Introduction

Holding thin-walled components with complicated geometry, e.g. turbine blades, compressor blades and nozzle guide vane (NGV) blades etc., in a single set-up for the machining operations has been a research challenge for many years. The benefits of single hit fixture is significant as it offers potential automation of machining and measurements of the components in one operation without human interference, as well as the reductions of error stack, inventory, and maintenance etc. In line with Rolls-Royce quality standard, the project develops a radical approach to fixturing technology using Nozzle Guide Vanes as case study.

Aims & Objectives

- To design, manufacture and evaluate single hit fixture prototypes for the NGV blades;
- To design fixture within a space that is collision free with tooling space and inspection space using CAD/CAM software;
- To propose optimal fixturing position and geometry using verified finite element analysis (FEA) and mathematic modelling etc.
- To evaluate fixture performance by experiments and virtual simulations;
- To extend the method to fixturing of other components that have thin-walled aerofoil.

Technical Approach

The project is composed of two strands: **Strand one** covers the fixture concept development and operational assessment of fixture and tooling for machining Trent 1000 HP NGV components to minimise the number of set-ups, considering machine platform envelop, CMM and machine in-cycle probing capability. The fixturing concepts seeks to optimize use of available fixturing and inspection space (both in-cycle and CMM), as well as identifying the means to experimentally assess and model the resultant fixtures to full proof of concept (in line with the requirements of Rolls-Royce MCRL 2).

**Strand two** covers the trial, testing and operational model validation of the fixture concept selected from the Strand 1 programme (on a machine platform selected from the Strand 1) for proof of concepts in line with the requirements of Rolls-Royce MCRL 3.

Notable Achievements

- Two concepts of single hit fixtures (Hard point and conformable) have been designed, manufactured and evaluated;
- Extensive finite element analysis (FEA) has been conducted to assist the fixture design;
- FEA has been partially be verified by experiments;
- Patent application forms for the two fixtures are submitted to Rolls Royce;
- Passed MCRL 2 & 3 of Rolls Royce standard
Fixture prototype considering CMM accessibility within the remaining space after tooling space is subtracted from the total working space

Researchers: Dr Yan Wang, Dr Jianfan Xie, Mr Jianyuan He, Mr Yuwei Li and Dr Ogzhan Yilmaz