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Quality and Safety, always a beginning! (1)

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LIFE ANALYSIS OF REUSABLE SPACECRAFT BASED ON MULTIPLE FAILURE MODES

Abstract

In this paper, the key components of reusable launch vehicle such as rocket engine are taken as the research object, and the life reliability of rocket engine based on fatigue and ablation failure is focused. The life reliability of key components of reusable launch vehicle under multiple failure modes is studied by copula theory. Firstly, the local stress-strain method is used to calculate the fatigue damage of engine bearing structure, and the randomness of fatigue damage is analyzed by Monte Carlo method. Based on the analysis of random coefficient method and pseudo life method, the average fatigue life of load-bearing structure is obtained, and the feasibility of the two methods is verified by comparing the test data. Secondly, based on the theoretical degradation model, the model of the engine ablation amount with the number of launches and working time is established, and the ablation amount of the barrel is analyzed. Based on the pseudo life analysis method, the average ablation life of the engine is calculated. Finally, the joint life distribution function is established by copula theory. The minimum distance method is used to test the goodness of fit of joint life distribution function and determine the optimal distribution. Then, the service life of the barrel considering the fatigue and ablation failure modes is analyzed by the optimal distribution. At the end, considering the influence of various failure modes, the life reliability of the system is analyzed.