Automatic Surface Defect Quantification in 3D

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Automatic surface defect inspection within mass production of high-precision components is growing in demand and requires better measurement and automated analysis systems. Many automotive industries may reject manufactured parts that exhibit even minor defects, because a defect may cause an operational failure at a later stage. Defect quantification (depth, area and volume) is a key element in quality assurance in order to determine the health of manufactured parts. Existing human visual analysis of surface defects is qualitative and subjective. 3D analysis should provide a robust and systematic quantitative approach for defect measurement. Various 3D measuring instruments generate point cloud data as an output, although they work on different principles. Instrument's native software processing of point cloud data is often subject to issues of repeatability and may be non-traceable causing significant concern with data confidence.

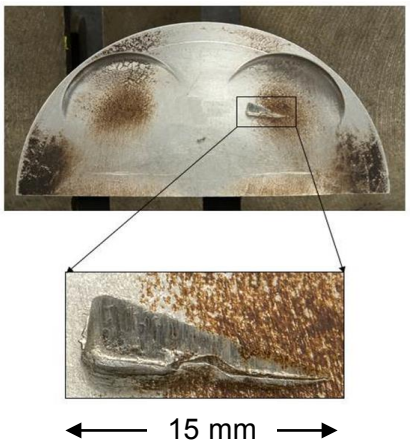

Figure 1. Defect on a Piston crown

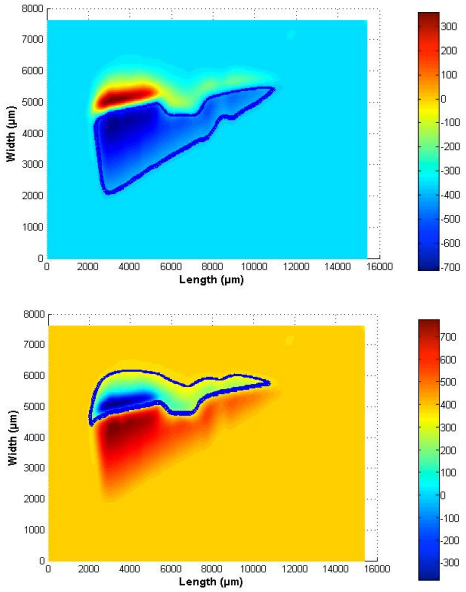

Figure 2. Isolated Positive/Negative defect

During the course of this research work, novel image processing based algorithms for automatic defect quantification in 3D have been created. Moreover, a defect on a piston crown (Figure 1) is measured using focus variation technique and quantified using the novel algorithm (Figure 2). However, it is important to validate the algorithms to gain confidence in the novel solution and derived output. The work reported here also charts the development of a novel 3D defect softguage with known size geometry. The defect softguage is characterised using the novel algorithms and results are validated. The results show that the novel algorithms for defect quantification are efficient, robust and more repeatable than current alternative approaches, and traceability to the metre can be achieved, thus ensuring confidence in the results.