FUZZY PARALLEL SYSTEM RELIABILITY ANALYSIS BASED ON LEVEL $(\lambda, \rho)$ INTERVAL-VALUED FUZZY NUMBERS

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ABSTRACT. In this paper, we examine the reliability of a parallel system. We use the level $(\lambda, \rho)$ interval-valued fuzzy numbers to find the fuzzy reliability of parallel systems and obtain the estimated reliability of the systems in the fuzzy sense by employing the signed distance method.

Keywords: Fuzzy reliability, Interval-valued fuzzy number, Statistical data, Confidence interval, Signed distance

1. Introduction. In this article, we consider the reliability of a parallel system. We know that in a factory production process if we want to consider the reliability of the production process experiments are necessary. It is difficult to obtain significant results with this reliability problem if we only consider a model without using experiments. Conventional optimization methods assume that all parameters and goals of a model are precisely known. However, in many practical problems incomplete and unreliable information exists. Therefore, we use the fuzzy concept to treat this parallel system reliability problem.

Because the population reliability $R_j$ of the subsystem $P_j$ $(j = 1, 2, \ldots, n)$ is unknown, we can obtain reliable statistical data $R_{jq}$, $q = 1, 2, \ldots, n_j$ from the subsystem $P_j$ in the parallel system. If we use the average value $\bar{R}_j$ as the point estimate $R_j$ from past statistical data, we will not know the probability of the error $R_j - \bar{R}_j$. Moreover, the system reliability may fluctuate around the point estimate $\bar{R}_j$ during a time interval. It follows that using the point estimate $\bar{R}_j$ to estimate the population reliability $R_j$ is not suitable for real cases. Therefore, it is more desirable to use the statistical confidence interval. We use the statistical confidence interval instead of the point estimate. We transfer the statistical confidence interval into the level $(\lambda, \rho)$ i-v fuzzy number. We consider the fuzzy reliable system through these level $(\lambda, \rho)$ i-v fuzzy numbers. We fuzzify the reliability of parallel systems. Through defuzzifying the fuzzy parallel system reliability using the signed distance method we obtain a fuzzy reliability estimate in the fuzzy sense.

There are two fundamental hypotheses in conventional reliability theory, namely the probability assumption and the binary-state assumption. (1) The probability assumption: The system behavior is fully characterized in the context of the probability measure. (2) The binary-state assumption: At any given time, the system has only two states. One is the functioning state and the other is the failed state. In earlier papers [1-4], the authors modified (2) to (2') as follows. (2') The fuzzy state assumption: at any given time, the system has only two states. One is the fuzzy success state and the other is the fuzzy failure state. In [5], the authors used the $\alpha$-cut of level 1 fuzzy numbers to obtain