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EXPERIMENTAL PROCESS DIAGNOSIS USING QUALITY CRITERIA AND SELF-DRIVE PROGRAMME

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ABSTRACT
Through a measurement system based on data acquisition, an interface software between the data acquisition system and the CNC part software, three quality assurance criteria can concomitantly be optimised, in “the while process” moment. The optimisation is possible due to the integration, i.e. of closing the adaptive control loop using the diagnostics technique.
Keywords: quality, integrated system, data acquisitions, diagnostics technique

1. GENERALITIES
It is more and more obvious the world-wide concern for the quality level improvement in products and processes both on behalf of the businessmen and experts working in all fields of activity, be they production or service-related. These demands have led to the research and in-depth study on quality assurance and management techniques, based upon the use of computers for all the operational functions and information processing, from market surveys to order reception, design, manufacturing and delivery.
By combining the capacity of the computer to analyse and calculate and the functions typical of data acquisition and control one can have a very flexible instrument to be used for practical applications.
Usually, a NC manufacturing program remains valid for the whole manufacturing number of work pieces even if some changes occurs in the manufacturing conditions which request changes in the NC program. Taking into account quality criteria it is possible to adapt on-line the NC program, during the manufacturing of the whole number of pieces.
The LabVIEW programming environment is used for the measurements based on data acquisition for a diameter processed by outlining on a manufacturing minicentre. The program allows the achievement of interface software programmes that can modify the source programme of the manufacturing minicentre computer. In this manner the adaptive control loop is closed and the advantages for the manufacturing quality and costs are immense.
When the design-imposed warning tolerance limits are exceeded in the case of the measured value, a first command of radius correction for the outlining motion is given immediately after machining. The value of this correction is function of the sense and magnitude of tolerance limits exceeded.
The applications designed and achieved optimize, one by one, the three quality related factors under discussion, namely the processed diameter, i.e. a target criterion, the roughness, i.e. a criterion to be minimised and the cylindricity deviation, i.e. another criterion to be minimised.

2. DESCRIPTION OF THE EXPERIMENTAL STAND
The experimental stand is composed of a mini-processing centre, on the desk of which a pneumatically driven carriage was mounted. The carriage is driven by a linear engine. The solution chosen was dictated by the presence of air under pressure (6-7 bars) in the machine structure used to

drive the tool stock, the vice and tool guide in the main shaft. The carriage design for the motion of the inductive sensor is controlled by the pneumatic block made up of two electromagnetically driven distributors (12 V) and the throttles for the feed rate adjustment.
The parts to be processed are cylindrical in shape. They are simply outlined and batches of 10 parts are measured. In fact, one dimension is measured, i.e. the diameter processed, when the rod of the induction sensor moves.
The starting semi-finished product has a diameter of 19,5 mm and the diameter aimed at after outlining is 17,9 mm.
The tolerance field is large enough due to the machine errors, mainly originating in the outlining process and the system rigidity. Mention should be made that we mainly aimed at proving that the measurement control and process control respectively were possible. Less interest was paid to the measurement of the processing accuracy.
The LabVIEW environment used in the acquisition of the measurement data for the processed diameter is extremely ”friendly“ as it allows for the creation of the interface software that in turn can modify the source software of the miniprocessing centre computer. In this way, the adaptive control loop can be closed and this exhibits major advantages for the manufacturing quality and costs.
An on-line source software correction programme was made. When tolerance limits were exceeded for a value measured immediately after processing, a command for the correction of the radius of the outlining motion is given. The value of the correction depends upon the sense and the size of the tolerance limits exceeding.

