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CONTACT PROFILOMETER SURFACE MAPPING

MAPOVÁNÍ POVRCHU PEVNÝCH TĚLES KONTAKTNÍM PROFILOMETREM

Abstract

Taylor Hobson instrument Form Talysurf Series 2 is introduced into this paper. This device is mechanical contact inductive profilometer for measuring roughness, waviness and form of solid surfaces. Owing to special electric circuitry it is able to work with extraordinary resolution and high accuracy. To get possession of more complete picture of the surface the instrument can create 3D surface topography by software controlled measuring row of parallel profiles. Measurements are analyzed via PC using the TalyMap software manufactured by Taylor Hobson Precision.

Abstrakt

V příspěvku je představen přístroj Form Talysurf Series 2 od firmy Taylor Hobson. Toto zařízení je mechanický indukční profilometr proměření drsnosti, vlnitosti a tvaru pevných povrchů. Díky speciálnímu elektrickému zapojení je schopné měřit s mimořádným rozlišením a vysokou přesností. K získání komplexnější informace o povrchu můžeme s pomocí přístroje vytvořit též trojrozměrný obraz povrchu softwarově řízeným snímáním řady paralelních profilů. 3D měření jsou analyzována programem TalyMap vyvinutým rovněž firmou Taylor Hobson.

1 INTRODUCTION

Surface topography has great importance in specifying quality of a surface. One of the main parameter describing surface integrity is surface roughness. In the manufacturing industry, surface must be within certain limits of roughness. Therefore, measuring surface roughness is vital to quality control of machining work piece. Taylor Hobson Precision factory is firm with longtime tradition. It is well-known as a producer of approved devices for solid surface texture measuring. Form Talysurf Series 2 instrument offers hight performance hardvare and software for a wide range of industries and applications with the greattest possible accuracy in the shortest possible time.

An instrument Form Talysurf Series 2 is mechanical „contact“ inductive profilometer. Term *mechanical profilometer* means that mechanical transducer, called stylus - in our case with diamond tip - is dragged across a surface. It's movement in the vertical direction is recorded to obtain a surface profile. Stylus is the only active contact between the instrument and the surface, therefore it is very important part of the system. It's dimensions and shape are main factors. It can have a marked influence on the information which the instrument gathers. In our case there is a conical 90° stylus with a spherical diamond tip of 2 μm radius. The stylus tip acts as a mechanical filter. It is important to point out that within dragging of stylus the transducer uses as low moment of inertia as possible to allow the stylus to trace the surface without losing contact when passing over peaks. Owing to this minimal stylus force danger of surface damage is practically nonexistent. The stylus force is mentioned of 3 mN or less.

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Term *inductive profilometer* means, that an electrical signal is obtained and amplified to produce vertical magnification. The range to resolution ratio is important value for this kind of instruments - induction transducers. As we know, ordinary ratio value is approx 1,000 : 1. Special electric circuits used here are in charge of the range to resolution ratio has increased value better than 64,000 : 1. The device is able to work with three vertical ranges whose values and corresponding resolutions are listed in Tab.1. There is evident in this table the remarkable value 0.6 nm resolution can be reached with this device.

Tab. 1 Available instrument resolution

Range [mm]	Resolution [nm]
0.8	16
0.16	3
0.033	0.6

Contact instrument really can't register the finest surface valleys or cracs, but it is able to record cracs which are 270 nm or more wide if the smallest range is used.

Last notice is relative to gauge traverse length. It's interval is 120 mm/0.1 mm (*xmax/xmin*), data sampling interval is 0.25 μm for traverse length to 30 mm and 1 μm for longer one respectively. Speed of stylus movement is either 0.5 mm p/s or 1 mm p/s.

2 2D MEASURING

Measuring linear data are run with Taylor Hobson Ultra software in a way which is chosen. The first step is data filtering. One of the substantial reason is occasion (necessity) to separate roughness, waviness and form error. The device offers three types of filters. Gaussian filter, the most used at present, and two older analog instruments ISO 2CR or 2CR PC used earlier. It is able to extract from amplitude, spacing or hybrid parameters. These parameters can be calculated for Primary profiles, Roughness profiles or Waviness profiles, as indicated by the prefix letter (P, R or W respectively).

Probably the most frequent task is ascertaining of roughness. Roughness parameters have prefix letter R and user can extract from a long row of these ones. Parameters used in engineering, automobile industry, optics or printing industry can be counted after their chosen. Fig. 1 shows typical modified profile after analysing and counting prameters. In the table under the plot there is seen most of the roughness parameters the software offers.

Linear data are possible to use for several another calculations. As was mentioned above, the device is able to draw and count surface form from linear measurement. Among possible calculation fall determination of two slope adjacent surface planes, measuring of thin film thickness or calculation of radius of curved surface can be got too.

Linear measuring are easy, reliable and fast.

