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Partie 15: Descripteurs compacts pour analyse de vidéo

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

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This document was prepared by Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

A list of all parts in the ISO/IEC 15938 series can be found on the ISO website.

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Introduction

ISO/IEC 15938 (all parts), also known as "Multimedia content description interface", provides a standardized set of technologies for describing multimedia content. It addresses a broad spectrum of multimedia applications and requirements by providing a metadata system for describing the features of multimedia content.

The following are specified in this ISO/IEC 15938 (all parts):

Description schemes (DS) describe entities or relationships pertaining to multimedia content. Description schemes specify the structure and semantics of their components, which may be description schemes, descriptors or datatypes.

Descriptors (D) describe features, attributes or groups of attributes of multimedia content.

Datatypes are the basic reusable datatypes employed by description schemes and descriptors.

Description definition language (DDL) defines description schemes, descriptors and datatypes by specifying their syntax, and allows their extension.

Systems tools support delivery of descriptions, multiplexing of descriptions with multimedia content, synchronization, file format, etc.

The ISO/IEC 15938 series is subdivided into 15 published parts with further parts in development:

— **Part 1: Systems**: specifies the tools for preparing descriptions for efficient transport and storage, compressing descriptions, and allowing synchronization between content and descriptions.

— **Part 2: Description definition language**: specifies the language for defining the series set of description tools (DSs, Ds and datatypes) and for defining new description tools.

— **Part 3: Visual**: specifies the description tools pertaining to visual content.

— **Part 4: Audio**: specifies the description tools pertaining to audio content.

— **Part 5: Multimedia description schemes**: specifies the generic description tools pertaining to multimedia including audio and visual content.

— **Part 6: Reference software**: provides a software implementation of the series.

— **Part 7: Conformance testing**: specifies the guidelines and procedures for testing conformance of implementations of the series.

— **Part 8: Extraction and use of MPEG-7 descriptions**: provides guidelines and examples of the extraction and use of descriptions.

— **Part 9: Profiles and levels**: provides guidelines and standard profiles.

— **Part 10: Schema definition**: specifies the schema using description definition language.

— **Part 11: MPEG-7 profile schemas**: listing of profile schemas using description definition language.

— **Part 12: Query format**: contains the tools of the MPEG query format (MPQF).

— **Part 13: Compact descriptors for visual search**: specifies an image description tool for visual search applications.

— **Part 14: Reference software, conformance and usage guidelines for compact descriptors for visual search**: provides the reference software and guidelines, specifies the conformance testing.

— **Part 15: Compact descriptors for video analysis (this document)**: specifies a video description tool designed to enable efficient and interoperable video analysis applications, allowing visual content matching in videos.

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The structure of this document is as follows:

— Clause 5 specifies the binary representation syntax and descriptor component semantics for a CDVA descriptor.

— Clause 6 specifies the extraction and encoding process for a CDVA descriptor.

— Annex A specifies recommended values for the parameters of the encoding process of Clause 6.

— Annex B specifies parameters and a neural network model of the deep feature extraction process.

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Information technology — Multimedia content description interface —

Part 15: Compact descriptors for video analysis

1 Scope

This document addresses descriptor technology for search and retrieval applications, i.e. for visual content matching in video. Visual content matching includes matching of views of large and small objects and scenes, with robustness to partial occlusions as well as changes in vantage point, camera parameters and lighting conditions. The objects of interest comprise planar or non-planar, rigid or partially rigid, textured or partially textured objects, but exclude the identification of people and faces. The databases can be large, for example broadcast archives or videos available on the internet. Such applications thus require video descriptors that enable matching with smaller descriptor sizes and shorter runtimes as compared to application enabled by single-frame (still image) descriptors (e.g. CVDS, ISO/IEC 15938-13) in the video domain.

Compact descriptors for video analysis for search and retrieval applications:

— enable design of interoperable object instance search applications;

— minimize the size of video descriptors;

— ensure high matching performances of objects (in terms of accuracy and complexity);

— enable efficient implementation of those functionalities on professional or embedded systems.

This document provides a complementary tool to the suite of existing standards, such as ISO/IEC 15938-13.

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/IEC 15938-13:2015, *Information technology — Multimedia content description interface — Part 13: Compact descriptors for visual search*

Neural Network Exchange Format, The Khronos Group, Version 1.0, Revision 3, 2018-06-13.

RFC 3986, *Uniform Resource Identifier (URI): Generic Syntax,* Jan. 2005.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

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

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3.1
image descriptor
descriptor extracted from a single *key frame* (3.6) sampled from the *input video* (3.8), which contains *global descriptor* (3.2), *local feature descriptor* (3.3) and *deep feature descriptor* (3.4)

Note 1 to entry: Image descriptors are encoded as described in Clause 6.

3.2
global descriptor
aggregation of local feature descriptors into a compact representation of the *image* (3.5)

Note 1 to entry: The aggregation is as described in subclause 6.1.2.

3.3
local feature descriptor
descriptor of a local region, extracted around an interest point (a point in an *image* (3.5) showing detection stability under local and global perturbations in the image domain, including perspective transformations, changes in image scale, and illumination variations)

Note 1 to entry: The extraction is as described in subclause 6.1.3.

3.4
deep feature descriptor
feature descriptor extracted from a layer of a trained convolutional neural network

Note 1 to entry: The extraction is as described in subclause 6.1.4.

3.5
image
input *key frame* (3.6) to the *image descriptor* (3.1) encoder

Note 1 to entry: The image is as described in Clause 6.

3.6
key frame
frame extracted from the *input video segment* (3.7) by the frame difference process of colour histogram

Note 1 to entry: The extraction is as described in subclause 6.2.

3.7
input video segment
time range (temporal segment) of a video and from which a descriptor is extracted

3.8
input video
image sequence to be processed by the system containing a number of *input video segment(s)* (3.7) to CDVA extraction process

Note 1 to entry: Input video is as described in Clause 6.

3.9
segment descriptor
descriptor extracted from the sampled *key frames* (3.6) of an *input video segment* (3.7)

Note 1 to entry: Segment descriptors are encoded as described in Clause 6. They are contructed from the *image descriptors* (3.1) of the sampled key frames of the input video segment.

3.10
representative frame
frame of an *input video segment* (3.7) for which an uncompressed descriptor is represented and which is used as the basis for differential encoding

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3.11
pixel
indexable element on an integer grid of the original image or the converted image, comprising spatial coordinates, a luminance value and (optional) chrominance values

4 Abbreviated terms, operators, mnemonics, functions and symbols

4.1 General

The mathematical symbols used in this document are similar to those used in the C programming language. However, integer divisions with truncation and rounding are specifically defined. Numbering and counting loops generally begin with zero.

4.2 Abbreviated terms

ABAC	adaptive binary arithmetic coding
CDVA	compact descriptors for visual analysis as defined by this document
CDVS	compact descriptors for visual search as defined by ISO/IEC 15938-13
CNN	convolutional neural network
MPEG-7	ISO/IEC 15938 (all parts)
NIP	nested invariance pooling
NN	neural network
NNEF	neural network exchange format as defined by the Khronos specification referenced in Clause 2
PCA	principal component analysis
RGB	red-green-blue colour space
ROI	region of interest
SCFV	scalable compressed fisher vector
URI	uniform resource identifier as defined by RFC 3986
XOR	binary exclusive OR operation

4.3 Arithmetic operators

+	addition
-	subtraction (as a binary operator) or negation (as a unary operator)
++	increment, i.e. x++ is equivalent to x = x+1
--	decrement, i.e. x-- is equivalent to x = x–1
*	multiplication
×	multiplication

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