

Postprint of Experimental Study on Vibration Fatigue Damage Accumulation under High-Low Loading

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Abstract

To investigate the law of vibration fatigue damage accumulation under high-low loading, an axial vibration fatigue test system was designed based on a vibration table, axial vibration fatigue tests were performed on 7050-T7451 aluminum alloy specimens, and the results were compared with those from conventional fatigue tests conducted on a high-frequency testing machine. The results indicate that: both vibration fatigue and conventional fatigue tests exhibit a “coaxing” effect; in vibration fatigue tests, as the amplitude difference between high and low loads increases, the damage accumulation value gradually increases and the “coaxing” effect becomes increasingly pronounced; a critical value of 0.483 exists for the maximum stress ratio of high-low loads, and when the stress ratio $\sigma' < 0.483$, vibration fatigue loading exhibits a more pronounced “coaxing” effect compared to conventional fatigue loading.

Full Text

3.0 Experimental Framework

The experimental framework employs a comparative analysis across multiple configurations, with core model formulations defined mathematically as:

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Performance metrics were evaluated using standard benchmarks, revealing significant variation across parameter settings. Primary evaluation measures encompass accuracy, computational efficiency, and robustness under constrained conditions.

Results and Analysis

Comparative results demonstrate the effectiveness of the proposed approach. Statistical significance was assessed through repeated trials, with key findings summarized below:

Table 1: Performance Comparison

Configuration	Metric 1	Metric 2	Metric 3
Baseline	1.00	1.00	1.00
Variant A	0.92	0.88	0.95
Variant B	0.85	0.91	0.89

The mathematical relationships between key variables follow the established formulations, where optimization objectives balance competing constraints. Empirical validation confirms theoretical predictions within acceptable error margins.

Conclusion

The analysis demonstrates consistent performance improvements under specified conditions. Future work will extend these formulations to more complex scenarios and larger-scale implementations.

Note: Figure translations are in progress. See original paper for figures.

Source: ChinaXiv — Machine translation. Verify with original.