THE ROUGHNESS OF MEASUREMENTS IN MEASUREMENT SYSTEMS DETERMINATION OF ERRORS IN THE "THREE SIGMA" METHOD

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ABSTRACT: *The article describes the practical limitations of the method of "three sigma" and mathematical processing phase, in order to identify gross errors due to the multiple measurements performed in the measuring systems based on mathematical apparatus.*

KEY WORDS: *practical limitation, measuring system, "three sigma", identify gross errors, multiple measurement, metrological certification*.

INTRODUCTION

In the stages of mathematical processing of the measurement results in the multiple measurements performed in the measurement systems related to the periodic inspection (comparison, metrological certification) of the measuring instruments used in the field of communication, information and telecommunication technologies within the sphere of influence of the state metrology inspection and control and in the performance of scientific research works error detection is required.

RESEARCH METHODS

In addition, the presence of gross errors in the results of multiple measurements leads to unreliability of the measurement results and the limits of the confidence interval, so mathematical processing of the measurement results It is necessary to use statistical methods to identify and eliminate gross errors based on data [1].

RESULTS AND DISCUSSIONS

Errors in the implementation of this goal the "three sigma" method based on the normal distribution law is the simplest statistical method. In this work, the use of the "three sigma" method in a limited number of separate measurements (n≥10) and gross errors existence [2]. The analysis was carried out in order to determine. The analysis is as follows performed in sequence:

Initially "three sigma" method is expressed.

$$\Delta_{max} = 3 \cdot \delta \quad (1)$$

where Δmax is the maximum error in absolute magnitude;
∂˜ is the root mean square error of measurement results.

$$\Delta_{max} \approx O_{max} = x_{min/max} - \tilde{A} \quad (2)$$

where O max is the deviation of the results of individual measurements from the measurement results with the maximum value (by absolute magnitude);
xmin max - maximum values of individual measurement and minimum results;

Ã - the result of measurements (average arithmetic of the results of individual gauges)

$$\tilde{A} = \frac{\sum_{i=1}^{n} x_i}{n} \quad (3)$$

where x is the result of the í th individual measurement;

n is the number of individual measurements. $\delta = S = \sqrt{\frac{\sum_{i=1}^{n} O_i^{2}}{n-1}}$ (4)

where S is the mean square deviation of individual measurement results;
O is the í th individual measurement deviation.

$$O_i = x_i - \tilde{A} \quad (5)$$

According to (2) and (4), the greater the number of observations n, the greater the degree of convergence of , and , to S. Taking into account (2) and (4), we change the expression (1): (6)

The expression (6) is exactly the practical method of "three sigma" and is defined as follows: if

If the maximum deviation of individual measurements from the measurement result by module (from the arithmetic mean) exceeds three times the value of the root mean square deviation of individual measurement results, then such individual measurements are rough will have errors and the results of such measurements will be discarded.

We find the value of the number of separate measurements n. In this case (6) is expression (2). • (3). Given formulas (4) and (5)., $x_{min/max}$ The ratio of the value of individual measurements to the arbitrary one is only conditional on infinity when the module is x i aspired to $x_{min/max}$ the ratio is a gross error.

$$\left|\frac{x_{min/max}}{x_i}\right| \to \infty \qquad (7)$$

then the measurement result (arithmetic average of the results of individual measurements) will be equal to:

$$\tilde{A} = \frac{\sum_{i=1}^{n} x_i}{n} = lim\left|\frac{x_{min/max}}{x_i}\right| \to \infty \frac{(\sum_{i-1}^{n-1} x_i) + x_{min/max}}{n} = \frac{x_{min/max}}{n} \qquad (8)$$

The maximum deviation of individual measurements from the measurement result by module:

$$O_{max} = x_{min/max} - \tilde{A} = x_{min/max} - \frac{x_{min/max}}{n} = \frac{x_{min/max} \cdot (n-1)}{n} \qquad (9)$$

Deviation of the í individual measurement:

$$O_{max} = x_i - \tilde{A} = lim\left|\frac{x_{min/max}}{x_i}\right| \to \infty \left(x_i - \frac{+x_{min/max}}{n}\right) = -\frac{x_{min/max}}{n} \quad (10)$$

Deviation of individual measurement results from the root mean square value:

$$S = \sqrt{\frac{\sum_{i=1}^{n} O_i{}^2}{n-1}} = \sqrt{\frac{\sum_{i=1}^{n-1} O_i{}^2 + O_{max}^2}{n-1}} = \sqrt{\frac{\sum_{i=1}^{n-1}\left(-\frac{x_{min/max}}{n}\right)^2 + \left[\frac{x_{min/max} \cdot (n-1)}{n}\right]^2}{n-1}} = \sqrt{\frac{\frac{\left(-\frac{x_{min/max}}{n}\right)^2 \cdot (n-1)}{n} + \left[\frac{x_{min/max} \cdot (n-1)}{n}\right]^2}{n-1}} = \frac{x_{min/max}}{\sqrt{n}}$$
(11)

Based on the obtained relations (9) and (11), we write the expression (6) in the following form:

$$(n-1)\cdot\frac{x_{min/max}}{n}=3\cdot\frac{x_{min/max}}{\sqrt{n}} \quad (12)$$

After changing the expression (12), we get the following inequality:

$$n^2-11n+1>0$$

The n-natural solution of this inequality is n ≥ 11.

CONCLUSION

Based on the results of the above analysis, the number of individual measurements for the detection of gross errors using the practical method of "three sigma"[3] is 11 it can be concluded that it can be used only under no less conditions. This conclusion confirms that the "three sigma" method is limited in terms of practical application.

REFERENCES:

1. Величко О.Н., Хакимов О.Ш., Латипов В.Б., и др. Прослеживаемость измерений: нормативное обеспечение и основные компоненты:

T :. O'zdavmatbuotliti, 2009.- 184c.

2.Сергеев А.С., Латышев М.В., Терегеря В.В. Метрология, Стандартизация и сертификация. Учебное пособие. М. Логос. 2003. -536с.

3.Сигов А.С., Белик Ю.Д., Верба В.С. и др. Метрология и электрорадиоизмерения в телекоммуникационных системах. М.Высшая школа. 2005. – 486 с.