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ІНТЕРВАЛЬНА ОЦІНКА ПОКАЗНИКІВ НАДІЙНОСТІ ЗА РЕЗУЛЬТАТАМИ ВИПРОБУВАНЬ КОМПОНЕНТІВ СКЛАДНОЇ СИСТЕМИ

Interval estimation of reliability indices from the results of complex system component tests

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The goal of this work is to find the lower estimate of the no-failure probability (NFP) of a complex monotonic nonrecoverable system from the results of independent binomial tests of its components. Using the general-and-probabilistic method, the NFP is considered as a probability function polynomial, which is a linear homogeneous polynomial in each of the *S* variables where *S* is the number of system component types. Based on the method of confidence sets, the NFP lower estimate is found as the minimum of a function of an unknown multidimensional parameter at a probability of the aggregate test results (failure-free operation) of the system components equal to one minus the guaranteed confidence coefficient. The paper reports a system of equations, each of which for two component types relates the component reliability derivatives of the NFP (and one more equation relates the component reliability and the confidence coefficient). Conditions are found for the initial guess in a numerical solution of the above system of nonlinear equations (the number of the conditions is equal to the number of the component types minus one; each condition is a like sign for two functions each of which depends on the probability of the test results of a particular component type and the component reliability of this probability). In some specific cases, the program dimension can be reduced due to the simple structure of the probability function polynomial. The presented method gives a confidence reliability estimate with a guaranteed confidence coefficient for complex system that cannot be reduced to a serial-parallel or a parallel-serial structure and consist of components with an arbitrary type of failure time distribution. The method allows one to get an estimate at a small number of tests and a small number of failures or in their absence, which is of especial importance for high-reliability systems.

Keywords: complex system, binomial tests, reliability, confidence sets, monotonic system.

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