

Numerical modelling of fretting fatigue crack initiation and propagation

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Fretting fatigue is a combination of two complex mechanical phenomena; namely fretting and fatigue. Fretting appears between components that are subjected to small relative oscillatory motion. Once these components undergo cyclic fatigue load at the same time, fretting fatigue phenomenon occurs. Due to fretting, the fatigue lifetime is significantly reduced as compared to that when no fretting takes places. Many failures in mechanical components due to fretting fatigue have been investigated, e.g. threaded pipe connections, riveted joints, blade-disk attachment in turbine, shrink-fitted shaft and aero-engine splined couplings.

In general, fretting fatigue failure process is divided into two main phases, namely crack initiation and crack propagation. The fraction of fretting fatigue lifetime spent in crack initiation and in crack propagation depends on many factors, e.g. contact stresses, amount of slip, frequency, environmental conditions, etc., and varies from one application to another. Therefore, both crack initiation and propagation phases are important in analysing fretting fatigue.

In fretting fatigue real applications and laboratory experiments, it is very difficult to detect the crack initiation and crack propagation phases; the onset of crack growth and the crack growth rate because damage and cracks are always hidden between the two contact surfaces. Therefore, numerical modeling techniques for analysing fretting fatigue crack initiation and propagation phases are very desirable. Furthermore, these numerical models could be used to predict the fatigue lifetime of components subjected to fretting conditions.

The main aim of this project is to develop generic numerical model of fretting fatigue phenomenon. This numerical model can be used to predict the response of materials and the damage initiation and propagation. Furthermore, it will be used to predict the total lifetime of components that are subjected to fretting fatigue.