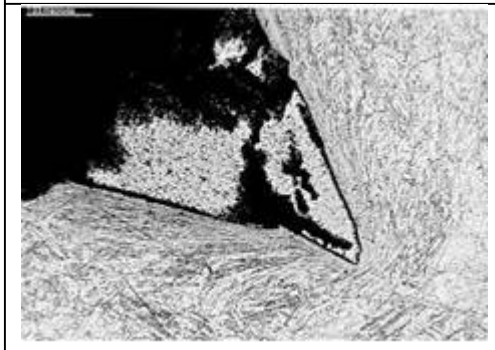
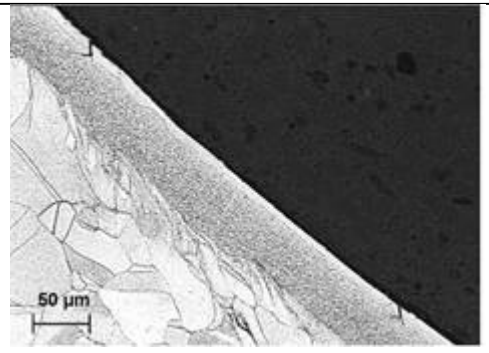
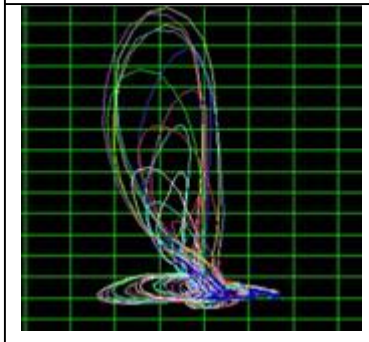
Integrating Process Controls with Manufacturing to Produce High Integrity Rotating Parts for Modern Gas Turbines (MANHIRP) (5th Framework Project)

Damage caused to aircraft hull and engine from fan disc failure in the Pensacola incident





Example of an anomaly: Tool tip embedded in a steel disc



EC signal in the complex plane

Contribution from IWF:

Multi-frequency eddy current (EC) technique is developed to detect, to identify and to quantify anomalies. Therefore, high resolution eddy current sensors are designed to be mounted on automatic scanners providing images of the distribution of conductivity and permeability of near surface regions. These signals are processed and visualized using a LabView environment.

An analysis of events in service discs, which includes both cracking and burst, shows that manufacturing anomalies, mostly caused by machining abuse, are rising and in the 1990s have become the biggest cause of disc burst. Anomalies include, for instance, broken tool tip, smearing of foreign material, chatter, high roughness, etc.

A significant difference between lifing misses and these anomaly based causes is the low frequency of occurrence of the latter, perhaps as low as 1 in a million in the case of holes. While lifing misses can be addressed in service by sampling at part life and campaigning out the parts which do not meet the required duty, anomalies are unlikely to be found by random sampling and therefore can only be addressed by regular inspections and improved manufacturing processes.

The work in this programme will integrate process controls, including Process Monitoring (PM) and Non-Destructive Inspection (NDI), with the manufacturing process and the duty that the part is required to sustain to deliver a ten times reduction in the number of events associated with manufacturing anomalies.

Objectives

- The ability to specify process controls to achieve a specified low level of the risk of burst from machining anomalies
- A scientific basis on which to control manufacturing process development, change and sentencing of non-conforming product in terms of the required surface condition in the materials
- A reduction in the probability of burst of a disc from a manufacturing anomaly by a factor of ten

Partners

Germany, Sweden, UK, France, Italy, Greece