, 3].

Analyzing the image of the discharge, it is possible to determine the state of the liquid [4], in particular the components of the blood. The investigation of images of the gas discharge to reveal the features of the structure of the blood components: plasma, platelets and erythrocytes [5], the investigation of the statistical difference between the parameters of the GDV of patients with colon tumors and the control group [6], in the training of athletes [7] and even in the investigation of the influence of the church Liturgy on some biophysical and physiological indicators of healthy people. [8].

In contrast to the investigation of the image of a single image of a gas discharge (GDV-gram), which is an indirect method, there is a method of direct research of the light characteristics of the glow of a liquid under the conditions of GDV [9 - 12]. Its difference from bioelectrography Korotkov K.G. [13], which is at the basis of obtaining GRV-grams, consists in the fact that the method of Korotkov K.G. involves obtaining an image and further processing it with the appropriate software. Thus, we have a method of indirect object research. When directly investigation the glow of an object in a high-voltage field in a certain frequency range, investigating the behavior of the discharge in real time, as well as introducing a metrological assessment of the measurement results, since the light activity of natives in the conditions of GDV can be evaluated in units of the SI system - candelas, or in reduced units cd/m2, in which brightness is measured.

The purpose of the work is the correlational research of the brightness measurement of GDV-grams using computer graphics methods and the method of direct brightness measurement using a brightness-meter.

The research methodology by the method of direct brightness measurement using a discharge-optical device is described in [10, 12], and its design features in [14, 15].

In our case, the liquid for research was poured into a sample, as a pill of activated carbon, which was saturated with water. The pill is used to prevent splashing of water during discharge.

Schema of the installation for providing an investigation of the brightness of the glow of liquid created under the conditions of GDV is given on Fig 1 [16].

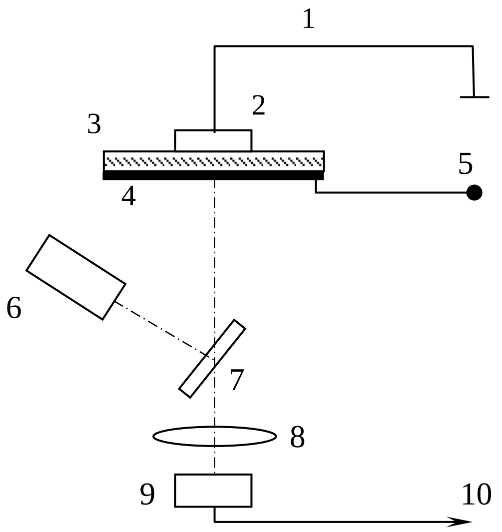

Fig. 1. Schematic image of the installation for conducting a study of brightness of the liquid created in the conditions of GDV.
1 - Electrode 2; 2 - Charcoal tablet;
3 - Transparent insulator (2.5 mm glass);
4 - Electrode 2; 5 - The output of the working electrode 2; 6 - Eyepiece; 7 - Translucent mirror; 8 - Object-glass; 9 – Photodiode of luminance meter; 10 - To the measuring device.

The installation is structurally a discharge block (DB) - a light-proof cubical chamber. The discharge gap (transparent insulator 3) is mounted on the upper wall of the DB and is closed with a cover during operation. A radiometric head (8, 9) is installed on the lower wall, which can be removed if necessary. An eyepiece (6) is installed on the front wall. On the back wall of the DB there is a clamp for connecting the high-voltage voltage generator (5) and the grounding terminal.

The main channel for quantitative assessment of discharge intensity is formed by the three-lens high-power lens of the radiometric head (8) and the FD-288B photodiode (9), which are part of the Tensor-28 light meter [17]. During the operation of the radiometric head, the translucent mirror can remain in place, or it can be moved to a non-working position - it can be removed from the zone of passage of optical radiation to the photodiode.

The visual observation channel consists of a double-lens eyepiece, a single-lens eyepiece and a mirror. This allows the discharge to be observed and photographed. Channel focusing is performed by moving the eyepiece.

The discharge block contains a glass insulator with a transparent conductive coating applied on one side, which serves as a working electrode. The thickness of the glass insulator is 2.5 mm. The diameter of the working area of the working electrode is 50 mm, the diameter of the free area is 70 mm. The maximum permissible operating voltage supplied to the discharge unit is no more than 25 kV. The test sample is placed on the working electrode (the conductive coating is on the back side) and connected to the common electrode (to the device body) using a needle-shaped electrode.