3. THE MEASUREMENT STRATEGY

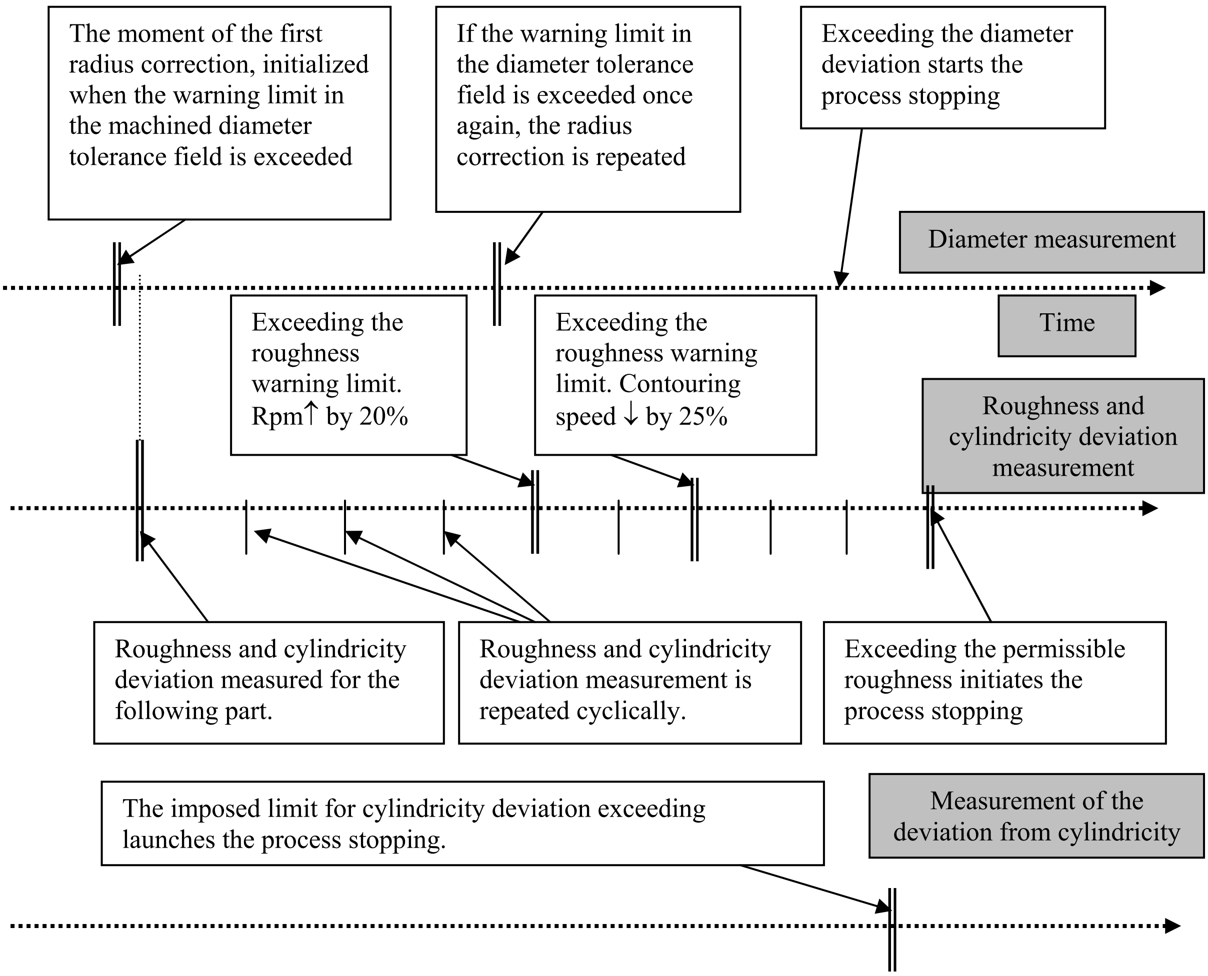


Figure 1. The strategy for quality surveillance by means of the interface software.

The strategy for the measurements and the interface software programme to manage the machining by intervention into the source-programme of the manufacturing minicentre computer is presented in figure 1.
During the machining, the diameter of each part and the deviation from the target value of the nominal size, respectively are measured. The value measured and acquired is compared to the theoretical nominal value to fit in the prescribed tolerance field that is limited to the warning tolerance field to avoid trash parts. The warning tolerance field is 20% lower than the end one, established by design.
When one of the warning limits is exceeded, the part being considered as in good shape and near the permitted limits, the correction programme for the outlining radius is launched. At the same time, the roughness and cylindricity deviation measurements are also launched for the following part.

4. CONCLUSIONS

The processing quality control interface software can survey the framing within the tolerance field of the part to be manufactured by including a warning tolerance field that is smaller in value. When its limits are exceeded the corrective operations are launched in the part processing programme.
Such a system is beneficial as it is much cheaper and easier to implement as compared to a control system during the process.

