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.: SM1**
- **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

Mechanical modelling tends to be a very complex mathematical task.One of the most important problems related to modelling probability in mechanics is to find the reliability of materials that are used to build objects. A lot of research has taken place to compute fatigue effects on materials and structures.There have been a lot of developments in this area after the proposal Paris' Law. Most of the models proposed related to fatigue crack propagation are deterministic and have some limitations such as that they arise from arbitrary empirical assumptions.A proper estimation of fatigue crack propagation rates with respect to residual stress and stress ratio helps us to estimate optimal materials for mechanical tasks.

The First breakthrough in the field of fatigue propagation estimation was the Paris' Law which was followed by various approaches.Initially Local strain-based approaches were proposed to model fatigue crack propagation on notch based components further a link was established between local strain-based approached to fatigue and Fracture mechanics based fatigue crack propagation models. As research continued models were proposed that using residual stress concepts explained stress ratio effects as well as interaction effects on crack growth rates.Several approaches were proposed which were analytical and or numerical.The underlying concept behind the proposed local approaches for fatigue crack propagation modelling consists of assuming fatigue crack propagation as a process of continuous failure of consecutive representative material elements (continuous re-initialization).

We plan to take the unigrow model and extend it to relate it with a probabilistic construct to find probabilistic fatigue crack propagation rates various materials based on the strain-life model and further propose a mode based on the SWT damage parameter. Further we plan on creating a closed form model where in the parameters assumed can also be estimated using sane mathematical contructs. One such case being, estimation of the weibull parameters given the experimental data.

References

[1] J.A.F.O. Correia, A.M.P. de Jesus, A. Fernández-Canteli, R.A.B. Calçada,"Modelling probabilistic fatigue crack propagation rates for a mild structural steel " in *Frattura ed Integrità Strutturale, 31 (2015) 80-96*