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Selected problems of complex assessment of technical surface topography

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Abstract

In the paper was introduced the system which consists collections of modules for receiving, normalization and data processing from profilographometer (coordinates of profiles - 2D) and modules to calculate of numerous collection of surface parameters (3D) and surface visualisation module. Additionally in the system developed a module for canvassing images 2D of technical surfaces and transformation data to images 3D along with estimation surface. Calculating of stereometric surfaces parameters with data representing flat image of surface (2D). It allow to additional enlargement range of the system on estimation tasks of surface topography such as surfaces of abrasive tools without use of contact- methods and without their disassembly from machine tools.

Keywords: profile measurements, knowledgebase, neural network.

Wybrane problemy kompleksowej oceny topografii powierzchni technicznych

Streszczenie

W artykule przedstawiono poglądowy opis opracowywanego systemu składającego się z baz wiedzy zawierających relacje między parametrami 2D i 3D, baz danych, baz reguł wnioskowania, modułów analiz i wizualizacji, dokumentacji zespołów pomocniczych (akwizycji obrazów 2D) i modułów komunikacji z użytkownikiem. System umożliwia przetwarzanie danych z profilografometru, który wykorzystując wyniki z jednego lub dwóch pomiarów (zarysów w jednym przekroju o długości określanej przez system, dwóch pomiarów w przekrojach do siebie prostopadłych lub też zarys pomiaru po torze spiralnym według nowych koncepcji realizacji pomiarów profilografometrycznych opracowanych w polskich ośrodkach badawczych) oraz wykorzystując wiedzę zgromadzoną w formie reguł wnioskowania i w module sztucznych sieci neuronowych, pozwala na wyznaczenie licznego, komplementarnego zbioru parametrów stereometrycznych powierzchni. Możliwe jest ponadto wyznaczenie obrazu powierzchni o cechach statystycznych zgodnych z powierzchnią, na której przeprowadzono pomiar.

Słowa kluczowe: pomiar profilu, baza wiedzy, sieci neuronowe.

1. Introduction

The most surfaces meet in technique do not have determined statistical features and contain irregularities of different shape and position. The assignment to surface of qualitative features introduces necessity of analysis and measurement of this surface parameters. Exploitative properties of surface greatly are related to its stereometric features. Parameters characterizing stereometric properties of surface are much often different from appointive parameters for surface profile (Fig.1). On the basis of typical procedure consisting of analysis of profiles surface [1, 2, 3, 4, 5, 6, 7] we cannot infer about statistical features of the surface without working out of suitable inferring system. Besides determination of parameters characterizing stereometric features of surface topography thorough a profile is an expensive operation, labour-consuming and table demanding to make possible such measurement. To solve introduced problems the author worked out and dynamically develops the system (named „Realsurface v1.0") to processing data from profilographometer. It use results of one or two measurements (profile measurements in one section in length qualified by the system or two measurements in sections normal to itself), and use aggregated knowledge in form of inferring rules and module of artificial neural networks. Taught on very numerous data, it would allow to calculate numerous and complementary parameter collection of stereometric surfaces. Besides is possible to calculate a surface images with statistical compatible features with a surface which the measurement is realized on. Worked out system consists of collection of modules to receiving, normalization and data processing from profilographometer (coordinates of profiles - 2D) and modules to calculate numerous collection of surface parameters (3D), and surface visualisation module. Additionally in the system there is a module of canvassing images 2D of technical surfaces and transformation data to images 3D with estimation of a surface. Calculating of stereometric surfaces parameters with data representing flat images of surface (2D), allow to additional range enlargement of the system on estimation tasks of surface topography such as surfaces of abrasive tools without use of contact-methods and without their disassembly from machine tools.

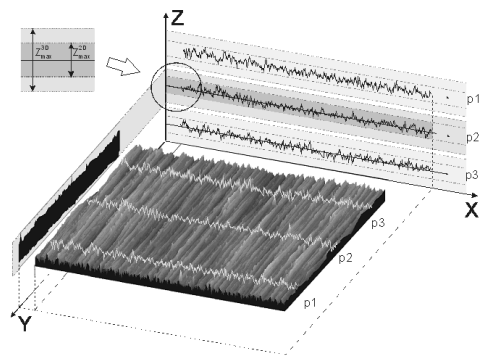


Fig. 1. The surface and its example profiles
Rys. 1. Powierzchnia i jej przykładowe profile

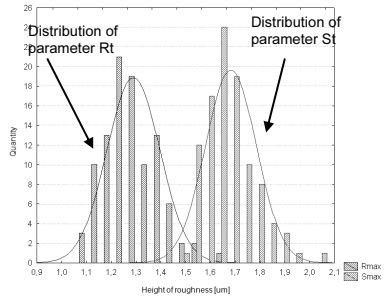
It is necessary to notice that the probability in examined section profile peak will be peak of surface topography extremely small, theoretically equal to zero. In own works of the author showed, that differences between parameters of profiles and parameters of surface are considerable, what was introduced on Fig. 2-5 with the use data of 120 surfaces with specified characteristics. As it results from the performed comparisons the expected values of each determined parameter of profiles and of surfaces are much more different (Tab.1).