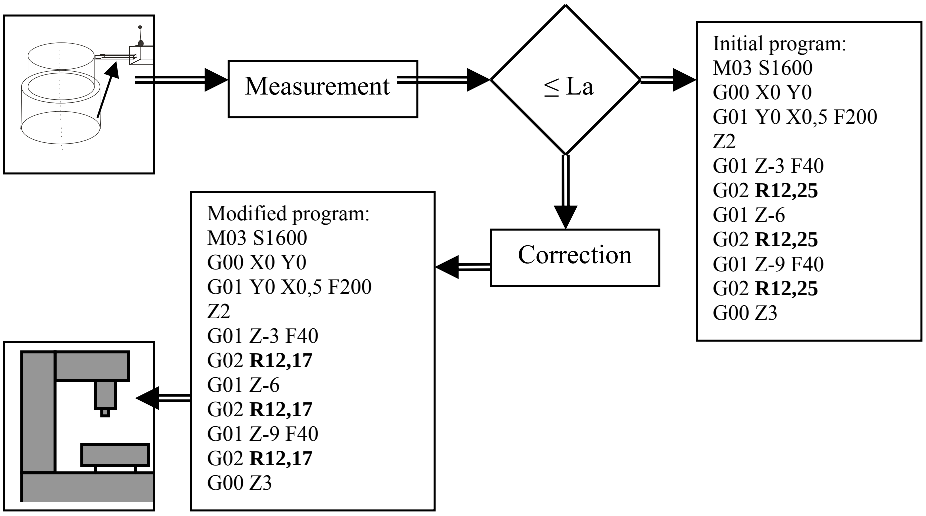
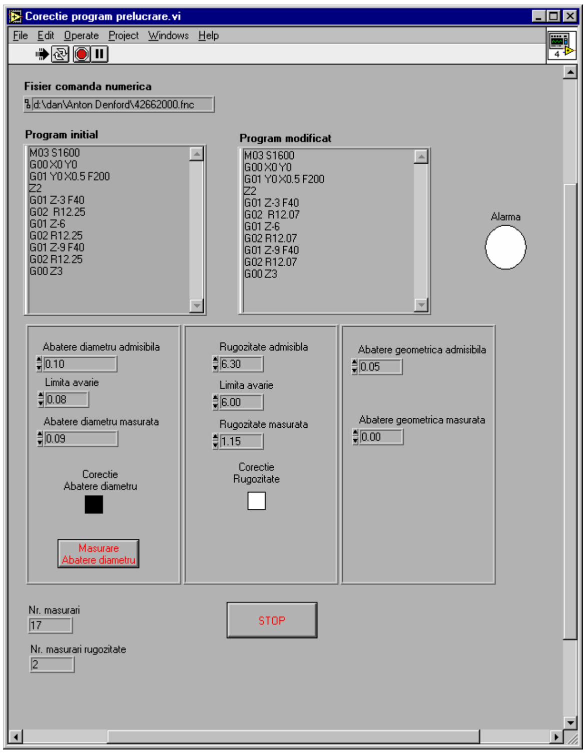


Figure 2. The measurement and control algorithm.

To integrate the measurement system (immediately after machining) using data acquisition makes possible an on-line intervention process. The corrections transmitted from the process computer to the computer of the miniprocessing centre, though post-process, permit a control due to the rapid reactions launched before the required admissible limits are exceeded (figure 2).
The measurement of the processed dimension, that is the 17.9 mm diameter, is made on-line after the process, the signal coming from the induction sensor is taken over through the data acquisition system, is analysed and stored, then it is used for the adaptive drive of the process, while continuously making use of the same LabVIEW programming environment that has acquired the data.
The application and the interface software for the quality control of the part machining can control the inclusion in the tolerance field of the part to be worked upon by introducing these smaller-sized warning tolerance fields. Exceeding the warning limits means to launch corrective operations in the part processing software.
Such a survey and control system for the machining quality has the advantage of being cheaper and easy to implement than the while-process control system.
The corrections sent from the process computer to the minicentre computer, though sent post-process lead to an on-line control due to the quick reactions triggered well before the imposed permissible limits are exceeded, due to using the warning tolerance limits.



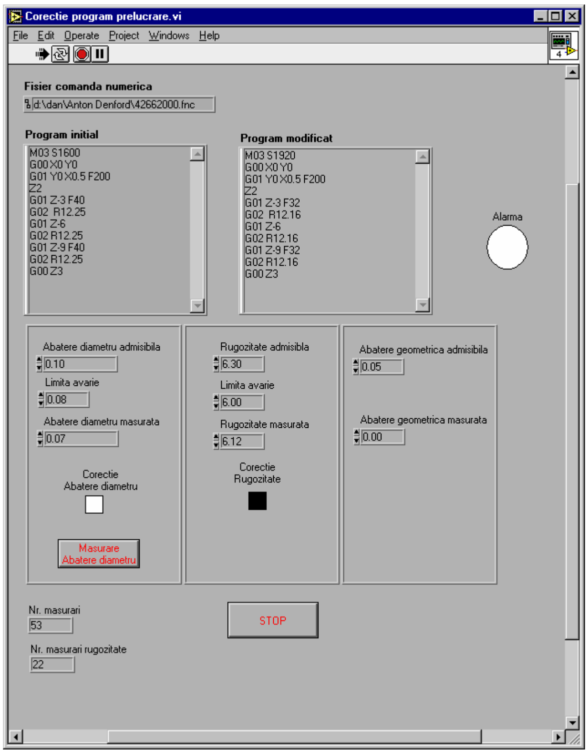


Figure 3. New radius correction and the roughness is inside the prescribed limits

Figure 4. The warning roughness limit is achieved and the cutting speed is slowed down to 32[mm/min].

This type of optimisation is possible due to integration, respectively to use the adaptive control loop based on the diagnostics technique.

5. REFERENCES

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