уровня интеллекта ПрИС привела к появлению интеллектуальных измерительных средств, которые радикально изменили требования к составу и организации измерительного обеспечения. Отметим, что данный вид измерительных средств предполагает полную формализацию [1] представления используемых и получаемых знаний, гипотетических, идеальных и неидеальных измерительных процедур.

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AUTOMATED FACILITY FOR CALIBRATION OF LUXMETERS/PHOTOMETERS UPF-2

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Introduction. One of the priorities of the Belarusian industrial policy is energy saving. Up to 20% of consumed in the country electricity is used for lighting of streets and buildings. So-called energy saving lamps) are widespread in last years.

The one of the main problems by the assessing of the correctness validity of light source exploitations is the measurements of created illumination.

This value (illumination) is strictly standardized by the number of technical regulations and should be controlled carefully [1-3]. However, all types used in Belarus luxmeters are calibrated or tested against the standard source CIE type A with correlated color temperature T_c = 2856 K, which relative spectral distribution of the radiation power is quite different the spectral distribution of the LED. Theoretical studies show, that by this reason the measurement error of illumination should significantly rise [4-6]. In our previous research was defined, that in the case of changing from CIE type A source to the LEDs illuminance measurement uncertainty in some cases increased [4]. In this case the illuminance relative measurement uncertainty of the luxmeters is not bigger than 4 %, the illuminance relative measurement uncertainty decelerated by the producer is 6% - 10% according to the type of luxmeter.

The nowadays used in BelGIM Facility UPF for calibration of luxmeters are obsolete, the automated Facility for calibration of luxmeters/photometers UPF-2 was created. Facility based on the light source, which includes both incandesced lamps and LEDs.

According to the definition, illuminance (at a point of a surface) is a integral, taken over the hemisphere visible from the given point, of the expression $L_v \cos\theta d\Omega$, where Lv is the luminance at the given point in the various directions of the incident elementary beams of solid angle $d\Omega$, and θ is the angle between any of these beams and the normal to the surface at the given point. Unit: lx = lm·m-2. From other side according the Lambert law the illuminance is proportional the cosine of the angle of the light direction and the illuminance is possible to calculate from the follow equation.

$$E_n = Lv\cos(a) / r^2 \qquad (1)$$

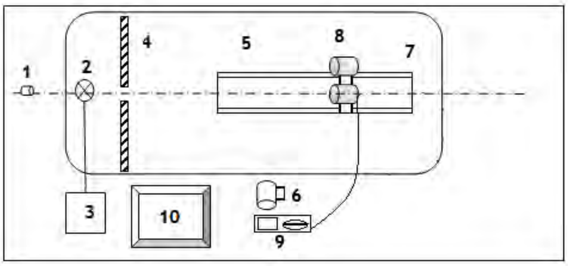
where r – distance to the light source. The most common method of the assessing the measurement error (uncertainty) is the method of substitution, i.e. comparison of measurements of illuminance produced by stable light source done with the standard photometer and the DUT. Thus, the measurement error of the DUT is defined as

$$\Delta E = \frac{\Sigma(E_{iисп} - E_{iэ})}{n} \qquad (2)$$

where $E_{iисп}$ – illuminance measured by the DUT, $E_{iэ}$ – illuminance measured by the standard photometer, n – number of measurements, usually not less than 3.

The required value of illuminance is created by changing the distance from the light source or with use of the neutral attenuator of luminous flux. On the base of the Facility UPF-2the the both methods was decided to use. The block diagram on Figure 1 shows the Facility's structure.

The Facility consists of four units. There are the unit of the linear positioning and the luminous flux adjustment, the unit of electric measurements equipment and standard receivers, the unit of automatic registration of measurement results and the unit of light source based on a combination of a hemispherical light source.



1 - laser pointer; 2 - light source; 3 - power supply of the light source; 4 – attenuators of the luminous flux; 5 - mobile automated platform 8MT295-340-2,5; 6 - a video camera; 7 - automatic mobile platform 8MT175; 8 - standard optical detector and DUT in the holder; 9 - DUT; 10 - a personal computer.

Figure 1 – Block diagram of the automated Facility for calibration of luxmeters/photometers UPF-2

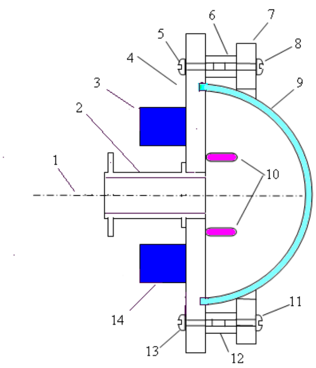
The unit of linear positioning and the luminous flux adjustment. As can be seen from eq.(1) the significant illuminance measurement uncertainty source is the distance to the light source reproduction accuracy. Calculations show, if the distance between the source and detector is 1 meter and the error due to the positioning of DUT is 1cm, the provided illuminance measurement uncertainty is 4%. Also due to the spectral sensitivity of the receiver area non-uniformity (which is especially important for receivers with the large area, such as the luxmeters type U-116),the precise positioning of the light spot in the same place of the photodetector is important.

