# CRITICAL PLANE APPROACH AND ITS APPLICATION IN RANDOM FATIGUE LIFE PREDICTION

AUTHORS:
Zhen Wu, Qiang Liu

Autoliv (Shanghai) Vehicle Safety System Technical Center
1000 Beihe Highway, Shanghai, 201807, China

## Abstract:

A new feature of random vibration analysis is available in LS-DYNA since version 971, which has been shown to be a powerful tool for the simulation of vibration shaker table test driven by power spectrum density (PSD). In particular, LS-DYNA uses Von-Mises stress for fatigue life calculation. Von-Mises stress is a function of principle stresses. The principle stresses are calculated from the eigenvalues of the stress tensor, which is a real, symmetric tensor for static load cases. For vibration cases, however, it is difficulty to calculate the principle stresses, because the stress tensor derived from the frequency response function (FRF) is complex and there is no general solution for such a complex matrix.

In this paper we introduce a more theoretically correct method known as critical plane method for fatigue life prediction. Critical method was first developed by Findley for high-cycle fatigue in the 1950. It is based on the experimental observations that cracks nucleate and grow on so-called critical planes on the component's surface. In calculation, the FRF is resolved onto a set of planes whose normal lie in the plane of the component's physical surface. Then the FRF on each plane and hence the maximum one can be determined. And the end of this paper, a comparison between the maximum principle stress method and the critical plane method will be presented.

## Keywords:

Random vibration, Fatigue Failure, Frequency Response Function, Critical Plane