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INTELLIGENT DIAGNOSTICS BASED ON THE MAHALANOBIS TAGUCHI METHOD FOR SPACE SYSTEMS

Abstract

Space systems including launch vehicles and ground facilities achieved very high safety and reliability throughout past operations. However, build-up and check-out operations need several months and tens of labors to maintain the safety and reliability. Complicated check-out operations cause to increase the cost and to decrease the operational efficiency. Therefore, next generational launch systems have to be easier operation and to resolve these problems. Autonomous diagnosis is one of solutions and it can make an innovation of launch system. In most check-out operations, several electric current are recognized on wave form patterns. Previously, skilled labors diagnosed the wave form one by one on these operations. Using statistical diagnosis algorithms to the wave form, launch operations obtain more efficiency and autonomy. One of effective recognition methods is the Mahalanobis Taguchi (MT) method that is used in a wide range of areas such as quality engineering, industrial and medical field. The MT method is one of conversion methods that convert from multidimensional data to the only one value (that value is called Mahalanobis Distance: MD). Using MD to check-out, launch operators can detect faults more easily and simply. One of the advantages of the MT method is using correlations between each parameter that can diagnose more accurately than threshold based methods using each parameter independently. In another advantage, this method can execute with lower computational resource than other methods like a neural network because the algorithm is simple and explicit. Furthermore, the neural network has undefined parts because results are obtained from some inner layer. However, the MT method is more clearly defined by using statistical data. On the other hand, choices of normal reference data are the most important point for the MT method. Diagnosis accuracy depends on how many accurate and homogeneous reference data can be collected from correct physical model or skilled labors. Additionally, selection of optimum feature amounts is needed because it affects accuracy of diagnosis. Optimization of reference data and feature amounts using statistical algorithm makes the MT method more accurately and reliability. In this study, the MT method is applied to a failure model of electric motor that drives a nozzle on launch vehicle. These results will show the efficiency of this method, and it can make the space system check-out more intelligently.