11th International Research/Expert Conference
”Trends in the Development of Machinery and Associated Technology”
TMT 2007, Hammamet, Tunisia 05-09 September, 2007.

THE SURFACE QUALITY INSPECTION, AIDED BY COMPUTER

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ABSTRACT
The paper describes the way in which the surface quality control of some probes could be improved by the point of view of the process necessary times reducing, regarding the main information obtained in vivo and also regarding the measuring precision increase. It was taken as an example a gauge for the ruggedness measurement of the surfaces for the plan – parallel probes. The measuring was made for the probe's active surface, for small areas, equidistant chosen, so that the other deviations like regarding the probe's geometry, to be negligible, reporting to the ruggedness deviations.
The surfaces quality control improvement was assured using a displacement transducer having a very high measuring resolution, the transducer being coupled to the PC. For the graphic interfacing, Lab VIEW virtual instrumentation software were used.
Key words: *ruggedness, displacement transducer, virtual instrumentation*

1. THE ADVANTAGES OF THE USE OF THE VIRTUAL INSTRUMENTATION FOR THE QUALITY SURFACES INSPECTION
Nowadays the surfaces control takes a very important role, because by the active surfaces quality of some key – role components, it depends the functioning in optimal conditions of some sub – ensembles in rotation or translation movement. In case of some in translation guidance elements, like mobile skids, the accidentally scratching of the active surface can lead to the fasten down of the guidance during its functioning. In case of the elements in rotation, like bearings, a non-corresponding ruggedness of the active slipping or rolling surface can lead in short time to the seizing so to the gone out of the use of the bearings.
As a fallowing, for the functional influenced by ruggedness components, it is expressly prescribed into the execution documentation of each surface. By this reason, just in the manufacturing process, in the adjustment phase of the components active surfaces, it is strictly required of the surfaces ruggedness control [1].
One of the most efficient solutions for the surfaces quality inspection consists in the using of some gauges or measuring devices, equipped with displacement transducers having a very high measuring resolution and the possibility to be coupled to the PC. For the displaying, memorization, interpreting, listing and even for the improvement of the measuring results, is enough to create flexible programs, who can easily used for any type of application concerning the dimensional measuring. A very proper for measuring, simulation, data acquisition, interpreting, statistic calculus and a lot of other applications is the software system Lab VIEW, developed by *National Instruments.* This graphic programming environment permits to create any virtual instrument to measure physical,

mechanical, geometrical or chemical parameters, but also to simulate any phenomena in order to its optimization just in the conception or projecting phase, that meaning a very high necessary time and costs reduction.
The use of the virtual instrumentation has the main advantage that the simulation or measuring of some parameters or process eliminates the necessity to use real measuring apparatus, which costs are frequently very high. But the virtual instrumentation, coupled with the data acquisition assures the same performances by the point of view of the times reducing and the measuring precision increase, in comparison with the real measuring instrumentation. Besides, a virtual instrumentation program has the advantage that it cab be easily adapted for different applications (like the dimensional measuring of different components having different geometries), reporting to the real instrumentation, who, frequently is required for a single application.

2. THE QUALITY CONTROL OF A PLANE PARALLEL SURFACE, VIA THE VIRTUAL INSTRUMENTATION

In this paper there it was took a representative example, in fact the quality surface measuring of a plane – parallel gauge block, with 30 x 7 x 8 mm dimensions. It is known that usually the adhesive surfaces of the plane – parallel gauge blocks have ruggedness who do not exceed values of tens of μm, but in this case, the study was made for an worn out gauge block, who presents any scratching traces mean to a low variation ruggedness of the gauge block surface.
For the aided by computer ruggedness measuring, we used an incremental displacement transducer, functioning by the optical principle. Its measuring resolution is 0.2 μm, having a TTL in quadrature output signal. For the adapting to the PC of the transducer we need also a LS7366 decoder, equipped with a PIC18F452 μcontroller, produced by MICROCHIP [2].
The surface control was made fallowing an array of equidistant points, reporting to the length and width of the gauge block.