As a high-voltage generator, an original generator with a voltage of up to 15 kV was used, which provides the generation of pulses with a duration of about 10 - 100 μs with a frequency of up to 1 - 2 kHz. The Tensor-28 television and monitor brightness meter, produced by the Tensor Industrial Plant (Chernivtsi) [17], was used as a measuring unit. The limits of the main relative permissible measurement error of the brightness meter are no more than ± 7%.

A typical digital image of the glow generated by a pill of activated carbon without water is shown in Fig. 2, a digital image of the illumination of water-saturated activated carbon pills, shown in fig. 3. At first look, the "crown" of the glow of a coal pill without water and with water have the same appearance. But in fact, and this is the peculiarity of the proposed method, the difference in brightness between them is from 10 to 30%. The brightness of the glow was measured directly in the gas discharge chamber in real time using a Tensor-28 TV and monitor brightness meter (the limits of the main relative measurement error are no more than ± 7%). The measurements showed the following. Illumination in the conditions of GDV from a pill of activated carbon without water showed a brightness of 14 cd/m^2. In the second case, activated carbon pills saturated with water showed a brightness of 11.3 cd/m^2. The difference, respectively, is about 20%.

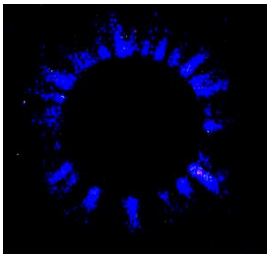

Fig. 2.

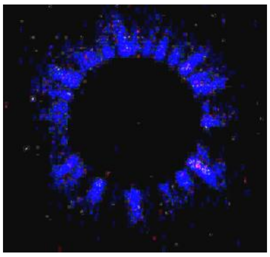

Fig. 3.

Also, a investigation of the brightness of a separate streamer, created by lighting a pill of activated carbon saturated with water (GRV-grams), was carried out. The research was carried out both for the digital image of this streamer displayed on the computer monitor screen, and by measuring the brightness of this streamer using the Tensor-28 TV and monitor brightness meter in real time, at the time of receiving the digital image of the streamer.

The area of illumination in which the streamer fell was chosen to be 8 mm x 6 mm. For this purpose, a program was developed to analyze the brightness of the image on the monitor screen, capable of analyzing individual image objects of a given size.

The values of the brightness of the area were analyzed, as shown in Figure 4. At the same time, the brightness of the black and white background of the image was taken into account, taking into account the corresponding coordinates of their color.

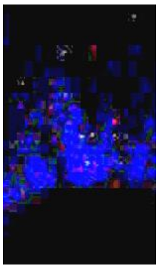

Fig. 4.

First, the brightness of the white background of the monitor screen, L_{Wa}, was measured, which should be at least 250 cd/m^2. The value of the brightness of the white background indicates how close the computer monitor screen is to the requirements [18]. In our case, it was 270 cd/m^2. Then the brightness of the black background of the L_B monitor screen was measured. This measurement is required to determine the effect of background lighting on the results of the investigation. The next measurement is the brightness of the GDV-gram image of the carbon pill L_S. The last measurement is the brightness of the image of the GDV-gram of the carbon pill with water L_W. The resulting L_R brightness value was determined according to the formula:

$$L_R = L_W – (L_B + L_C), \qquad (1)$$

The brightness measurement for one section of the 8 mm x 6 mm GDV-gram was carried out five times. The results are shown in Table 1. As can be seen from the table, the brightness of the image of the GRV-gram of the carbon pill with water L_R ranges from 1.4 to 1.6 cd/m^2. The average brightness value is 1.5 cd/m^2.

