School of Engineering and Applied Science (SEAS), Ahmedabad University

B.Tech (CSE Semester IV): Probability and Random Processes (MAT 202)
Special Assignment Abstract Submission #2

Submission Deadline: January 26, 2020 (11:59 PM)

- **Group No.: S_M1**
- **Project Area:Mechanical**
- **Project Title: Probabilistic prediction of fatigue damage based on linear fracture mechanics**
- **Name of the group members :**
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Abstract

All mechanical structures and objects have a finite time of survival after which they are subject to break. However breaking of a mechanical object in a working machine is very costly and can lead to subsequent machine damage as well as harm to its operators and users. Due to this, it is very important to devise a technique that can accurately estimate when an object has come to its end of lifespan. One way of doing this is by examining the object for developing and propagating cracks' size after when that object was subject to some load (i.e. used in some task).Therefore the problem here is finding acceptable crack size using linear fracture mechanics and using probability in determining the initial variables required by the theoretical construct.

The three important characteristic sizes of a fatigue crack propagation are:

- **Initial size** (length of fatigue crack is smaller than that detectable during inspection)
- **Detectable size** (minimum length at which the fatigue crack is detectable during inspection)
- **Acceptable size** (final size before a brittle fracture results into failure)

A fatigue crack develops through these stages over time through each passing stress cycle. Even after calculating the stress intensity per cycle and its effect on the fatigue crack, the time required by the fatigue crack to reach the acceptable size cannot be determined due to uncertainty in the current size (initial size cannot be determined unless it reaches detectable), position and propagation of the fatigue crack. This uncertainty can be minimized using the probability and linear fracture mechanics.

We plan on constructing a model of fatigue crack propagation based on a linear fracture mechanics. The conditions provided by inspection can be used to determine the probability of each characteristics size of fatigue crack over the time using conditional probability. Thus the degree of reliability can be determined along with the time for the next inspection.We plan on using Direct Optimized Probabilistic Calculation for the same.

References

[1] M. Krejsa, L. Koubova, J. Flodr, J. Protivinsky, Q. T. Nguyen, "Probabilistic prediction of fatigue damage based on linear fracture mechanics " in *Frattura ed Integrità Strutturale, 39 (2017) 143-159*