In connection with the foregoing, we have decided to create (build-up) the linear positioning and regulation of luminous flux unit. This unit is based on Motorized Linear Stages 8MT295-340-2,5 and 8MT175 (Standa, Lithuania). These translators allow the linear movement of the DUT and the standard photodetector in 2 perpendicular planes with the 12.5 micrometers accuracy and the high reproducibility. The illuminance regulation without the moving of the photodetectors is performed by using the automated iris diaphragm and 3 neutral attenuators from frosted glass, which are mounted on the revolving holder. The moving of the photodetectors with the respect to the light source, the disclosure of the iris diaphragm and insertion of the attenuators is carried out automatically under the control of Facility's software. The range of the produced illumination together with the hemispherical light source (HLS) is from 0.1 to 40 000 lux.

The unit of electric measurements equipment and standard receivers. Unit of electric measurements equipment and standard receivers consists from photometer head LMT P30 SCT (dynamic range of the measurement illuminance from 0.00001 to 100 000 lux, f1≤ 1.0%, extended standard illuminance measurement uncertainty ≤ 0,8%), and a digital multimeter Keithley 2100.

The unit of automatic registration of measurement results. Most common types of luxmeters in our country are: ТКА-ПКМ, ТКА-Люкс (Russia) and the photometer-brightnessmeter ТЭС 0693 (Ukraine). The design peculiarity of these devices does not allow connecting them directly to the electrical equipment of the Facility or to the computer. In this regard, for automatic registration of measurement results we have created a new software and hardware. The unit includes the video camera for recording the measurement information directly from the display panel of luxmeter and the program for its recognition. The data, together with the results of the measurements received from the standard receiver are processed with software and displayed on (the computer display) as finished protocol with the conclusion pass / not pass.

Unit of light source based on a combination of a hemispherical light source. On the picture are demonstrated the structure chart of created HLS, which consists of a hemisphere and a reflector. The inner surface of the hemisphere is coated with barium sulfate. The ratio of the hemisphere diameter to the diameter of the output aperture ration is 5/1. [5] According to test results HLS showed high stability and reproducibility. Drift of illuminance produced per 3 hours is not higher than ± 0,25%. The unevenness of the light spot at a distance of 0.5 m was 2.23%. Correlated color temperature to 2863 K. [5]



1 – optical axis of the HLS; 2 – tube; 3, 14 – cooling radiators; 4 – circuit board of the HLS; 5, 8, 11, 13 – screws; 6,12 – pillars; 7 – ring; 9 – hemisphere; 10 – light sources

Figure 1 – Construction of the HLS

Conclusion. It was founded that the Facility has high performance and metrology characteristics. Due to the implementation of automation measurement the uncertainty was reduced. It was provided the possibility of calibration of photometers against energy-efficient light sources with the Facility spectral distribution of the radiation power. The safe implementation of the energy-saving light sources is provided on this work, and it is an important part of ensuring the uniformity of measurements of light sources with a Facility spectral distribution of the radiation power. The patents for a utility model of the created Facility and a hemispherical radiation source are received.

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ОПРЕДЕЛЕНИЕ ГЕОГРАФИЧЕСКОГО ПРОИСХОЖДЕНИЯ ВИНОДЕЛЬЧЕСКОЙ ПРОДУКЦИИ ИЗ ВИНОГРАДА С ПОМОЩЬЮ МНОГОПАРАМЕТРИЧЕСКОГО АНАЛИЗА СПЕКТРОВ ПРОПУСКАНИЯ

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В странах, являющихся лидерами производства высококачественного вина в Европе (Италия, Испания, Португалия, Германия и в последнее время Россия), большое внимание уделяется совершенствованию методов контроля качества продукции из винограда. В этой связи объективная оценка возраста выдержки вина и виноматериалов [1], идентификация производителя [2] и географического происхождения напитка [3] являются актуальной проблемой.

В основе классификации виноградных вин в странах ЕС лежит региональное происхождение и качество. Молдавское виноделие также продвигается к производству вин, бренди, дивинов (коньяков) и других напитков с географическим указанием и наименованием по месту происхождения.

Установление региональной принадлежности вин и других винодельческих продуктов при их ассортиментной идентификации – достаточно сложная задача. Для ее решения применяют различные методы. Один из них основан на исследовании большого массива данных (переменных) об объектах хемометрическими методами, позволяющими найти скрытые взаимосвязи между этими переменными и правильно определить вклад каждой из них в статистическую модель, целью построения которой является решение идентификационной и/или классификационной задач. Чаще всего в этих случаях применяются метод главных компонент (МГК [4]), дискриминантный анализ (ДА [5]), искусственные нейронные сети (ИНС [6]), метод формального независимого моделирования аналогов классов (SIMCA [7]), кластерный анализ (КА [8]) и др.

В нашей работе исследована выборка молдавских дивинов (коньяков), содержащая 24 образца от двух географически различающихся производителей. Спектры пропускания дивинов были зарегистрированы с помощью запитываемого от USB-порта компьютера портативного спектрометра OceanOptics USB-650 VIS-NIR (см. рис. 1) (диапазон длин волн от 350 до 1000 нм, детектор с 650 активными элементами (650 значений на один полный спектр, или 1 значение на 1 нанометр), входная щель шириной 25 мкм обеспечивает оптическое разрешение около 2 нм).

Рисунок 1 – Спектрометр OceanOptics USB-650