Abstract

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Faculty of Mechanical Engineering and Aeronautics

Department of Manufacturing Processes and Production Engineering

DOCTORAL DISSERTATION ABSTRACT

Title: Development of methodology of rapid evaluation for the 5-axis, multitasking machining centers, compensation of diagnosed errors and confirmation suitability for technological operations

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Key words: multitasking machine tool, on-machine measurement, rotary axis performance, correlation of variables, thin wall machining

Abstract:

The doctoral dissertation concerns the methodic for current ability assessment of the 5-axis multitasking machining centers equipped in advanced part probing system assigned to the machining of complex turbine engine large cases.

Presented complex methodology was investigated in the course of various trials under manufacturing regular conditions.

The 1st part of methodology includes research and implementation of active compensation error of center point of the rotary axes for the machine tool table.

The presented methodology enables errors compensation resulting from the change of machine tool state of the geometric and motion structure in conjunction with various height of machining parts. The presented solution allows error compensation during long term machining without process interruption. The collected data by the stages helped to determinate range of compensation variability in relation to the machine tool geometry change. The method effectiveness was determined by the trials with temporary fixture and 79 parts machining during implementation.

The next section presents advances in the methodology of rapid comparative evaluation of various probe configurations for the five-axis, tilting-head machine tools in conjunction with master artifacts. The aim of the study was to investigate whether 6

of probes configurations have comparable measurement capability for use in manufacturing environment conditions. The collected data and research helped to determine the mutual measurement errors and determine the application limitations of probes for an adaptive process flow.

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The last section of the methodology presents the rapid evaluation of the machine tool and touch probe readiness based on the analysis of selected machine and probe parameters including additional control parameters. The standard solution was analyzed, and the proposed improvement was implemented. As part of the was work performed, the concept of dedicated control and calibration fixture was improved. The main research was carried out on both machine tools in the test stand. For machine tool No. 2, 606 sets of parameters were collected and analyzed in two long term time frames. Similar, for the machine tool No. 3, 126 sets of parameters were collected in the single long term time frame. The final stage of the completed research work was to determine the range of correlation value between selected machine, probe parameters and inspection features to determine the most effective way of monitoring and control. The validation of the results and adopted limits was performed. The evaluation results of methodology implementation effectiveness were presented in relation to the risk reduction of possibility of nonconformance machining of complex engine components.