CLEANING COMPLEX 3D GEOMETRICAL SHAPES WITH LASER RADIATION

Task

Within the scope of regular turbine engine maintenance, combustion residues must be removed from compressor rotors (including blades). Up to now, these rotors have been cleaned with wet-chemical processes. Due to tightening legislation, such as REACH & RoHS (Restriction of Hazardous Substances), this cleaning method has come under increasing scrutiny and should soon be replaced by a laser-based process. As disassembling the compressor rotor into its individual parts is costly and should be avoided, the complex component should be cleaned in its assembled state.

Method

This maintenance faces a particular challenge since the components to be cleaned are complex and there is limited access to the surfaces of the individual parts. In particular cases, the CAD component data is also missing, e.g. due to the age of the component, so that this data has to be reengineered by scanning the component in 3D and transferring the measurement points to mathematical surfaces. This data is then used to simulate the accessibility, to break down the processing into scannable segments by means of path planning, and then to clean the component automatically in a multi-axis processing machine using the adapted laser parameters. The laser beam focus is tracked while the part geometry is processed.

1 Compressor rotor cleaned with laser radiation, two blades are in the uncleaned state.

Results

Pulsed laser radiation can be used to automatically clean both blade and rotor surfaces in the assembled compressor rotor. The path planning for the laser treatment takes into account the dynamics of the axes as well as the required high processing speeds – in the range of several m/s. A 5 + 3 axis system (5 mechanical axes + 3 scanner axes) was used for this purpose.

Applications

Provided accessibility is given, the system can be used to clean other components with complex 3D geometrical shapes and to remove other contaminants from almost all industrial components, e.g. injection molds and coating chambers. With suitable process control, worn coatings or functional layers (e.g. non-stick, anti-wear or anti-corrosion coatings) can also be removed, if necessary, in order to replace them efficiently with new functional layers.

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