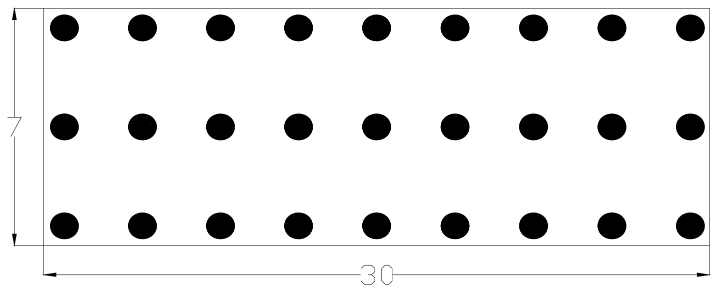

Figure 1. The disposing of the measuring points to the gauge block surface

The virtual instrument for the quality control of the surface was created in LabVIEW 7.1 graphical programming environment, being obtained an interface with the user, in which there are displayed all the necessary information regarding the inspected surface. The graphic interface consists into a panel window, who displays the following data:

a) data regarding the disposing of the measuring points matrix: the length and width of the measuring points matrix, the number of measuring points and measuring 1 – D arrays, the distance between successive measuring points and the distance between the 1 – D arrays of measuring points;

b) data regarding the ruggedness values in each measuring point: - in measuring points, following the current 1 – D measuring array, respectively in all the measuring points of the gauge block active surface; there are also displayed the minimum, maximum and total ruggedness values.

c) graphic data for the displaying of the ruggedness variations distribution profile: a 2 – D graphic indicator for the displaying of the ruggedness deviations distribution for each of the three measuring 1 – D array and a 3 – D chart of ruggedness for the entire measuring area, materialized by the measuring equidistant points.