Table 1

L_{Wa}, cd/м^2	L_B, cd/м^2	L_C, cd/м^2	L_W, cd/м^2	L_R, cd/м^2
270	0,1	12,7	14,2	1,5
270	0,0	12,5	13,9	1,4
270	0,1	13,1	14,5	1,4
270	0,0	12,6	14,1	1,5
270	0,0	13,2	14,6	1,4

In parallel, in real time, at the moment of receiving a digital image of the streamer, the brightness values of this streamer were measured using a Tensor-28 TV and monitor brightness meter, during discharge. To highlight the area of illumination in which the streamer fell, measurements were made through an aperture measuring 8 mm x 6 mm, as in the previous case to ensure equality of experimental conditions. The distance between the light meter sensor and the surface of the bit gap (3, Fig. 1) was 8 cm, which creates conditions under which the image area of the streamer can be considered as a point object. Brightness measurements were made five times.

Measurements were carried out in three stages. The first one, the surface brightness of the discharge gap was measured during the discharge without the L_0 pill. Then, the brightness created by the carbon pellet without L_S water was measured. And, finally, the brightness of the pill saturated with L_W water was measured. The resulting L_R brightness value was determined according to formula:

$$L_R = L_W – (L_0 + L_C), \qquad (2)$$

The results of the measurements are given in Table 2.

Table 2 2

L_0, cd/м^2	L_C, cd/м^2	L_W, cd/м^2	L_R, cd/м^2
0,0	13,2	14,9	1,7
0,0	13,8	15,4	1,6
0,0	13,6	15,2	1,6
0,0	13,4	15,1	1,7
0,0	13,5	15,1	1,6

As can be seen from Table 2, the measured and calculated values of the L_R streamer brightness for one 8 mm x 6 mm area of illumination according to formula (2) are distributed as follows. The luminance of the carbon pill with water L_R ranges from 1.6 to 1.7 cd/m^2. The average brightness value is 1.65 cd/m^2.

So, we can see that when directly measuring the brightness of the streamer in comparison with measuring its brightness on a digital image (GRV-grams), we have different results. In direct measurements, the brightness values are higher (up to 1.7 cd/m^2) than when investigating the brightness of a digital image of the same streamer obtained at the same moment in time (up to 1.5 cd/m^2). In addition, the total area of illumination from the streamer, which is a light source, during direct measurement and when exploring a digital image (GRV-gram) is almost the same value - 6 mm x 8 mm. But its brightness is different with different methods of its assessment. This difference is 13%, which significantly exceeds the measurement error of the brightness meter (± 7%).

In our case, the object of research was water. However, the method of researching GDV-grams (or more precisely, the digital image of the illumination created by the object of research in the conditions of GDV) is used, as shown above, not only in the investigation of liquids, but also in the investigation of the state of human health [5 - 7]. Therefore, in our opinion, it is worth, at the very least, when calibrating the devices that create GRV-grams, to use direct measurements, which are more reliable, since they are carried out with the help of calibrated measuring equipment.

Conclusions.

Correlational investigation of measuring the brightness of GDV-grams using computer graphics methods and the method of direct brightness measurement using a light meter were carried out.

It is shown that with direct measurements the brightness values are greater than when investigating the brightness of a digital image of the same streamer obtained at the same moment in time. Namely 1.5 cd/m^2 and 1.7 cd/m^2. The difference is 13% and significantly exceeds the measurement error of the brightness meter (± 7%).

The results of the investigation show that direct measurements should be used when calibrating devices that create GDV-grams.

Literature

1. Sharapov V.M. Using the method of gas-discharge visualization for the investigation of the psychophysiological state of man / V.M. Sharapov, S.V. Rotte // Bulletin of the ChSTU. -2008. - № 9. -C. 179-183.

2. Kaznacheev V. P. Bioinformation function of natural electromagnetic fields / V. P. Kaznacheev, L. P. Mikhailov. -Novosibirsk: Nauka, 1985. -246 p.

3. Bilinsky J.J. Research of characteristics of gas-discharge visualization of images of liquid-phase objects / J.Y. Bilinsky, O.A. Pavlyuk, B.P. Knysh // Bulletin of Vinnytsia Polytechnic Institute. Radio electronics and electronic equipment. -2013.- № 1. -P. 178-183.

4. Kolomiets R.O. Analysis of errors of optical systems and image sampling in the registration of GDV images of the total field structure of biological objects in statics / R.O. Kolomiets, V.P. Manoilov, V.A. Rudnytsky // Opto-electronic information energy technologies. -2007. -№ 1. -P. 25-29.

