Міністерство освіти і науки України
Сумський державний університет
Факультет іноземної філології
та соціальних комунікацій

IX

ВСЕУКРАЇНСЬКА НАУКОВА КОНФЕРЕНЦІЯ

СОЦІАЛЬНО-ГУМАНІТАРНІ АСПЕКТИ РОЗВИТКУ СУЧАСНОГО СУСПІЛЬСТВА

15-16 квітня 2021 року

Матеріали

Отже, професійно орієнтовані тексти, на думку багатьох дослідників, задовольняють інформаційно-пізнавальні потреби студентів, служать опорою для стимулювання навчальної мовленнєвої взаємодії студентів на професійну тематику та доповнюють їх знання з фаху. Тексти фахового спрямування є джерелом для розширення фахового термінологічного словника, предметом читання та обговорення на заняттях, основою для використання в ситуаціях мовлення, для аудіювання, тобто для цілеспрямованої і продуктивної мовленнєвої діяльності студентів.

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Mykola Nikonov,
student of Sumy State University
Igor Kramskyi,
student of Sumy State University

DEVELOPMENT OF ALGORITHMS FOR MEASURING NONSINUSOIDALITY VOLTAGE AND TEMPORARY OVERVOLTAGE

Today, operating electrical networks, low and high voltage devices, and engines cause incidents that are characterized by the deviation of parameters from the

nominal values. Yet, due to switching of the load cause temporary overvoltages. Besides, emergency modes caused by power outages and sudden failure of equipment of consumers, additionally cause the temporary overvoltages. On the other hand, the operation of powerful consumers: melting furnaces, frequency converters, and even household appliances significantly affect the non-sinusoidal voltage, which is characterized by the coefficient of the n-th harmonic component of the voltage and the coefficient of distortion of the sinusoidal voltage curve.

The topicality of the paper is determined by the importance of developing automated measuring systems to calculate the basic parameters of voltage using digital devices for collecting and processing data in real-time. Why are these parameters so important?

All-electric installations, engines, and devices are rated for the set values and deviation of these parameters beyond the normalized limits leads to economic losses. Besides, deviation of these indicators of quality of the electric power from limit values, influences work of the power electric equipment, relay protection and even on systems of the account of the electric power. Changing these indicators additionally affects the loss of active and reactive power, reducing the service life of electrical insulation, the creation of electromagnetic interference, which is negative for the automation and protection systems. Therefore, the development of automated measuring systems for electricity quality indicators using digital devices for real-time data collection and processing is an urgent task.

The purpose of this paper is to develop a measuring system for determining the coefficient of the n-th harmonic component of the voltage, the coefficient of distortion of the sinusoidal voltage curve and the temporary overvoltage following DSTU using the data collection device National Instrument USB-6009 and software package MatLab.

Necessary parameters for calculating the coefficient of the n-th harmonic component of the voltage and the coefficient of distortion of the sinusoidal voltage curve are the harmonic voltages of the output signal. To determine these parameters,

we use the fast Fourier transform (FFT) method, and the additional Quinn's Estimator method to increase the accuracy of the frequency and voltage amplitude [2, p. 815].

Their main idea of FFT is to decompose one periodic output signal into the sum of several sine functions. The result of this decomposition is the amplitude-frequency spectrum where each spectral component is represented as a row, the horizontal position of which corresponds to its frequency and the height to its amplitude. This method remains a filter through which it is possible to pass a mixture of a liquid and receive separate components from which it would consist [1, p. 2]. Moreover, the number and proportions remain the same. But this method has a big error. This is happening due to the multiplicity of time between the measurements of the signal to its period [2, p. 815]. In other words, the FFT cannot accurately determine the frequency when its maximum does not match with the maximum of the voltage spectrum. To increase the accuracy in determining the frequency, it is necessary to use the additional methods, such as Jacobsen's Modified, Quadratic Estimator, Quinn's Estimator, Quinn's Second Estimator, Macleod's Estimator, Grandke's method, Parabolic Interpolation, Gaussian Interpolation [2, p. 15]. The essence of these methods is to find the intermediate values of the series that we have. In other words, to finish building sine intermediate values, and this correction does not change the structure of the signal. In our work, we use Quinn's Second Estimator. This method allowi to build up only three points near the maximum of the signal and finds the frequency with less error.

