Modelling of fatigue crack growth by cumulative random processes(*)

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ACCORDING to many experimental observations, fatigue crack grows intermittently and consists of active and dormant periods. On the other hand, it is reasonable to assume that crack grows mainly due to a sequence of peaks of a random stress process or, in other words, due to a sequence of shocks occuring randomly in time as events of some counting stochastic process. This leads to modelling of fatigue crack growth by random cumulative jump processes.

In the paper the fatigue crack length is characterized by a random sum of random positive components. These components are the elementary increments in fatigue crack growth and they are constructed from the experimental crack propagation laws. The intensity of the random counting process (which describes a number of jumps in crack length in the interval $(t_0, t])$ is related to the average number of maxima of a stochastic loading process.

The probability distribution of a crack size at arbitrary time t is evaluated. Also a distribution of a time to reach a fixed critical value is analysed (this is the first passage time distribution for the random cumulative fatigue process). The parameter of assumed exponential distribution of random elementary increments is estimated from the fatigue crack growth equation.

Analytical results are illustrated by numerical calculations. It will also be indicated that this kind of modelling is also useful in the case of fatigue crack growth in metal specimens under constant amplitude loading with occasional overloads causing a retarded crack growth.

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