Journal of Technical Science & Technologies; ISSN: 2298-0032; e-ISSN: 2346-8270; Volume 5, Issue 2, 2016

Identification of Two Sorts of Processes and Determining of Their Differences Criteria

Zaal AZMAIPARASHVILI*
Nona OTKHOZORIA**
Alexander MALTSEV***
Merab POLADASHVILI****

Abstract

The article shows the approach to the development of criteria for evaluating the differences between the two varieties of the processes that occur in the generation of high-power output pulses of various power devices, such as wireless electricity transmitting devices. In the proposed article, the method also allows to obtain a quantitative estimation of power parameters of the analyzed device. The mathematical expression was founded the characteristic parameter and signal processing.

Keywords: Wireless Power Transmission, Deterministic Processes, Fisher Test.

Introduction

In recent years a wireless electricity transmission has become topical. Several wireless power transmission devices have been created and for one of them a patent was taken (Georgia Patent No. P 6089, 2012).

During experiments on wireless power transmission, we faced the need of studying and obtaining information about the processes occurring during electricity transmission; namely, the process of accumulation and releasing energy to generate power output of pulses at which high voltage in the range of tens of kilovolts (KVs) is generated. These devices must meet the following requirements: high energy density; high electric strength; the ability to provide high current discharge; the duration of the energy storage (small leak rate); high efficiency during charging and discharging; high power multiplication factor (the ratio of the discharge to the charge power); ability to work with repetition pulses; durability, etc. (Bluhm, 2006).

Obviously, some of these requirements contradict each other. Depending on the field of application and the particular restriction, it is necessary to look for certain compromises. We turned to indirect acoustic research methods. To control these processes, we used a piezoelectric acoustic transducer, which allowed to observe the process of accumulation and release of energy, by measuring certain parameters of acoustic signals that high-voltage discharge radiates. The information can be compared with the place process, for example, counting the number of generated high-power pulses in a certain period of time, estimating the power of the energy radiation, and contributing in evaluation of the efficiency of the device.

Methodology

To perform the experiments above, a microprocessor device that provides a digital processing of investigated low frequency signal was used.

The microcontroller includes an analog-to-digital converter, with which the analog signal is converted to a digital form. The digitization of the test signal over timetakes place at a constant pitch sampling Δt. Conversion results in a digital (binary) code are written to the internal flash memory of

*Prof. Dr., Faculty of Informatics and Control Systems, Georgian Technical University, Tbilisi, Georgia. E-mail: z.azmaiparashvili@gtu.ge
**Prof. Dr., Faculty of Informatics and Control Systems, Georgian Technical University, Tbilisi, Georgia. E-mail: n.otkhozoria@gtu.ge
***Prof. Dr., Faculty of Informatics and Control Systems, Georgian Technical University, Tbilisi, Georgia. E-mail: man030149@gmail.com
****Ph.Dc., Faculty of Informatics and Control Systems, Georgian Technical University, Tbilisi, Georgia.
E-mail: intecgeorgia@gmail.com

the microcontroller. The data are then evaluated. Some statistical parameters of the test process are the calculation of the minimum and maximum values of a series of observations; the range, amplitude, mean value, and the deviation from the mean.

Below, the graphs of two processes are presented (Fig. 1,2).

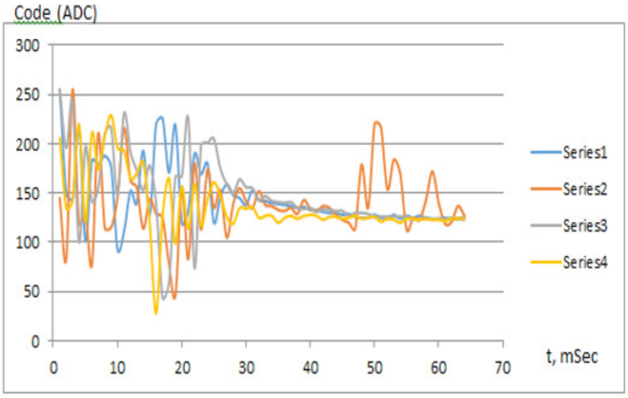

Figure 1. *Series of observations of the first process*

Our aim was to develop criteria for evaluating the differences between the two varieties of processes, allowing to identify and to quantify the observed processes.

