INTERNATIONAL STANDARD

ISO 16610-85

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Geometrical product specifications (GPS) — Filtration —

Part 85: Morphological areal filters: Segmentation

Spécification géométrique des produits (GPS) — Filtrage —
Partie 85: Filtres surfaciques morphologiques: Segmentation

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Contents

Page

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Foreword

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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 16610-85 was prepared by Technical Committee ISO/TC 213, *Dimensional and geometrical product specifications and verification*.

This first edition of ISO 16610-85 replaces Annex A (Segmentation) in ISO 25178-2:2012.

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

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— *Part 1: Overview and basic concepts* [Technical Specification]

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— *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* [Technical Specification]

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

— *Part 30: Robust profile filters: Basic concepts* [Technical Specification]

— *Part 31: Robust profile filters: Gaussian regression filters* [Technical Specification]

— *Part 32: Robust profile filters: Spline filters* [Technical Specification]

— *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 62: Linear areal filters: Spline filters*

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— *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 82: Morphological areal filters: Motif filters*

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

See Annex C for relationships to other filtration documents.

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Introduction

This part of ISO 16610 is a geometrical product specification (GPS) standard and is to be regarded as a general GPS standard (see ISO 14638). It influences the feature characteristics chain link in the GPS matrix structure.

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.

For more detailed information on the relation of this part of ISO 16610 to other standards and to the GPS matrix model, see Annex E.

This part of ISO 16610 develops the terminology and concepts for areal segmentation.

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Geometrical product specifications (GPS) — Filtration —

Part 85:
Morphological areal filters: Segmentation

1 Scope

This part of ISO 16610 develops the terminology and concepts for areal morphological segmentation. In particular, it describes the watershed segmentation method and the Wolf pruning method. This document assumes a continuous surface.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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[1)], *Geometrical Product Specifications (GPS) — Data extraction techniques by sampling and filtration — Part 1: Basic terminology*

ISO 25178-2:2012, *Geometrical product specifications (GPS) — Surface texture: Areal — Part 2: Terms, definitions and surface texture parameters*

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3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 16610-1, ISO 25178-2:2012 and the following apply.

3.1 Geometrical feature terms

3.1.1
peak
point on the surface which is higher than all other points within a neighbourhood of that point

Note 1 to entry: For discrete data, a triangulization of the surface is necessary.

Note 2 to entry: There is a theoretical possibility of a plateau. In practice, this can be avoided by the use of an infinitesimal tilt.

Note 3 to entry: For specific implementation, see ISO 25178-3.

[SOURCE: ISO 25178-2:2012, 3.3.1]

3.1.1.1
Maxwellian hill
region around a peak such that all maximum upward paths end at the peak

Note 1 to entry: In ISO 25178-2:2012, 3.3.1.1, the term corresponding to this definition was “hill”.

1) To be published (Revision of ISO/TS 16610-1:2006).

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3.1.1.2
course line
curve separating adjacent hills

[SOURCE: ISO 25178-2:2012, 3.3.1.2]

3.1.1.3
hill
region around a single dominant peak whose boundary consists of a ring of course lines

Note 1 to entry: There may be other peaks in the hill but they will all be insignificant compared to the dominant peak.

3.1.2
pit
point on the surface which is lower than all other points within a neighbourhood of that point

Note 1 to entry: For discrete data, a triangulization of the surface is necessary.

Note 2 to entry: There is a theoretical possibility of a plateau. In practice, this can be avoided by the use of an infinitesimal tilt.

Note 3 to entry: For specific implementation, see ISO 25178-3.

[SOURCE: ISO 25178-2:2012, 3.3.2]

3.1.2.1
Maxwellian dale
region around a pit such that all maximum downward paths end at the pit

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Note 1 to entry: In ISO 25178-2:2012, 3.3.1.1, the term corresponding to this definition was “dale”.

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3.1.2.2
ridge line
curve separating adjacent dales

[SOURCE: ISO 25178-2:2012, 3.3.2.2]

3.1.2.3
dale
region around a single dominant pit whose boundary consists of a ring of ridge lines

Note 1 to entry: There may be other pits in the dale but they will all be insignificant compared to the dominant pit.

