ISSN 2413-1032

International Scientific and Practical Conference "WORLD SCIENCE"

№ 10(14), Vol.1, October 2016

Proceedings of the III International Scientific and Practical Conference "Topical Problems of Modern Science and Possible Solutions (September 28 – 29, 2016, Dubai, UAE)"

Copies may be made only from legally acquired originals.
A single copy of one article per issue may be downloaded for personal use (non-commercial research or private study). Downloading or printing multiple copies is not permitted. Electronic Storage or Usage Permission of the Publisher is required to store or use electronically any material contained in this work, including any chapter or part of a chapter. Permission of the Publisher is required for all other derivative works, including compilations and translations. Except as outlined above, no part of this work may be reproduced, stored in a retrieval system or transmitted in any form or by any means without prior written permission of the Publisher.

Founder –
ROSTranse Trade F Z C company,
Scientific and Educational Consulting Group "WORLD Science", Ajman, United Arab Emirates

http://ws-conference.com/

Publisher Office's address:
United Arab Emirates, Ajman

Amberjem Tower (E1)
SM-Office-E1-1706A

E-mail: worldscience.uae@gmail.com

Tel. +971 56 498 67 38

The authors are fully responsible for the facts mentioned in the articles. The opinions of the authors may not always coincide with the editorial boards point of view and impose no obligations on it.

CONTENTS

ENGINEERING SCIENCES

TRANSPORT

THE ANALYSIS OF SUGAR PLANT AS A COMPLEX NONLINEAR AND DYNAMIC OBJECT OF CONTROL

Candidate of technical science, Professor, Kishenko V.
PhD student, Sych Maryna

Ukraine, Kyiv, National University of Food Technologies

Abstract. *For the efficient control of the technological complex of a sugar plant, as a complex nonlinear control of object is necessary to analyze time series of algorithms using of nonlinear dynamics, namely to determine the Hurst exponent, correlation dimension and recovery phase space.*
Keywords: *nonlinear dynamics, fractal analysis, sugar plant.*

Significant importance, especially in the chaotic of the processes are inherent to the sugar plant, obtain methods of the fractal analysis. One of the methods of fractal analysis is method that based on the algorithm R / S - analysis of the time series.

For the classification system can be used the calculating of the correlation dimension or receive Hurst exponent [1]. Correlation dimension Dc, based on calculating of the correlation integral is an important quantitative characteristic attractor that carries information about the complexity of the behavior of dynamic systems.

The correlation integral C (r) calculates the average disagreement between the points of reconstructed phase space, whose coordinates are the values of the time series with the increasing number of delays over time. If the time series is fully determined, its behavior is determined by some dependencies that have k variables. Then with the increasing the order of delay the order of growth the

correlation integral will be stabilized between the number k and k + 1, and it's will be taken as evaluating of the fractal dimension of time series. If a range is chaotic and random, the order of ascending of the integral of correlation is increases by about the same rate as the dimension of the phase space.

The function C (r) for each r is equal to normalized to the number of pairs of points under consideration set (object), the distance between them does not exceed r

$$C(r) = \frac{1}{n^2} \sum_{\substack{i,j=1 \\ i \neq j}}^{n} H(r - | y_i - y_j |) \quad , \qquad (1)$$

where the Heaviside function H (x) = 0 if x <0; H (x) = 1 if x ≥ 0, for all pairs of values i and j, if i ≠ j, | yi - yj | - the absolute value of the distance between the points of the set, i, j = 1,2,3, ..., n, where n - the number of points. The size of amount depends on r, and C (r) ~ rDc, where Dc - correlation dimension. For practical calculation of dimension on graphics ln (C (r)) = f (ln (r)) it's allocated area of linear dependence (area scaling) and the function is approximated straight line by least squares. Then the slope of graph is the dimension Dc [2].

Fig. 1 shows the determination of the correlation dimension time series for digestion (sugar content in beets).

