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Part 62: Linear areal filters: spline filters

Spécification géométrique des produits (GPS) — Filtrage —

Partie 62: Filtres surfaciques linéaires: filtres spline

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 213, *Dimensional and geometrical product specifications and verification*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 290, *Dimensional and geometrical product specification and verification*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

A list of all parts in the ISO 16610 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

This document is a geometrical product specification (GPS) standard and is to be regarded as a general GPS standard (see ISO 14638). It influences chain link C on feature properties in the GPS matrix model.

The ISO GPS matrix model 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 information on the relationship of this document to the filtration matrix model, see Annex A.

For more detailed information of the relation of this document to other standards and the GPS matrix model, see Annex B.

This document specifies the terminology and concepts for linear areal spline filters. It specifies how to separate long- and short-wave components of a surface with a global shape retainment.

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Geometrical product specifications (GPS) — Filtration —

Part 62:
Linear areal filters: spline filters

1 Scope

This document specifies the characteristics of a linear areal spline filter with a global shape retainment.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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, *Geometrical product specifications (GPS) — Filtration — Part 1: Overview and basic concepts*

ISO 16610-21, *Geometrical product specifications (GPS) — Filtration — Part 21: Linear profile filters: Gaussian filters*

ISO 16610-22:2015, *Geometrical product specifications (GPS) — Filtration — Part 22: Linear profile filters: Spline filters*

ISO 16610-60:2015, *Geometrical product specification (GPS) — Filtration — Part 60: Linear areal filters — Basic concepts*

ISO 16610-61, *Geometrical product specification (GPS) — Filtration — Part 61: Linear areal filters — Gaussian filters*

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 16610-1, ISO 16610-21, ISO 16610-22, ISO 16610-60, ISO 16610-61 and ISO/IEC Guide 99 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
spline
linear combination of piecewise polynomials, with a smooth fit between the pieces

[SOURCE: ISO 16610-22:2015, 3.1, modified — Note 1 to entry removed.]

3.2
spline filter
linear filter based on splines

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3.3
linear areal filter
areal filter which separates surfaces into long-wave and short-wave components and is also a linear function

[SOURCE: ISO 16610-60:2015, 3.1, modified — Notes to entry removed.]

3.3.1
linear planar filter
linear areal filter (3.3) which separates planar surfaces into long-wave and short-wave components, which applies to nominal planar surfaces

[SOURCE: ISO 16610-60:2015, 3.1.1, modified — Note 1 to entry removed.]

3.3.2
linear cylindrical filter
linear areal filter (3.3) which separates cylindrical surfaces into long-wave and short-wave components, which applies to nominal cylindrical surfaces

[SOURCE: ISO 16610-60:2015, 3.1.2, modified — Note 1 to entry removed.]

3.4
cut-off wavelength
wavelength of a sinusoidal surface of which 50 % of the amplitude is transmitted by the *linear areal filter* (3.3)

Note 1 to entry: Linear areal filters are identified by the filter type and the cut-off wavelength.

Note 2 to entry: The cut-off value for the spline filter is an example of a nesting index.

Note 3 to entry: The cut-off 50 % value is by convention.

[SOURCE: ISO 16610-60:2015, 3.7, modified — Note 2 to entry revised.]

4 Spline areal filter

4.1 General

The following low-pass filter formula for spline profile filters is based on cubic splines with a regularization parameter depending on the cut-off wavelength for the smoothness of the resultant waviness profile (low-passed signal) and a tension parameter influencing the slope of the transfer function. It is the areal extension of the linear profile spline filter as specified in ISO 16610-22. Two versions of the areal spline filter are specified, one as linear planar filter for open surface areas and another as linear cylindrical filter for closed surface areas, i.e. cylindrical surfaces with periodic continuation.

4.2 Filter formula for cubic spline filter for topography maps on uniformly sampled grids

4.2.1 General

The filter formula is shown in Formula (1):

$$\boldsymbol{w} = \boldsymbol{A}_y \boldsymbol{z}\, \boldsymbol{A}_x^{\mathrm{T}} \tag{1}$$

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