Note 2 to entry: Motifs are dales, see ISO 12085:1996.

3.1.3
saddle
set of points on the surface where ridge lines and course lines cross

[SOURCE: ISO 25178-2:2012, 3.3.3, modified — ISO 25178-2:2012 had “scale-limited ridge lines” in the definition.]

3.1.3.1
saddle point
saddle consisting of one point

[SOURCE: ISO 25178-2:2012, 3.3.3.1]

3.1.4
topographic feature
areal, line or point feature on a surface

[SOURCE: ISO 25178-2:2012, 3.3.4, modified — ISO 25178-2:2012 had “scale-limited surface” in the definition.]

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3.1.4.1
areal feature
hill or dale

[SOURCE: ISO 25178-2:2012, 3.3.4.1]

3.1.4.2
line feature
course line or ridge line

[SOURCE: ISO 25178-2:2012, 3.3.4.2]

3.1.4.3
point feature
peak, pit or saddle point

[SOURCE: ISO 25178-2:2012, 3.3.4.3]

3.1.5
contour line
line on the surface consisting of points of equal height

[SOURCE: ISO 25178-2:2012, 3.3.5]

3.2 Segmentation

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3.2.1
segmentation
method which partitions a surface into distinct regions

[SOURCE: ISO 25178-2:2012, 3.3.6, modified — ISO 25178-2:2012 had "scale-limited surface" in the definition.]

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3.2.1.1
event
mutually exclusive surface portions whose union covers the whole surface

EXAMPLE Ordinate values, Maxwellian hills, Maxwellian dales, etc.

3.2.1.2
watershed segmentation
segmentation which uses the concept of filling dales (hills) with water to determine the saddle at which the water first overflows and the adjacent dale (hill) into which it overflows

3.2.2
segmentation function
function which splits a set of events into two distinct sets called the significant events and the insignificant events and which satisfies the three segmentation properties

Note 1 to entry: A full mathematical description of the segmentation function and the three segmentation properties can be found in Scott (2004).[8]

[SOURCE: ISO 25178-2:2012, 3.3.6.1, modified — Notes 1 and 3 have not been included here.]

3.2.3
first segmentation property
P1
property where each event is allocated to the set of significant events or the set of insignificant events but not both

P1: $\forall A \subseteq E,\ \Psi(A) \cup \Phi(A) = A \text{ and } \Psi(A) \cap \Phi(A) = \varnothing$

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where

E is the set of all events;

$\Psi(.)$ maps events onto the set of significant events;

$\Phi(.)$ maps events onto the set of insignificant events.

SEE: Figure 1.

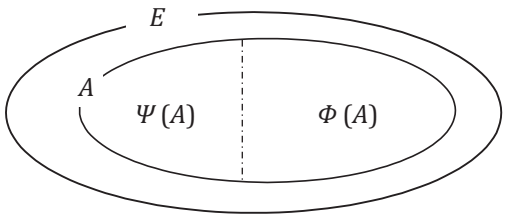

Figure 1 — Venn diagram of first segmentation property

[SOURCE: ISO 25178-2:2012, 3.3.6.2]

3.2.4
second segmentation property
P2
property where a significant event is removed from the set of events then the remaining significant events are contained in the new set of significant events

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P2: $\forall A \subseteq B \subseteq E, \quad \Phi(A) \subseteq \Phi(B)$

ISO 16610-85:2013
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where

E is the set of all events;

$\Psi(.)$ maps events onto the set of significant events;

$\Phi(.)$ maps events onto the set of insignificant events.

SEE: Figure 2.

