CAE Correlation with Test for Door Slam in Nonlinear Dynamic Stress and Fatigue Life Analysis

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Abstract

In automotive industry, CAE fatigue life analysis is very important in durability evaluation and product optimization to dramatically reduce the design period and minimize the expensive durability testing. In the past time, CAE fatigue life analysis is constrained to the linear stress based methodology in the local strain approach. Generally, the linear stress based methodology is stress analysis with linear material properties. Contact surface could be defined if needed for large deformation and rotation dynamic problem. Then, the stress time history result is retrieved to input to further fatigue life analysis or firstly converted to nonlinear stress with Neuber's rule with considering plastic deformation effect. But in some cases, the structure's large deformation and rotation movement can make large area plastic deformation. Under those cases, the linear stress based methodology can't precisely predict the load path, and further affect the following fatigue analysis accuracy. Nonlinear dynamic method with material nonlinearity should be used in stress prediction for those cases, and the principal strain time history retrieved from nonlinear stress analysis can be directly input to fatigue analysis. This investigation takes door slam as example with LS-DYNA as solver in both the linear and the nonlinear methodology based stress analyses and with Fe-Fatigue in fatigue life analyses to show the linear stress based methodology more conservative and the nonlinear stress based methodology more accurate together with strain life method for low cycle fatigue in nonlinear dynamic problem.

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