Tab. 1. Comparison of analyzed parameters
Tab. 1. Porównanie analizowanych parametrów

Profile parameters $P_{(i)}^{2D}$ [μm]		Surface parameters $P_{(i)}^{3D}$ [μm]		$P_{(i)}^{2D} / P_{(i)}^{3D}$
Rt	1,29	St	1,68	Rt:St 0,77
Rz	1,19	Sz	1,65	Rz:Sz 0,72
Rp	0,63	Sp	0,84	Rp:Sp 0,75
Rv	0,56	Sv	0,85	Rv:Sv 0,66

In the examined case value of estimated parameters of a surface are 23-34% greater than value adequate parameters of a profile. It means that on the basis of typical procedure consisting of surface profile analysis, we cannot infer about statistical features of the surface without working out suitable inferring system (Fig. 6). The system would consist of knowledge base containing relationships between parameters 2D and 3D, database, base of inferring rules, modules of analyses and visualizations, specifications of auxiliary units (canvassing images 2D) and modules of communication with

the user. To improve incorrect state of current knowledge and minimize consequential errors of two-dimensional form of assessment surface after abrasive processing, the author worked out new and modern system to inferring, modeling and analyse the technical surfaces topography, named Realsurface v1.0 (Fig. 5). It is used for own investigation and for doctoral dissertation.



Rys. 2. Porównanie rozkładów parametru profilu Rt i parametru powierzchni St
Fig. 2. Distribution comparison of profile parameter Rt and surface parameter St

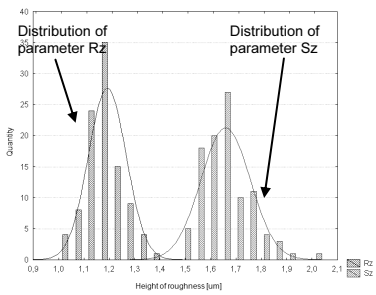


Fig. 3. Distribution comparison of profile parameter Rz and surface parameter Sz
Rys. 3. Porównanie rozkładów parametru profilu Rz i parametru powierzchni Sz

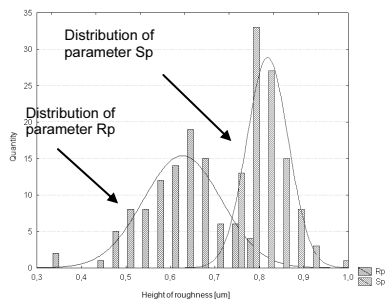


Fig. 4. Distribution comparison of profile parameter Rp and surface parameter Sp
Rys. 4. Porównanie rozkładów parametru profilu Rp i parametru powierzchni Sp

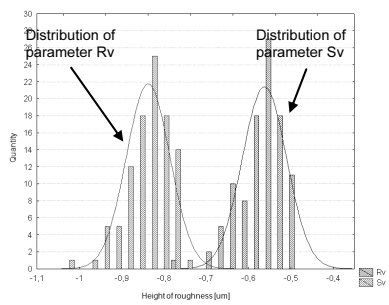


Fig. 5. Distribution comparison of profile parameter Rv and surface parameter Sv
Rys. 5. Porównanie rozkładów parametru profilu Rv i parametru powierzchni Sv

The system Realsurface v1.0 is complex collection of modules, oriented on data processing from most popular profilographometers used in many research centres. Worked out system makes possible inference about stereometric features of a surface on the basis of its profiles, appointed toward longitudinal and transverse tooling signs, using modern methods of artificial intelligence and fuzzy logic. The system makes also possible the use additional parameters, such whose usefulness in specific analyses is higher than specific parameters at present in common documents. The system of analyses contains also modules to the automatization of inferring and classification surface.

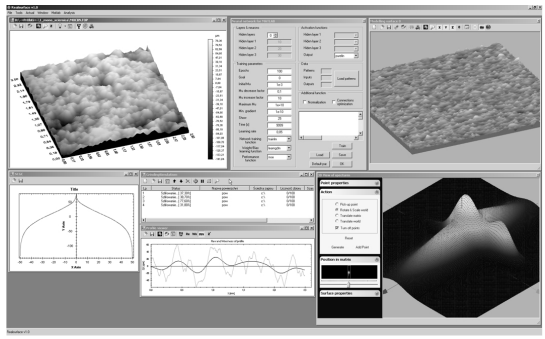


Fig. 6. Example analysis modules of system Realsurface v1.0
Rys. 6. Przykładowe moduły analiz systemu Realsurface v1.0

2. Effects of the inferring system

Effects of developed and described system are as following:

- Creation of the system, assuring low costs of quick and complex estimation of stereometric surfaces property on the basis of universally and practically linear measurement. Multiple (even to ten times) decreasing time of marking parameters describing stereometric surface structure.
- Saving compatibility of the used methods with past devices and parameter estimation of surface roughness. It means that past metrology equipment for linear measurement can be used to evaluation the stereometric surface parameter.
- Automatic compatibility tests of technological effects with regards constitutions of tooling process.
- Easy and comfortable result presentation of machined surfaces, for scientific papers, publications and technical specifications.

Scientific importance and utility of the system for development of knowledge and applications follows besides from wider effects which are:

- Prognosing of surface estimation parameters. It makes possible better selection and optimization of parameters of the tooling, and assures obtainment of required properties of stereometric machined surfaces.
- Testing of new solutions of technological tools, and methods of tooling already on designing stage with the use of generating surface systems after abrasive processing. It will contribute to considerable savings of new technology introductions in industry, and can accelerate technological development.
- Creation of complex modeling and surface topography estimation system allow to make cheap estimation of geometrical surface structure.

3. References

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