OPTIMISATION OF STRUCTURAL HEALTH MONITORING SYSTEMS THROUGH INTEGRATION OF TECHNOLOGICAL AND ANALYTICAL METHODS

Problem Statement

This project is related to the bending strain data collected for calculating the life obtained from bending strain gauges. Unfortunately at present this data is applied at only specific locations on the structure and thus the other part of the structures are unknown. So a method of extrapolation is developed to find the strain across the structure. This method will also be used to determine the life of the structure that have been affected by pitting corrosion.

Introduction

The wind energy business is moving offshore. The deployed structures are following a trend by growing larger and further from shore. As they do so, the OPEX will increase drastically if frequent and inefficient Periodic based maintenance strategies are employed. To mitigate such problems, sensors are carefully installed on the structure and the data is analysed to assess the health of this structure. This technique is known as SHM(structural Health Monitoring). One very important data collected is the bending strain gauge that can provide valuable information on the fatigue life of the structure.

The aim of this project are:

1. Extrapolating strain data across the structure and thus determining the life at required parts.
2. Finding a method for propagation of pits across a structure and then using extrapolation technique to find when they turn to a crack.

Methodology

The cosine fit has been employed to circumferentially extrapolate the data circumferentially.

A linear extrapolation is considered from the top of the structure to the position of the sensors and goes under the assumption that at the top of the structure the bending stress is zero.

The formula used requires a minimum of three strain gauge and need to be applied at each time step. That will increase the size of the dataset. Refer to figure 1.

For the second problem, the pits will be propagated using the distance sampling method based on coupons and plates deployed for measurement of the corrosion. To calculate the pit to crack transition, the method is shown in figure 2.

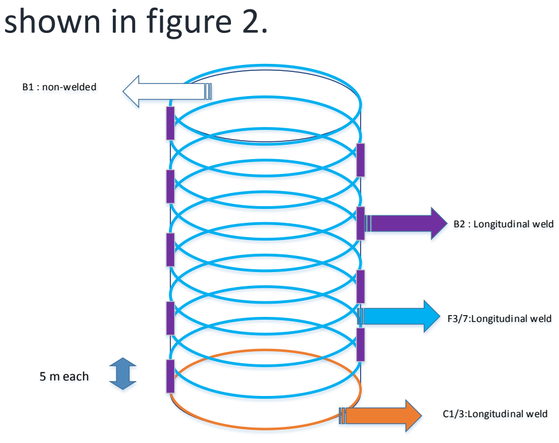

Figure 3: showing applications of different welds to the model.

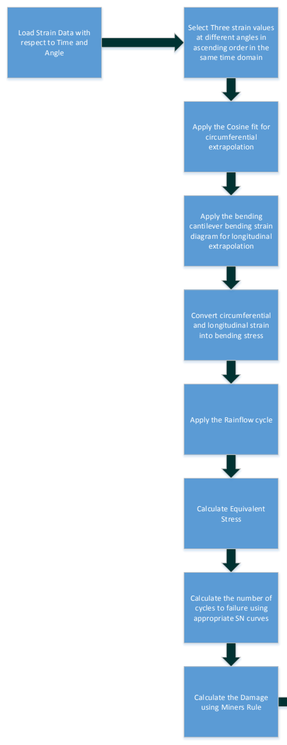

Figure 1: Methodology for extrapolation

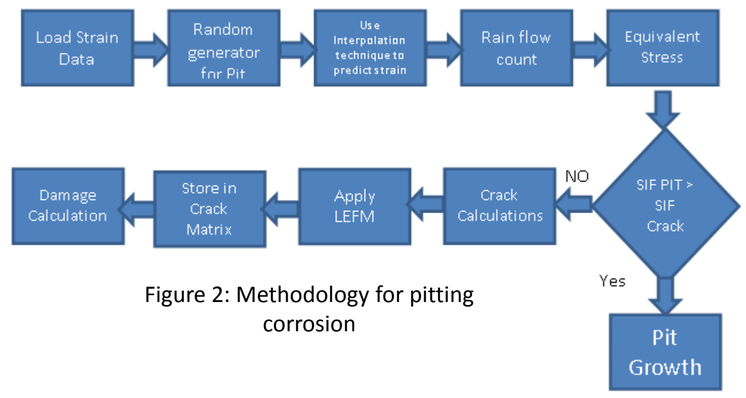

Figure 2: Methodology for pitting corrosion

Results

Upon application of real data to the algorithm for method 1, the damage at different locations shown in figure 3.

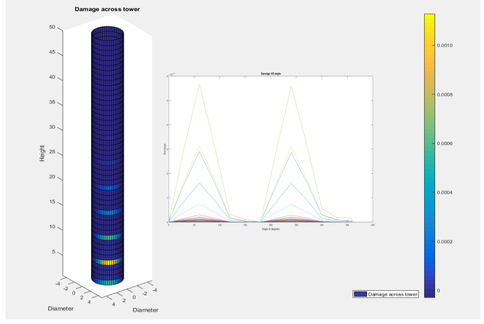

Figure 4: showing the damage at different extrapolated values

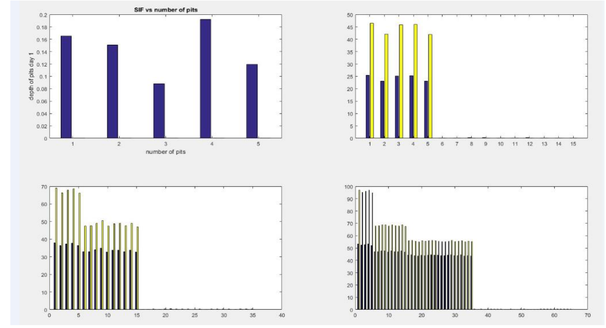

Figure 5: SIF of pits vs crack characterising the pit to crack transition

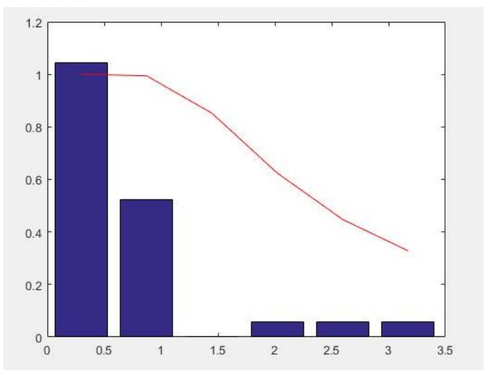

Figure 6: population extrapolation from area under the graph using the distance sampling method.

Conclusion & Future works

The pits propagations in the study are approached in a random manner. This is incorrect as different regions will have different distribution of pits in terms of their numbers and sizes.

A field experiment is being deployed to feed the model built with those values.

Reference

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