SLOVENSKI STANDARD
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Specifikacije geometrijskih veličin izdelka (GPS) - Filtriranje - 31. del: Robustni filtrni profil: Gaussovi regresijski filtri (ISO/DIS 16610-31:2015)

Geometrical product specifications (GPS) - Filtration - Part 31: Robust profile filters: Gaussian regression filters (ISO/DIS 16610-31:2015)

Spécification géométrique des produits (GPS) - Filtrage - Partie 31: Filtres de profil robustes: Filtres de régression gaussiens (ISO/DIS 16610-31:2015)

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ISO/DIS 16610-31

ISO/TC **213**

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Voting begins on:
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Geometrical product specifications (GPS) — Filtration —

Part 31:
Robust profile filters: Gaussian regression filters

Spécification géométrique des produits (GPS) — Filtrage —

Partie 31: Filtres de profil robustes: Filtres de régression gaussiens

ICS: 17.040.20

ISO/CEN PARALLEL PROCESSING

This draft has been developed within the International Organization for Standardization (ISO), and processed under the **ISO lead** mode of collaboration as defined in the Vienna Agreement.

This draft is hereby submitted to the ISO member bodies and to the CEN member bodies for a parallel five month enquiry.

Should this draft be accepted, a final draft, established on the basis of comments received, will be submitted to a parallel two-month approval vote in ISO and formal vote in CEN.

To expedite distribution, this document is circulated as received from the committee secretariat. ISO Central Secretariat work of editing and text composition will be undertaken at publication stage.

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 16610-31 was prepared by Technical Committee ISO/TC 213, *Dimensional and geometrical product specifications and verification*.

This first edition cancels and replaces ISO/TS 16610-31:2010 which has been technically revised.

ISO 16610 consists of the following parts, under the general title *Geometrical product specifications — Filtration*:

— *Part 1: Overview and basic concepts*

— *Part 20: Linear profile filters: Basic concepts*

— *Part 21: Linear profile filters: Gaussian filters*

— *Part 22: Linear profile filters: Spline filters*

— *Part 28: Profile filters: End effects*

— *Part 29: Linear profile filters: Spline wavelets*

— *Part 30: Robust profile filters: Basic concepts*

— *Part 31: Robust profile filters: Gaussian regression filters*

— *Part 32: Robust profile filters: Spline filters*

— *Part 40: Morphological profile filters: Basic concepts*

— *Part 41: Morphological profile filters: Disk and horizontal line-segment filters*

— *Part 49: Morphological profile filters: Scale space techniques*

— *Part 60: Linear areal filters: Basic concepts*

— *Part 61: Linear areal filters: Gaussian filters*

— *Part 71: Robust areal filters: Gaussian regression filters*

— *Part 85: Morphological areal filters: Segmentation*

The following parts are planned:

— *Part 26: Linear profile filters: Filtration on nominally orthogonal grid planar data sets*

— *Part 27: Linear profile filters: Filtration on nominally orthogonal grid cylindrical data sets*

— *Part 45: Morphological profile filters: Segmentation*

— *Part 62: Linear areal filters: Spline filters*

— *Part 69: Linear areal filters: Spline wavelets*

— *Part 70: Robust areal filters: Basic concepts*

— *Part 72: Robust areal filters: Spline filters*

— *Part 80: Morphological areal filters: Basic concepts*

— *Part 81: Morphological areal filters: Sphere and horizontal planar segment filters*

— *Part 89: Morphological areal filters: Scale space techniques*

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ISO/DIS 16610-31:2014(E)

Introduction

This part of ISO 16610 is a geometrical product specification (GPS) standard and is to be regarded as a global GPS standard (see ISO/TR 14638). It influences the chain link 3 of all chains of standards.

For more detailed information of the relation of this part of ISO 16610 to the GPS matrix model, see Annex C.

The ISO/GPS Masterplan given in ISO 14638 gives an overview of the ISO/GPS system of which this document is a part. The fundamental rules of ISO/GPS given in ISO 8015 apply to this document and the default decision rules given in ISO 14253-1 apply to specifications made in accordance with this document, unless otherwise indicated.

