

Abstract of PhD Thesis

Title: Synthesis of dedicated tools implemented in robotic applications
for machining aircraft engine parts

The dissertation is about the development and implementation of tools used in robotic deburring of aircraft engine components. Due to stringent quality and dimensional requirements, especially narrow manufacturing tolerance ranges, which are below the repeatability of an industrial robot, robotic technologies have been developed using standardized tools, authoring tools and various strategies for implementing robot motion have been analyzed. Passive adaptive tools were tested first, followed by tools with pneumatic force progression, and lastly tools with force control.

In the area of passive tools, were selected and designed tools for machining the ADT gear body, process parameters were determined, and their stability was checked. Tools with pneumatic force progression were tested using the example of machining a V-2500 engine diffuser made of Inconel 718 material. A procedure for determining process parameters for the deburred edges of the diffuser was proposed, and the problem of process disturbance at the start of the process was solved by methodically selecting the contact force and speed of tool movement. Special attention in the form of extended analysis of motion strategies as a function of a number of parameters was devoted to robotic solutions with force control. Process limitations were identified, and author's tool designs were designed, studied and tested. Process parameters were selected for such proposed solutions.

In addition, IT tools were analyzed, with their ability to monitor, record and process data from the process, can expand the possibilities of implementing robotic stations for more demanding technological processes.

The research work was completed with the development of a proprietary metrology algorithm that allows fully automatic measurement analysis. As part of its implementation, a proprietary algorithm was developed for determining the characteristic point of a tool that has no material representation. The correctness of the proposed solution was confirmed by a real experiment.

The results of the research work have been implemented and deployed in production conditions bringing tangible financial and quality benefits and significantly increased the level of health and safety in the production plant. Four robotic stations were given as examples of robotic technology implementations using the results of the research work: for deburring the edges of V2500 engine diffusers, for deburring the edges of ADT gearbox, and for deburring the edges of FDGS gearbox. The implementations were documented with photos.

In conclusion, the research work defined in the implementation dissertation, documented by several implementations, was achieved in an oversized manner, thereby fulfilling the defined purpose of the work.