Thus, using these methods allows us to obtain the amplitude-frequency spectrum. Using this spectrum, we find amplitudes and frequencies of 40 harmonics and write them to separate array [3, p. 16]. After that, we calculate the coefficient of the n-th harmonic component of the voltage and the coefficient of distortion of the sinusoidal voltage curve, as the average value of the voltage U_n of each harmonic during a short time of interval which equals 3 seconds. The number of observations during this period should be at least 9.

The quality of electrical energy by the coefficient of the n-th harmonic component of the voltage and the coefficient of distortion of the sinusoidal voltage

curve is considered to comply with the standard if the largest of all the values of the distortion coefficients measured for 24 hours does not exceed the maximum limited value [3, p. 17].

At the same time, the quality of electrical energy by the coefficient of the n-th harmonic component voltage is considered to comply with the standard if the total duration of the time for going beyond the normally permissible values is no more than 5% of the set period, that is 1 hour 12 minutes, and for the maximum permissible values - 0% of this period of time [3, p.18].

The temporary overvoltage coefficient K and its duration Δt are used to analyze the quality parameter of the temporary overvoltage electricity. To determine them, an algorithm developed in the MatLab software package according to DSTU EN 50160: 2014 is used [4]. The operation of the algorithm begins with the division of the output signal into intervals. The magnitude of such intervals is equal to the half-period. After that, at each interval, the measured voltage amplitude is compared with the nominal voltage amplitude. Deviation of the measured value of the voltage amplitude beyond the limit value indicates that a temporary overvoltage has occurred in the network [3, p. 22]. The time of the beginning of overvoltage is fixed on the investigated interval. Next, using the developed algorithm we determine the maximum value of the voltage amplitude at subsequent intervals and their values are recorded in a separate array. The end of the overvoltage is defined as the decrease of the voltage amplitude at a certain interval to the nominal value and if in the next half-period the maximum value of the voltage amplitude does not exceed the limit value [3, p. 22]. After that, the overvoltage duration Δt is calculated as the difference between the end time and the overvoltage start time, and the time overvoltage factor K. To calculate the time overvoltage factor, first determine the maximum value of the voltage amplitude Umax in the data set in which the program recorded the voltage value at each interval. After that, the value of the temporary overvoltage factor K is calculated as the Umax divided by the rated signal voltage [3, p. 22].

In conclusion, it should be noted that while operating engines and devices there might be incidents that are characterized by the deviation of parameters and the question

of compensation energy directly depends on how accurately we measure and calculate the amplitude and frequency of the harmonics and determine the temporary overvoltage.

In this paper, we developed the program that allows to record input signal and to calculate with high accuracy the deviations of the indicator's quality of electricity and the algorithms in order to find non-sinusoidal voltage and temporary overvoltage and to save data for future additional analyses. Besides, using measured data, recommendations can be made for optimizing the operation of electrical networks, to eliminate undesirable phenomena by various consumers and reduce electricity losses in distribution networks.

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Academic adviser: A. M. Diadechko, PhD in Philology, Associate Professor of foreign languages department, Sumy State University

Євгенія Бурнос,

старший викладач кафедри мовної підготовки іноземних громадян

Сумського державного університету

Мохамед Разі,

студент Сумського державного університету

ПРОФЕСІЙНА КОМУНІКАТИВНА КОМПЕТЕНТНІСТЬ ІНОЗЕМНИХ СТУДЕНТІВ-МЕДИКІВ

Мета дослідження: охарактеризувати мовнокомунікативні навички як складника професійної компетентності іноземних студентів медичних