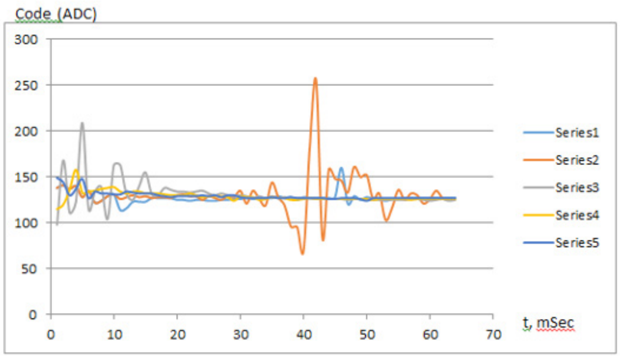

Figure 2. *Series of observations of the second process*

In statistics, there are different algorithms homogeneity criteria for the two observed groups. Fisher test was used to verify these groups. According to this criterion, the uniformity of the group could not be established, as the average values and the corresponding dispersion did not differ significantly from each other (Zedginidze, 2000).

For the qualitative assessment of the observed processes, we have developed the algorithm for calculation of the characteristic parameter of the process S, determining the value of the criteria for different kinds of deterministic processes. We compiled a program that performs sampling of the input signal and calculates the specified parameter as follows:

1) $$S = \frac{1}{n}\left[\sum_{i=1}^{n} |(x_i - 127)| + B_1 + B_2\right]$$

where xi are the values of the quantized signal at a point t_i, “127” is an average value of the signal in accordance with the code of analog-to-digital conversion, n is the number of observations, B1 and B2 additional components whose values are determined by the frequency components, the upper UH and lower UL levels. B1 and B2 values for the following expressions are:

(2) $$B_{1j(xj)} = \begin{cases} 0, & x_j < UH \\ |x_j - 127|, & x_j \geq UH \end{cases}$$

(3) $$B_1 = \sum |x_j - 127| \; i < j < n$$

and similarly the lower level

(4) $$B_{2j(xk)} = \begin{cases} 0, & x_k < UL \\ |x_k - 127|, & x_k \geq \mathrm{UL} \end{cases}$$

(5) $$B_2 = \sum |x_k - 127| \; i < k < n$$

As a result, using expression (3) and (5) additional components B1 and B2 are calculated, that are shown in expression (1). The characteristic parameter of the process S is also calculated.

Through repeated experiments, we get a data set of characteristic parameter S_i, (i = 1, N), where N is the number of experiments conducted. On the basis of the resulting data set Si which is defined criteria to distinguish values kd. In addition, the program includes indicating index m, taking only two values - 0 and 1. The value of indicating index depends on the criteria kd value. Provided that if S <kd, the process under study belongs to the accumulation process and the parameter of the indicator is zero (m = 0), and if S>kd, the process under study belongs to the process of the release of energy (level) and the indicator index becomes equal to unity (m = 1). Observing the values of m and counting the number of received pulses Km of the internal microcontroller counter in unit time t, we receive quantitative assessment - power estimated parameter of generated output pulses - P = Km / t .

Thus, the calculation of the characteristic parameter S and the determination of difference criterion value kd allowed us to identify and distinguish between the process accumulating (charge) power and the process releasing (discharge) energy. Observing the values of the indicator index m and the production of the pulses in a certain time t through the microcontroller internal counter allowed quantification of the rate of the output power pulses which are generated by analyzed device.

Journal of Technical Science & Technologies; ISSN: 2298-0032; e-ISSN: 2346-8270; Volume 5, Issue 2, 2016

Conclusion

Thus, this approach has allowed to work out ways of finding a distinctive criterion of different types of deterministic processes and to identify quantitative index of the signals. Result of the experiments and analysis have proven the correctness of the criterion of the differences between the two processes.

References

Azmaiparashvili, Z., & Poladashvili, M., & Meskhidze, N. (2012). *Georgia Patent No. P 6089.*

Bluhm, H. (2006). *Pulsed power systems. Principles and Applications.* Berlin, Germany: Springer-Verlag Berlin Heidelberg.

Zedginidze, I. (2000). *Organization and Planning of Engineering Experiment.* Tbilisi, Georgia: Georgian Technical University.

Jeevanjee, Nadir. *An introduction to tensors and group theory for physicists*. Birkhäuser, 2011.

Pinedo, M. *Scheduling Theory, Algorithms, and Systems.* Springer, 2016.