This part of ISO 16610 develops the concept of the discrete robust Gaussian regression filter. The robust process reduces the influence of the deep valleys and high peaks. The subject of this part of ISO 16610 is the robust Gaussian regression filter of degree $p = 2$, which has very good robust behaviour and form approximation for functional stratified engineering surfaces.

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Geometrical product specifications (GPS) — Filtration —

Part 31: Robust profile filters: Gaussian regression filters

1 Scope

This part of ISO 16610 specifies the characteristics of the discrete robust Gaussian regression filter for the evaluation of surface profiles with spike discontinuities such as deep valleys and high peaks.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 16610-1:2006, *Geometrical product specifications (GPS) — Filtration — Part 1: Overview and basic terminology*

ISO 16610-20, *Geometrical product specifications (GPS) — Filtration — Part 20: Linear profile filters: Basic concepts*

ISO 16610-30, *Geometrical product specifications (GPS) — Filtration — Part 30: Robust profile filters: Basic concepts*

ISO/IEC Guide 99, *International vocabulary of metrology — Basic and general concepts and associated terms (VIM)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC Guide 99, ISO 16610-1, ISO 16610-20, ISO 16610-30 and the following apply.

3.1
robust filter
filter that is insensitive to output data against specific phenomena in the input data

3.2
regression filter
M-estimator based on the local polynomial modelling of the profile

3.3
robust Gaussian regression filter
regression filter based on the Gaussian weighting function and a biweight influence function

3.4
biweight influence function
asymmetric function which is scale-invariant, expressed by

$$\psi(x) = \begin{cases} x \times \left(1 - \left(\dfrac{x}{c}\right)^2\right)^2 & \text{for} \quad |x| \le c \\ 0 & \text{for} \quad |x| > c \end{cases} \tag{1}$$

where

    c is the scale parameter

4 Robust Gaussian regression filter

4.1 Weighting function

The weighting function of the robust Gaussian regression filter depends on the profile values (distance to the reference line) and the location of the weighting function along the profile.

4.2 Filter equation

4.2.1 General

The robust Gaussian regression filter is derived from the general discrete regression filter (see Annex A) by setting the degree to $p = 2$, using the biweight influence function and the Gaussian weighting function according to ISO 16610-21. In the case of $p = 2$, the robust Gaussian regression filter follows form components up to the second degree.

4.2.2 Filter equation for the robust Gaussian regression filter for open profiles

For open profiles, the filter equation for the robust Gaussian regression filter is given by

$$w_k = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} \times \left(\boldsymbol{X}_k^T \times \boldsymbol{S}_k \times \boldsymbol{X}_k \right)^{-1} \times \boldsymbol{X}_k^T \times \boldsymbol{S}_k \times \boldsymbol{z} \tag{2}$$

The regression function is spanned by the matrix

$$\boldsymbol{X}_k = \begin{bmatrix} 1 & x_{1,k} & x_{1,k}^2 \\ \vdots & \vdots & \vdots \\ 1 & x_{n,k} & x_{n,k}^2 \end{bmatrix} \tag{3}$$

where

$$x_{l,k} = (l-k) \times \Delta x, \qquad l = 1, ..., n \tag{4}$$

The space variant weighting function, $\boldsymbol{S}_k$, is given by

$$\boldsymbol{S}_k = \begin{bmatrix} s_{1,k} \times \delta_1 & 0 & \cdots & 0 \\ 0 & s_{2,k} \times \delta_2 & & \vdots \\ \vdots & & \ddots & 0 \\ 0 & \cdots & 0 & s_{n,k} \times \delta_n \end{bmatrix} \tag{5}$$

with the Gaussian function

$$s_{l,k} = \frac{1}{\gamma \times \lambda_c} \times \exp\left(-\pi \left(\frac{x_{l,k}}{\gamma \times \lambda c} \right)^2 \right), \qquad l = 1, .., n \tag{6}$$