# Study of the Relationship between Pulse Duration and the Accuracy of Evaluation of the Critical Frequency of Light Flashing

**V. V. Rozhentsov**

Translated from *Byulleten' Eksperimental'noi Biologii i Meditsiny*, Vol. 136, No. 10, pp. 479-480, October, 2003
Original article submitted April 7, 2003

The relationship between pulse duration and accuracy of evaluation of the critical frequency of light flashing was studied. The accuracy of measurement of this parameter increased if the duration of light pulses decreased. Our results indicate that the optimal duration of light pulses for determining critical frequency of light flashes is 3-5 msec.

**Key Words:** *critical frequency of light flashes; accuracy of measurements*

Determination of critical frequency of light flashes (CFLF), *i.e.* frequency of light flashes per second, at which they fuse and the visual analyzer perceives the source of light as continuously shining is a well-known method of psychophysiological examination. CFLF test is used in ophthalmology, ophthalmoergonomics, physiology, occupational and sport hygiene, and in experimental psychology.

Experimental studies showed that CFLF depended on many factors: parameters of light stimulus, psychophysiological parameters characterizing the status of the organism, environmental parameters.

Changes in CFLF are usually minor by their absolute value, which necessitates improvement of measurement accuracy, *i.e.* the quality of measurement reflecting the approximation of the results to the true value of the measured parameter. High accuracy of measurements corresponds to small errors [2]. The problem of providing accuracy of measurements in ophthalmology has been discussed previously [1], but these studies were not continued.

According to published reports, the majority of the known methods for CFLF determination are based on presentation of light pulses whose length is equal to 0.5 of the period of their presentation, the alteration of the frequency of light flashes involving alteration of the light pulse duration. On the other hand, it is known that CFLF value depends on the duration of the light pulses presented as well [5]. However it seems that the relationship between the duration of light pulses and accuracy of CFLF measurement was never studied.

We investigated the relationship between the duration of light pulses and accuracy of CFLF measurement.

## MATERIALS AND METHODS

CFLF was measured at the light pulses duration equal to 0.5 of period of their presentation and at fixed duration of 5 and 1 msec.

Fifteen trained volunteers aged 18-22 years with normal or corrected vision took part in the experiments. A series of 10 measurements was carried out in every case for each duration of pulses. Binocular measurements were carried out using a device for presenting the light pulses, controlled by an IBM-compatible computer. A yellow photodiode (5 mm in diameter) with light force of 1.5 mCd served as the source of light. The measurements were carried out during the light hours of the day (9.00-12.00).

Statistical processing of the results by a previously described method [4] included estimation of the

Marii State Technological University, Ioshkar-Ola. ***Address for correspondence:*** evs@marstu.mari.ru, rnil-fd@rambler.ru. Rozhentsov V. V.

0007-4888/03/1364-0427$25.00 

**TABLE 1.** Results of Statistical Processing of CFLF Measurements Using Light Pulses of Different Duration

| Pulse duration | Mean arithmetic, Hz | MQD, Hz | MQD decrease, % |
|---|---|---|---|
| 0.5 of presentation period | 42.8±3.1 | 0.344±0.100 | — |
| Fixed, 5 msec | 43.1±3.1 | 0.266±0.065 | 26.2±12.0 |
| Fixed, 1 msec | 42.6±3.0 | 0.220±0.063 | 40.1±19.4 |

mean arithmetic value and evaluation of the mean quadratic deviation (MQD). A decrease of MQD at 5- and 1-msec pulses in comparison with MQD value at pulse duration equal to 0.5 period of its presentation was estimated for each volunteer.

The data were statistically processed using Excel electronic tables.

## RESULTS

Analysis of experimental findings showed that at fixed (5 msec) duration of light pulses in comparison with light pulses whose duration was equal to 0.5 period of their presentation the decrease of MQD was equal to 14.2-38.1%, while at 1-msec pulses this decrease was 20.7-77.5% (Table 1).

On the other hand, experiments showed that the intensity of subjectively perceived flashes decreased if pulse duration was less than 3 msec and this impeded CFLF measurements. Increase of the radiation intensity to the normal subjectively perceptible level is undesirable because of probable injury to the visual analyzer retina [3].

Hence, analysis of experimental measurements of CFLF using light pulses of different duration indicate that light pulses of fixed duration (3-5 msec) should be presented to the examine for evaluation of CFLF.

## REFERENCES

1. I. M. Logai, V. L. Pekelis, G. R. Lerner, and V. I. Serdyuchenko, *Oftal'mol. Zh.*, No. 8, 449-451 (1990).
2. *Metrology. Terms and Definitions* [in Russian], Moscow (1987).
3. P. V. Preobrazhenskii, V. I. Shostak, and L. I. Balashevich, *Light-Induced Injuries to the Eyes* [in Russian], Leningrad (1986).
4. *Direct Measurements with Repeated Observations. Methods for Processing the Results of Observations. Basic Assumptions* [in Russian], Moscow (1986).
5. A. M. Shamshinova and V. V. Volkov, *Functional Methods of Examination in Ophthalmology* [in Russian], Moscow (1999).