Towards the development of a deposition technology for an automated rail repair system

1. Introduction

This paper explored the use of a laser line scanner to generate robotic deposition paths for the repair portion of an automated rail repair system. Currently surface defects cost the UK around £4 million per annum, with little traceability being available throughout the repair process. An example of such a surface defect, known as a squat defect can be seen in Fig 1.

Fig 1: Squat defect taken at Quorn Railway station, Leicestershire, UK

2. Methodology

The deposition system utilised two different deposition strategies. The first extracted the weld prep from the point cloud to generate the deposition paths for the robot and the second measured the height of the previously deposited material and adjusted the generated path accordingly.

3. Path Generation Algorithm

The technique used to extract the weld prep surface, utilised the eigenvalue of the covariance matrix to identify local changes in the data. The covariance matrix was a statistical tool where the largest eigenvector indicated the direction of the data. This ratio stayed consistent either side of the weld prep and a large change in this ratio was observed when the neighbourhood partially included data from the weld prep. The fill algorithm works by raising the build plane based on the estimated bead height and then intersecting the build plane with the point cloud. An example of the first layers' path generation can be seen in Fig 2.

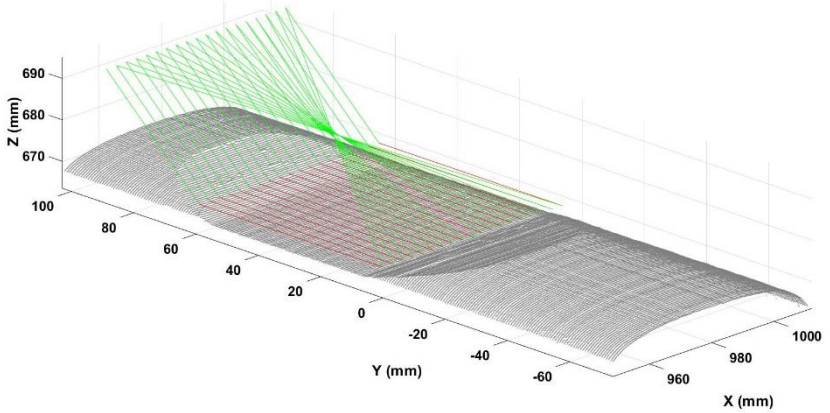

Fig 2: Scans showing path generation for the first layer.

4. Layer Update Algorithm

The layer update algorithm allowed for any difference between the bead height input by the user and the real-world bead height to be corrected for. This algorithm works on the highest 20% of Z values within the deposition area and fits a plane to those points. This plane was then used to adjust the next layers height values, an example of the path update algorithm working can be seen in Fig 3.

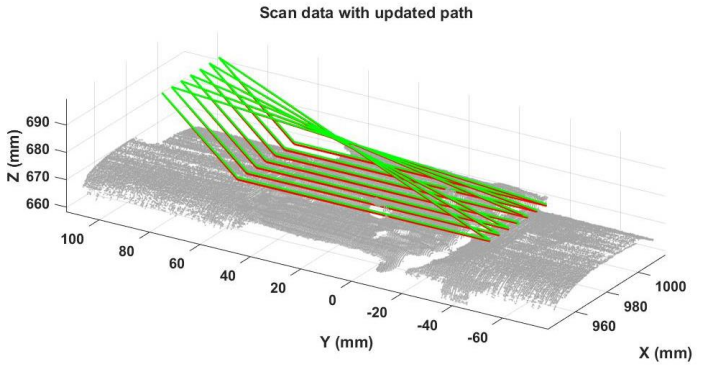

Fig 3: Scan data showing the path being updated

5. Conclusion/ Further work

- It was possible to extract the weld prep from a rail head using the covariance matrix method.
- Path generation and layer update algorithms will be first tested on a representative flat plate.
- Re-validate the testing carried out on the flat plate on a piece of real rail with the welding apparatus.

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