5. Stepovich M.A. The Use of Gas Discharge Visualization for Identifying Structured Peculiarities of Blood Components: Plasma, Platelets, and Erythrocytes / M.A. Stepovich, O.M. Maslennikova, M.N. Shipko, A.L. Sibirev, V.V. Chrishtop //Journal of Cardiology & Cardiovascular Therapy, Juniper Publishers Inc., 2018, vol. 9(4), pages 71-74. DOI: 10.19080/JOCCT.2018.09.555770.

6. Yakovleva E.G. Identifying Patients with Colon Neoplasias with Gas Discharge Visualization Technique / E.G. Yakovleva, O.A. Buntseva, S.S. Belonosov, E.D. Fedorov, K.Korotkov, T.V. Zarubina // The Journal of Alternative and Complementary Medicine. Nov 2015.720-724. doi.org/10.1089/acm.2014.0168.

7. Korotkov K.G. Gas-discharge visualization method in sport bioelectrography / Korotkov K.G., Korotkova A.K. // Theory and practice of physical culture. 2018. № 11. C. 65-67.

8. Popovych, I. Liturgy affects the parameters of gas discharge visualization, acupuncture points and neuro-endocrine-immune complex / I. Popovych, V. Babelyuk, W. Zukow, R. Muszkieta, G. Dubkova, L. Nesterova, V. Hubyts'kyi, V. Bilas, V. Musiyenko, T. Seniv, V. Mis'ko, R. Babylyuk, Y.Yaremchuk, L. Barylyak, A. Gozhenko // *Pedagogy and Psychology of Sport* [online]. 26 April 2020, T. 6, nr 2, s. 61–73. [accessed 16.1.2022]. DOI 10.12775/PPS.2020.06.02.006.

9. DobrovolsciyY.G., PidkaminL.J., PetrencoV.O. Gas-unloadin visualization. Correlation Optics 2009, Chernivtsi, Ukraine, September 20-24, 2009.

10. Y. Dobrovolskiy, Vitally P., L. Pidkamin., Installation for investigation of light activity of the water with the help of surface gas discharge,"TCSET-2010", February 23-27, 2010, Lviv-Slavske, Ukraine.c.343.

11. Ukrainian patent for utility model № 11160 Discharge-optical device. Dobrovolsky Yu.G. The newsletter. № 12, 2005.

12. Babelyuk V.Y. Usage of a gas-discharge visualization for an investigation of a human internal energy / V.Y. Babelyuk, Y.G. Dobrovolskiy, L.I. Pidkamin, I.L. Popovych, Yu.A. Ushenko // Proc. SPIE 11369, Fourteenth International Conference on Correlation Optics, 1136929 (6 February 2020); doi:10.1117/12.2553951.

13. Korotkov K. Kirlian effect / K. Korotkov. -SPb. : St. Petersburg GITMO (TU), 1995. -218 p.

14. Patent of Ukraine for utility model № 77327. Device for control of energy characteristics of optical radiation generated in the conditions of gas-discharge imaging. Dobrovolsky Yu.G., Prokhorov G.V. The newsletter. № 3. 11.02.2013.

15. Patent of Ukraine for utility model № 95769 Switch-optical device. Pryadko V.V., Dobrovolsky Yu.G., Baytsitm A.I., Sayuk. The newsletter. № 1.12.01.2015.

16. Dobrovolsky Yu.G. Method of water structuredness investigation with disruptive-optical device and energy-informational influence on it of an operator / Yu.G. Dobrovolsky, A.I. Gozhenko, V.Ye. Babelyuk, I.L. Popovich // Water: hygiene and ecology №2(1), 2013. -p. 120-134.

17. Tensor-28 TV and monitor brightness meter. Electronic resource. Access mode: https://tenzor.ua/products/izmerenie-opticheskih-harakreristik/pribory-dlya-izmereniya-harakteristik-vidimogo-izlucheniya-parametrov-svetovoy-sredy/tenzor-28/.

18. Medical Electrical Equipment, Part 1: General Requirements for Safety. UL Standard. Summary of Topics . Standard 60601-1, Edition 1 Edition Date: April 25, 2003. Electronic resource. Access mode: https://standardscatalog.ul.com/ProductDetail.aspx?productId=UL60601-1.