Characteristics of the Optimum Structure for Polesskii Reliability Estimation

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Abstract – **This paper deals with the structure used to estimate network reliability according to maximum permissible Polesskii estimation method as his most developed method.**

Key words – **Polesskii estimate, monotonous structure.**

I. Introduction

The choice of an adequate model is a relevant issue. It further provides for minimization of the number of factors that indirectly complicate reliability estimation.

II. Description of the Chosen Model

The monotonous structure under study may adopt two states: it may be either functioning (faultless) or not functioning (faulty).

Similarly, the elements forming this structure may also adopt only two states: they may be either functioning (faultless) or not functioning (faulty). Monotony means that replacing faulty elements with faultless ones has no negative influence on the system operation. Reliability of such a structure means probability of its operability. Reliability of a monotonous structure generalizes many characteristics of structural network reliability, in particular, double-pole reliability, connectivity probability, and terminal reliability.

A random monotonous structure is specified by an independent random set *(E;p)* and a monotonously increasing *Ω* family by *E*. The probability *P(Ω;p)* is called ***reliability*** of a random monotonous structure. To use the notion of reliability in terms of a monotonous structure clutter, suppose by definition that for a random family $\Im$ by *E*.(1)

$$R(\Im; p) = P(\Im^{\wedge}; p) \tag{1}$$

If μ is a clutter of the monotonously increasing family *Ω* by *E*, (2)

$$P(\Omega; p) = R(m; p) \tag{2}$$

Elements from the set $E - \bigcup \mu$ are called ***insignificant.*** If e is an insignificant element,

$R(m; p) = R(m; p/(E-e))$, where *p/(E* — e) is a restriction of the function *p* by *E — e*. Let Ω be a monotonously increasing family by E, and μ ={ $A_1, \ldots, A_k$ } be its cluster. It is obvious that (3)

$$\Omega = m^{\wedge} = \bigcup_{i=1}^{k} A_i^{\wedge}; p) \tag{3}$$

Furthermore, $P(A_i^{\wedge}; p) = R(A_i; p) = p^{A_i}$.

Let m_i, $i \in I$ be clutters by E with pairwise non-intersecting carriers, i.e.

$$i, j \in I, i \neq j \Rightarrow (\bigcup m_i) \bigcap (\bigcup m_i) = \otimes \tag{4}$$

It is clear that

$$P(\bigcap_{i \in I} m_i^{\wedge}; p) = \prod_{i \in I} P(m_i^{\wedge}; p) \tag{5}$$

$$P(\bigcap_{i \in I} m_i; p) = 1 - \prod_{i \in I} (1 - R(m_i; p)) \tag{6}$$

Let $a = \{m_i : i \in I\}$ be a random finite set of clutters in the set E. Let (E;p) be an independent random set.

Supposing $p'(s_i) = p(e)$ for $i \in I(e)$, and let p' — p(f) for $f \in E - e$. We have a new independent random set (E';p').

Let us consider the probability $P(\bigcup_{i \in I} m_i^{\wedge}; p)$ of a sum (combination) of clutters. It is obvious that (7)

$$P(\bigcup_{i \in I} m_i^{\wedge}; p) = P((\bigcup_{i \in I} m_i)^{\wedge}; p) = R(\bigcup_{i \in I} m_i; p). \tag{7}$$

This probability is called ***reliability of a sum of clutters*** $R(\bigcup_{i \in I} m_i; p)$ and is considered as generalization of monotonous structure reliability.

III. Conclusion

In this paper the optimum structure for maximum permissible Polesskii reliability estimation has been chosen. The basics of clutter summation in the structure are also described.

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