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基于临界面法的燕尾榫连接结构微动疲劳寿命预测

Fretting fatigue life prediction based on critical plane approach for dovetail joint

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中文摘要:

以航空发动机叶片/轮盘之间的燕尾榫连接结构为研究对象,分析了燕尾榫连接结构接触应力与应变的变化.根据多轴疲劳临界损伤平面原理,在燕尾榫连接结构的微动疲劳寿命预测研究中引入多轴临界平面法的疲劳损伤参数CCB (Chu-Conle-Bonnen),FS (Fatemi-Socie),MSSR (modified shear stress rang)和SWT (Smith-Watson-Topper).将预测寿命与试验寿命进行对比,结果表明:在预测微动疲劳寿命时,4个参数中寿命预测的最大误差为23%,可较好地预测低周微动疲劳寿命.其中基于临界平面法的SWT参数预测误差最小,为1.23%;4个参数均预测裂纹萌生位置在接触区末端,与试验结果一致.在预测裂纹萌生角度上,FS,MSSR,SWT参数预测结果与试验较一致,CCB参数预测结果与试验结果相差较大.说明基于临界平面法的寿命预测模型具有较好的预测能力.

英文摘要:

The contact stress and strain of the dovetail joint of aeroengine were analyzed. According to the critical plane approach of multiaxial fatigue theory, the multiaxial fatigue damage parameters: CCB (Chu-Conle-Bonnen), FS (Fatemi-Socie), MSSR (modified shear stress rang), and SWT (Smith-Watson-Topper), were introduced to predict the fretting fatigue life of the dovetail joint. By comparing the predicted fatigue life with the experimental life, the results show that: the maximum prediction error of fretting fatigue life was 23%, helping to predict satisfactorily low-cycle fretting fatigue life. And, the minimum prediction error was 1.23% based on SWT parameter. The predicted crack tip initiated at the end of contact area in agreement with the experiment test. In general, the critical plane approach can be used to predict the fretting fatigue effectively. The models based on FS, MSSR and SWT can predict the fretting fatigue crack position, while the models based on MSSR and SWT can predict the fretting fatigue life more correctly.