DIMENSIONAL AND GEOMETRICAL MEASUREMENTS AND INTERPRETATION OF MEASURING RESULTS ON THE BASIS OF THE SKIN-MODEL

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Abstract: Geometrical Product Specification and Verification (GPS) are a means to transform function dependent demands as defined by the customer into produced work pieces. The newly developed so-called Skin-Model allows the complete implementation of Geometrical Product Specification and Verification into Co-ordinate Metrology and vice versa. Selected series of work pieces from industrial manufacturers are measured in a precision measuring laboratory and based on the measurement results gained it is possible to carry out extensive evaluations by using statistical methods e.g. correlation analysis. This allows to get information about interrelationships between different geometrical deviations and on this basis it is possible to influence manufacturing conditions for decreasing production costs and increasing product quality.

Key words: work piece geometry, skin-model, GPS, statistical analysis

1 Introduction

The "Skin-Model" presents a new description for Geometrical Product Specification and Verification (GPS) with its associated details and on its basis every workpiece can be geometrically defined and considered by applying manipulations of the workpiece geometry [1].

Geometrical Product Specifications are a means to transform function dependent demands into produced workpiece and parts and are based on:

- mathematical rules and methods,
- consideration of macro and micro geometry,
- possibilities for measuring of quantities and especially toleranced quantities and
- evaluation of uncertainty, etc.

Generally there are many definitions and concepts in Geometrical Product Specification (GPS) but one of them which has been presented a few years ago named "Skin-Model" [2] was studied in this research. The "Skin-Model" presents a new description for Geometrical Product Specification and Verification (GPS) with its associated details and on its basis every workpiece can be geometrically defined and considered by applying manipulations of the workpiece geometry. This determination is based on mathematical rules and definitions. It means that according to this determination every workpiece can be designed and on the other hand according to the design it can be measured very clearly.

2 The “Skin-model”

The Skin-Model is a geometric model of the physical interface between a workpiece and its environment. It defines non-ideal features with consideration of ideal features at the workpiece circumference. A real feature is a non-ideal feature the shape of which depends of the production process and its conditions whereas ideal features exist only in theory (see Figure 1).

Ideal features Non-ideal features

Figure 1. Ideal model and Skin-Model of a workpiece

The Skin-Model is based on some general and basic definitions and using some tools which are named Operations which can be compared with mathematical operations as in arithmetics.

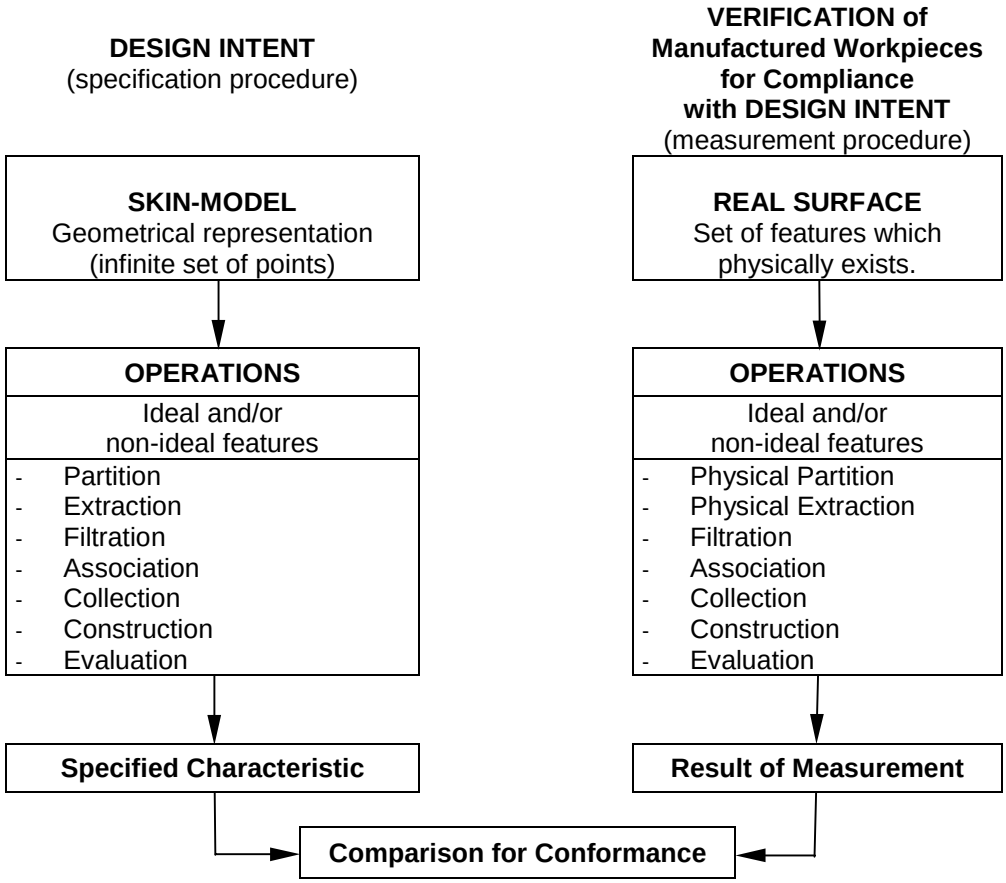

Figure 2. Comparison of Design Intent and Verification of manufactured workpieces

Operations which are applied within the Skin-Model are:

1) Partition,
2) Extraction,
3) Filtration,
4) Association,

5) Collection,
6) Construction and
7) Evaluation.