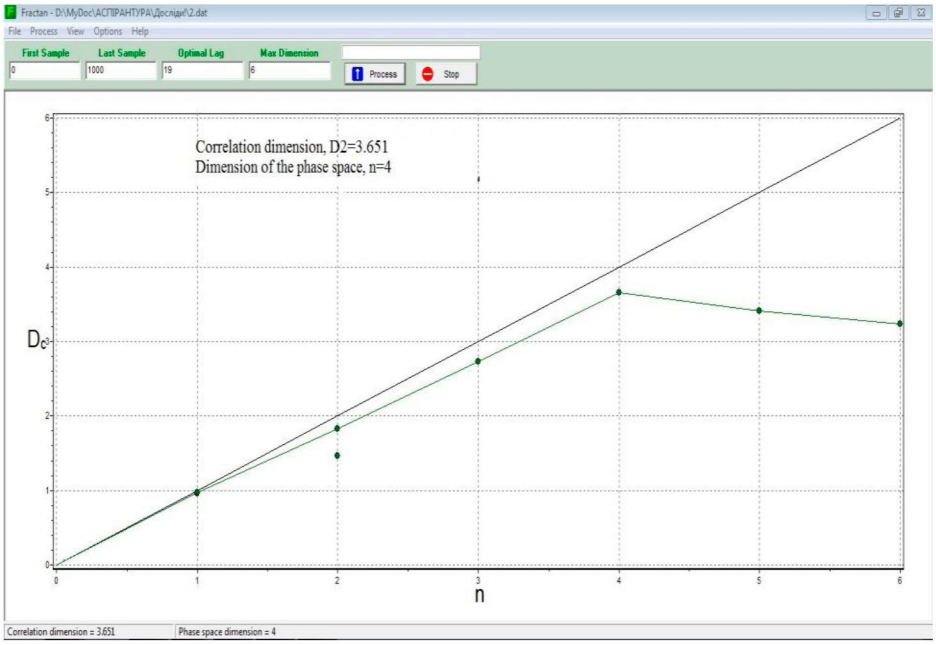

Fig. 1. The definition of correlation dimension of time series for digestion

Table 1 shows the values of correlation dimensions and corresponding dimensions phase space digesting quality indicators, obtained in the study of historical time series data for the week of work.

Table 1. The dependence of correlation dimension on the dimension of embedding

Day	Correlation dimension, D2	The dimension of the phase space, n
1	3.651	4
2	4.947	5
3	4.373	6
4	2.943	3
5	4.089	5
6	4.784	8
7	4.863	8

Calculating Hurst exponent carried out using the method normalized scale (Rescaled Range (R / S) Analysis). The main purpose of calculating Hurst exponent is to determine the long-term correlation in the time series, and the identification of its fractal structure. Also we note that using the R / S-analysis can identify existing statistical systems in dynamic cycles [3].

In accordance with the value of Hurst exponent index H, all time series can be classified into three types [4]

- anti-persistent time series (0 <H <0.5);
- random time series (H = 0.5);
- persistent time series (0.5 <H <1).

Research conducted Hurst exponent index values in the software environment - Fractan (Figure 2).

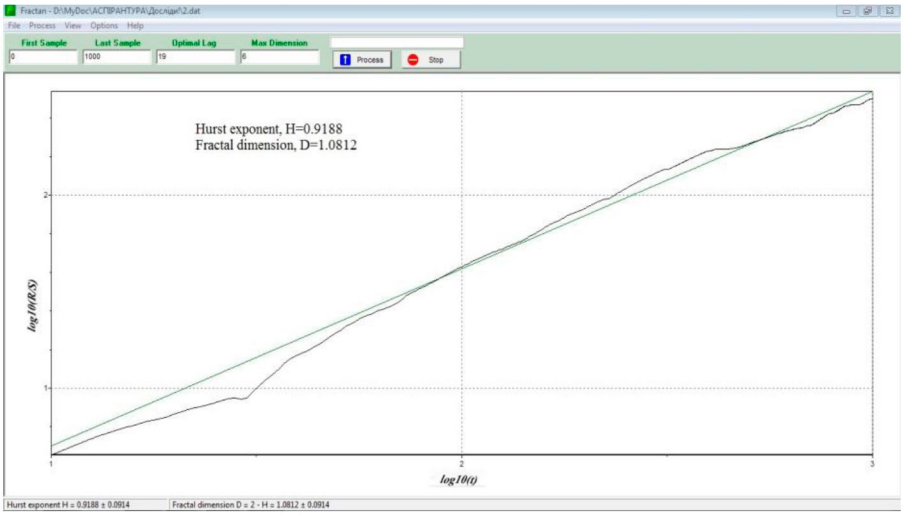

Fig. 2. The determination of Hurst exponent based on analysis of time series for digestion

Table 2 shows the values of fractal dimension and Hurst exponent quality indicator digestion obtained in the study of historical time series data for the week of work.

Table. 2. The calculation of Hurst exponent for digestion

Day	Hurst exponent, H	Fractal dimension, D
1	0.9188	1.0812
2	0.6160	1.3840
3	0.9599	1.0401
4	0.9703	1.0297
5	0.9720	1.0280
6	0.9607	1.0393
7	0.6749	1.5392

Based on the results, we can conclude that the nature of the processes taking place in the technological complex of the sugar plant have the persistent type (0.5 <H <1).

As a result of theoretical and experimental studies established that the nature of the processes taking place in the technological complex of the sugar plant obey the laws of the theory of dynamical chaos.

Established that the object is significantly nonstationary, so efficient control is necessary to use adaptive algorithms where using the methods of nonlinear dynamics are identified the critical variation.

REFERENCES

1. T. Sauer, J. Yorke, M. Casdagli, Embedology // J. Stat. Phys. 65, 579 (2007).
2. Peters, E.E.(1991). Chaos and Order in the Capital Markets, New York, John Wiley and Sons, 1991.
3. Nerenberg M.A., Essex C. Correlation dimension and systematic geometric effects.// Phys.Rev. A 42, 7605 (2005).
4. Mandelbrot B.B. The fractal geometry of nature/ B.B. Mandelbrot — San Francisco: Freeman, 2002. — 468 p.