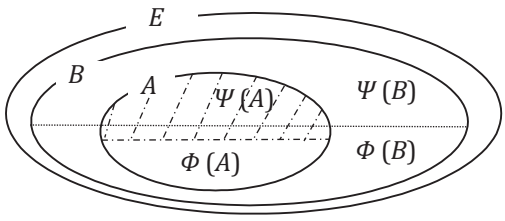

Figure 2 — Venn diagram of second segmentation property

[SOURCE: ISO 25178-2:2012, 3.3.6.3]

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3.2.5
third segmentation property
P3
property where an insignificant event is removed from the set of events then the same set of significant events is obtained

P3: $\forall A \subseteq B \subseteq E,\ \Psi(B) \subseteq A \Rightarrow \Psi(A) = \Psi(B)$

where

E is the set of all events;

$\Psi(.)$ maps events onto the set of significant events;

$\Phi(.)$ maps events onto the set of insignificant events.

SEE: Figure 3.

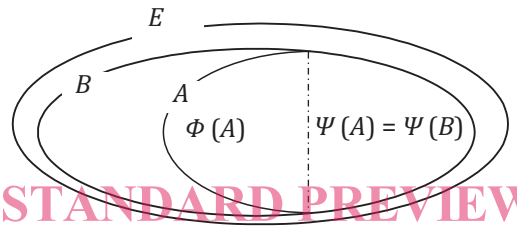

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Figure 3 — Venn diagram of third segmentation property

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[SOURCE: ISO 25178-2:2012, 3.3.6.4]

3.3 Pruning

3.3.1
change tree
graph where each contour line is plotted as a point against height in such a way that adjacent contour lines are adjacent points on the graph

Note 1 to entry: Peaks and pits are represented on a change tree by the end of lines. Saddle points are represented on a change tree by lines joining. See Clause 4 for more details concerning change trees.

[SOURCE: ISO 25178-2:2012, 3.3.7, modified — The reference in the note has been changed to Clause 4.]

3.3.2
pruning
method to simplify a change tree in which lines from peaks (or pits) to their nearest connected saddle points are removed

[SOURCE: ISO 25178-2:2012, 3.3.7.1]

3.3.3
height
signed normal distance from the reference surface to the surface

Note 1 to entry: The distance is defined normal to the reference surface.

Note 2 to entry: The height is negative, if from the reference surface, the point lies in the direction of the material.

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3.3.4
saddle height
height of the saddle

3.3.5
peak height
height of the peak

[SOURCE: ISO 25178-2:2012, 3.3.10]

3.3.5.1
local peak height
difference between the height of a peak and the height of the nearest connected saddle on the change tree

[SOURCE: ISO 25178-2:2012, 3.3.7.2]

3.3.6
pit height
height of the pit

[SOURCE: ISO 25178-2:2012, 3.3.11]

3.3.6.1
local pit height
difference between the height of a pit and the height of the nearest connected saddle on the change tree

[SOURCE: ISO 25178-2:2012, 3.3.7.3]

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3.3.7
Wolf pruning
pruning where lines are removed in order from the peak/pit with the smallest local peak/pit height up to the peak /pit with a specified local peak/pit height

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Note 1 to entry: The local peak/pit heights will change during Wolf pruning as removing lines from a change tree will also remove the associated saddle point.

Note 2 to entry: Other criteria for pruning are not covered in this part of ISO 16610. See References [9] and [10] for examples.

[SOURCE: ISO 25178-2:2012, 3.3.7.4, modified — Note 2 to entry has been added.]

3.3.7.1
Wolf peak height
minimum height threshold at which a peak is pruned using Wolf pruning

[SOURCE: ISO 25178-2:2012, 3.3.8, modified — The word “height” has been added in the definition.]

3.3.7.2
Wolf pit height
minimum height threshold at which a pit is pruned using Wolf pruning

[SOURCE: ISO 25178-2:2012, 3.3.9, modified — The word “height” has been added in the definition.]

3.3.8
height discrimination
minimum Wolf peak height or Wolf pit height of the surface which should be taken into account

Note 1 to entry: Height discrimination is a nesting index for Wolf pruning segmentation.

[SOURCE: ISO 25178-2:2012, 3.3.12, modified — ISO 25178-2:2012 had “scale-limited surface” in the definition. Note 1 to entry is different.]

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