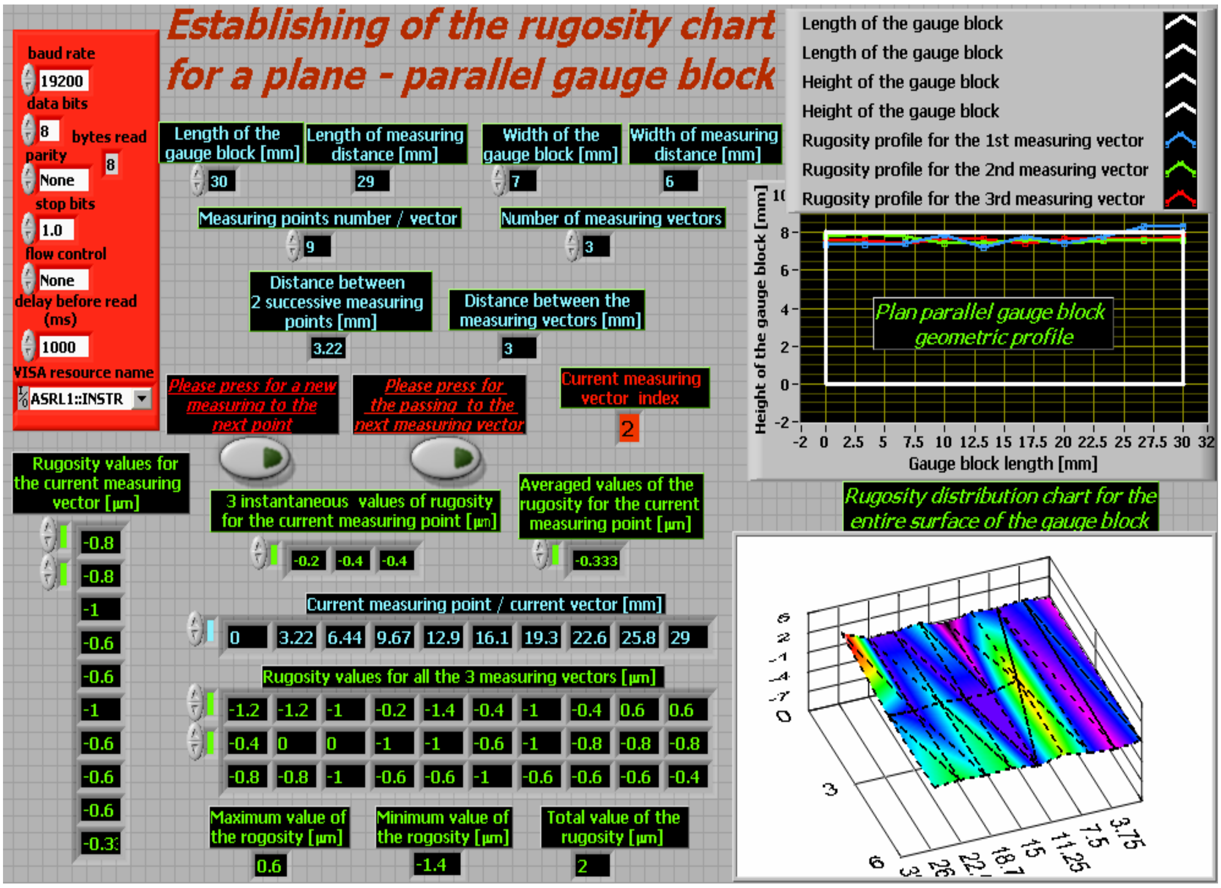

Figure 2. The panel window of the LabVIEW application for the control of the active surface of a plane – parallel block gauge

The panel contains also two virtual ordering knobs, for the passing to the next measuring point, respectively to the next 1 – D array of measuring points.

Regarding the diagram window, the key – role function for the data acquisition is *VISA SERIAL*, sealed in red and having set the acquisition parameters (baud rate, data bits, parity and so on). The signal is passed through a timer, having as output a string. *Read from string* converts the string into displacement signal [3]. In this phase, the virtual instrument permitted the displaying of the instantaneous value of the ruggedness for the current measuring point. For the information stabilization there were programmed three reading of the instantaneous value of the measured ruggedness, in the current measuring point, this values being averaged. For this reason, there was used a repetitive *FOR* structure, containing three iterations for each reading cycle.

Besides of the first FOR – LOOP structure, we programmed a WHILE – LOOP structure for the conditioning of the measuring continuing. In this way, the repeating of the measuring process, by the averaging of the three instantaneous values is made only by respecting the condition referring the positioning of the block gauge with the next point for the next measuring cycle. Another condition is that the user switches the virtual knob ***Please press for a new measuring to the next point***. Similarly it was conditioned the passing to the next measuring 1 – D array.

The repeating of the measuring for all the 1 – D array measuring points, was assured using another repetitive FOR structure, containing 9 + 1 iterations, corresponding to each point. The 10th iteration was necessary for the enclosing of the graphic profile corresponding to the current measuring 1 – D array. In this way, after the passing through the FOR structure, there were obtained the three 1 – D arrays containing the ruggedness values, for each 1 – D measuring point array. By each of these matrix were extracted the minimum and maximum values of the ruggedness deviation, so that the program calculated also the total ruggedness variation for the entire measured surface of the gauge block.

