

Fractal analysis as a method of creating the subsystem for monitoring the automation process

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Introduction. The fractal dimension D_f is the main characteristic of a fractal object. D_f represents the property of the large-scale invariance of the analyzed sets of values.

The idea of fractal dimension lies in the non-traditional representation of the scale and dimension. It was introduced for the first time as a coefficient that describes geometrically complex forms for which details are more important than a complete picture [1;2].

Materials and methods. The synthetic method and the theory of deterministic chaos were used to solve the problem of forecasting and monitoring the automation system on example of rectification system. An analysis of time series was performed using the normalized Hurst coefficient [1;2].

Results. If the Hurst coefficient is in the range (0.5; 1) or even above, then this suggests that the experimental parameters are not trendy and the changes in the trend of the parameters most likely are not expected. In other words, the system will be stable. Under the condition that the Hurst coefficient equals 0.5, then this indicates that the parameters might change according to the normal distribution law. Supposing that the Hurst coefficient is in the range [0; 0.5], in this case this suggests that the trend change is more likely than the saving of tendency of behavior of the parameters[1;2].

In our experiment, the Hurst coefficient characterizes the tendency of changing the steam consumption at the rectification installation. The experimental data were time series of changing the steam consumption at the rectification installation that were measured for 500 hours of working process.

As the result of experiment, the Hurst coefficient was ($H = 1.0282$) on the fractal dimension ($D = 2 - H$). As you can see, it is above 1, that means that this time series is trendy, so the system will continue its work with the same tendency and will remain stable with a maximum high probability.

Conclusions. Therefore, from this experiment, you can see how the parameters of the system behave. With this method, you can predict their future activity. Based on the obtained data, you can evaluate the behavior of the system as a whole process, during certain intervals of time with further optimization of the use of resources and the improvement of the system stability. This method perfectly works with all types of systems of automation, especially when they are in critical situations. You can use it as subprogram for monitoring and prediction for the SCADA system or for more sensitive regulator setting.

Using the fractal analysis does not require special costs of resources or changes in the structure of the automation system; it can also be applied as a separated subsystem. It can optimize the system at the right time intervals that significantly reduces the cost of resources and raw materials and will slow down the depreciation of equipment.

References.

1. Кроновер Н.М., Фракталы и хаос в динамических системах. Основы теории. / Н.М. Кроновер // М.: Постмаркет, 2006. – 352 с.
2. Дубовиков М.М., Локальный фрактальный анализ временных рядов / М.М. Дубников, А.В.Крянев, Н.В.Старченко // Сборник научных трудов научной сессии МИФИ, Москва, 2005.