Figure 2 shows the parallel procedures between “Design Intent” and the “Verification of manufactured workpieces” so that they comply with the design intent [3].

3 Concept for Evaluation of Measurement Results with Regard to GPS

The principal idea of this research project is the implementation of Geometrical Product Specification and Verification into the Skin-Model on the basis co-ordinate measuring technique by applying a specifically developed evaluation software. The general concept for this statistical evaluation of measurement results is introduced whereas only a first report on results gained up to now can be given. A more generally applicable solution will be given in the near future but additional investigations have to be carried out.

Under industrial conditions manufacturing processes can be divided into two principal groups:

1. The processes of the Testing group: this contains all of main activities which belong mainly to the quality control department, for example: measuring tasks, transformation and transfer of measuring results, primary statistical calculation, etc.
2. The non-testing group, which contains all other activities.

Figure 3 gives an overview of this concept.

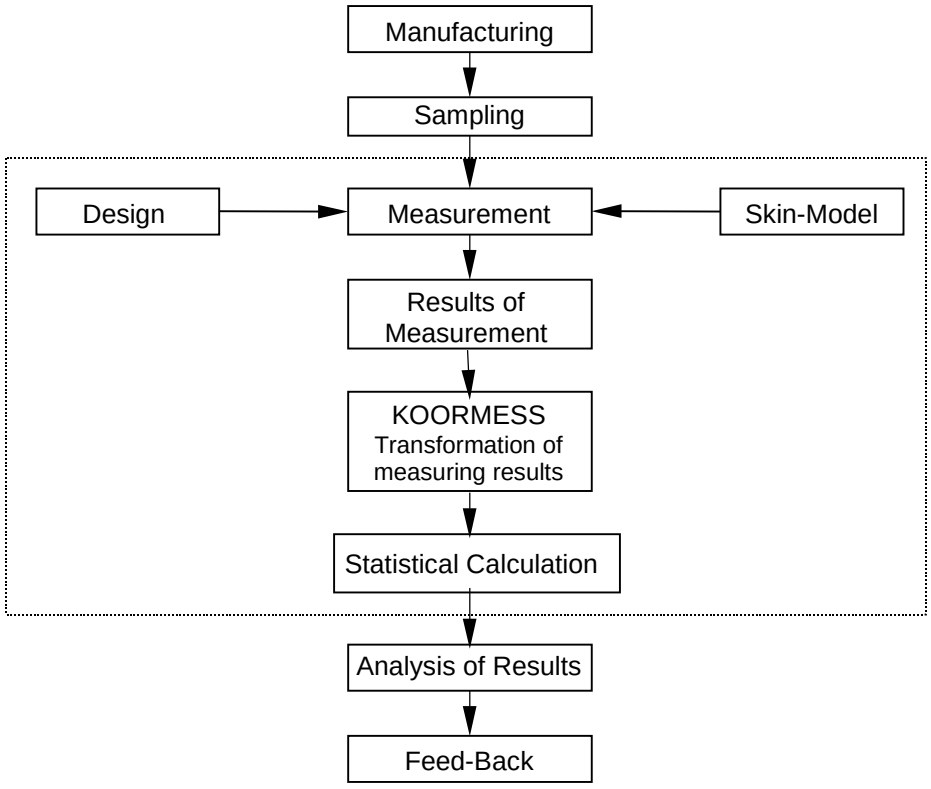

Figure 3. Overview of concept

A sample of workpieces will be taken after manufacturing or production. In the first step, nominal geometrical characteristic or feature can be obtained directly from design and its technical drawings. The operator can find the measuring strategy and characteristic by taking into account the Skin-Model. In the second step the series of workpieces will be measured. By application of the software KOORMESS the measuring results will be transformed into suitable data format that can be used for further calculation and study. In the next step the measuring results will be evaluated with applying computer programs which are available for statistical evaluations. Now the quality control department will be able to analyse this phase easily and can give necessary advice or notice to relevant other departments especially in the developing and planning domain.

4 Conclusion

In the described research work series of different workpieces from industrial manufacturers have been selected and samples of at least 15 parts from each workpiece have been taken. These workpieces were measured with an accurate co-ordinate measuring machine in a precision measuring laboratory. For statistical evaluation Correlation analysis was chosen and calculations have been carried out for all of these workpieces to investigate the correlation between different characteristics of them.

The correlation between different geometrical deviations and the manufacturing conditions can help to achieve lower costs and higher quality in present production. The presented study can be seen as a further step in the direction of a comprehensive analysis of workpiece geometry and is fully in line with research work already carried out in the past the ideas of which have been presented at former international conferences [4].

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