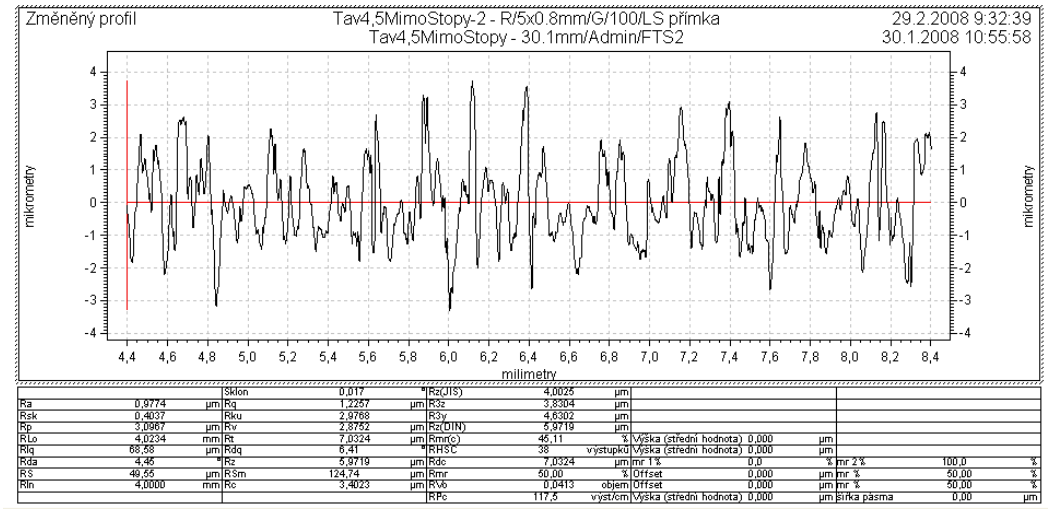

Fig. 1 Graphical output roughness measuring with table of roughness parameters

3 3D MEASURING

3D representation offers more complete picture of the surface. It is acquired by scanning parallel profiles over a surface. The distance between two adjacent lines can be 1 µm or more. Raster scanning is slower than single shot (non-contact) systems, but is more flexible in terms of area examined, data sensity and dynamic range. Another benefit of 3D picture is its ability to visualize surface defect or surface features. 3D representation is also better at detecting and analysing defect and more statistically stable.

Gained data are analysed via PC using the TalyMap software. Again it is able to choose among a lot of parameters, functions, diagrams or pictures. The offer includes data manipulation tools such as high-resolution zooming, filtering, levelling by least square line removal, symmetries, rotations, threshold setting and cylindrical, spherical or polynomial form removal, profile extraction, distance measurement, calculation of frequency spectrum or power spectral density etc. Parameter sets include area and volume, counting and sorting, roughness and waviness in both 2D and 3D and automatic step height calculation. Data presentation tools involve photo-realistic images in full color, meshed axonometric projections and contour diagrams.

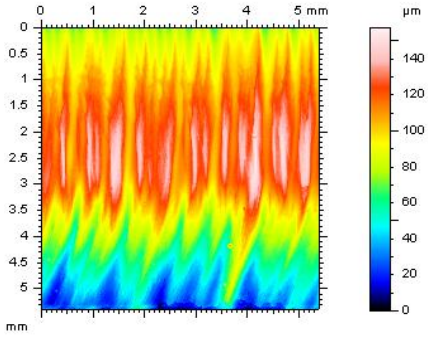

Fig. 2 One of the possible projection of area measuring. Cutting surface of 6 mm thick metal plate sawn with laser is here.

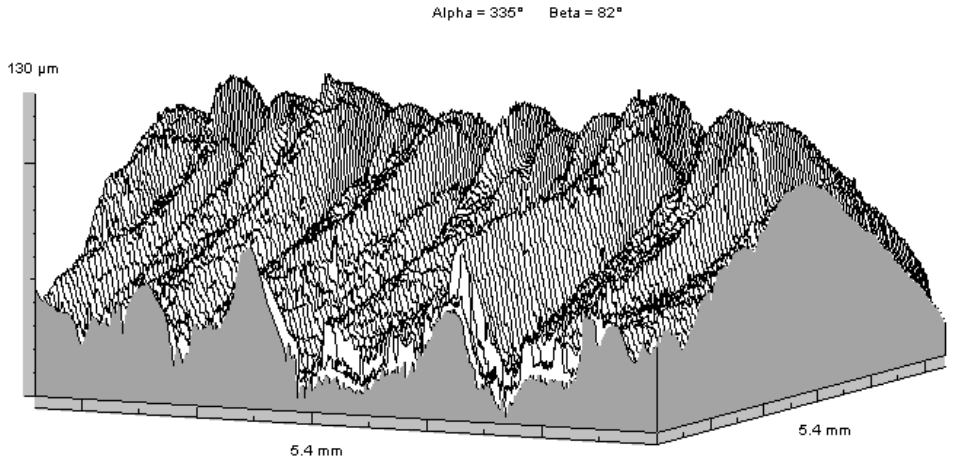

Fig. 3 View of the same surface as in the figure 2, axonometric map is used here

4 CONCLUSIONS

Present contact profilometry is always important implement for surface mapping. Some of it's advantages are long traverse length, high resolution, short measuring time and low price.

ACKNOWLEDGEMENT

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