For the deviations ruggedness displaying fallowing the three 1 – D arrays, we used a 2 – D graphic representation function, in Cartesian coordinates, type *X-Y Plot* (sealed in green). As input for this function we used a data MUX, through which were collected the 1 – D data in order to define equations for the straight lines who compose the nominal geometric profile of the gauge block. Also were defined the equations for the curves who materialize the real geometric profile of the gauge – block, for each of the three 1 – D measuring points array. The ruggedness deviation distribution curves equations were obtained cumulating the points 1 – D array who defines the nominal profile straight line with the three 1 – D arrays of the ruggedness variation.
Sealed in black there was defined the function for the tracing of the 3 – D ruggedness variation distribution chart, for the entire measured surface of the gauge block. It have as inputs three values arrays, for each coordinate axis. For the XOY plane there were generated two matrix: the first one containing the pair of coordinate points, fallowing the OX axis direction and the second the pair of coordinate points, fallowing the OY axis direction. The OZ axis direction is materialized by the ruggedness values obtained into the global matrix, due to the passing of the two FOR structures.

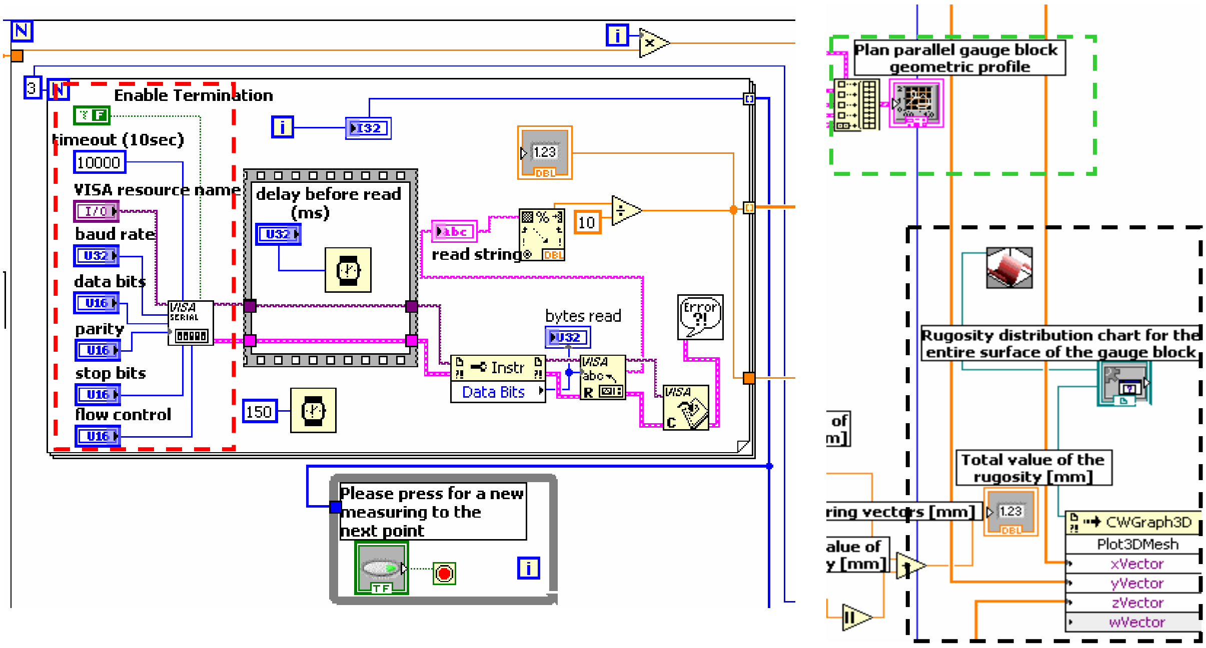

Figure 3. Aspects of the diagram for the active surface control of a plane parallel gauge block

3. CONCLUSIONS REGARDING THE MODULARIZATION OF THE SURFACES INSPECTION, VIA VIRTUAL INSTRUMENTATION

Another major advantage of this type of virtual instrument consists into its flexibility. Once created a surface control application, it can be easily adapted for a lot of cases concerning the surface quality inspection, not only for plane parallel pieces, but for more complex geometry probes, like the active rolling way of the bearings.
Besides, by the implementation of two or more displacement transducers, the application can be adapted so that it could measure simultaneously the quality of two or more active surfaces of a complex probe.

4. REFERENCES

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