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Information technology — Lossless and near-lossless compression of continuous-tone still images: Baseline

Technologies de l'information — Compression «lossless» proche de «lossless» des images fixes à ton continu: Ligne de base

Reference number
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Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 734 10 79
E-mail copyright@iso.ch
Web www.iso.ch

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Included files and programs:

– JPEG-LS reference implementation

– JPEG-LS conformance testing image set

– Auxiliary programs and examples.

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO/IEC 14495 may be the subject of patent rights other than those identified in annex J. ISO and IEC shall not be held responsible for identifying any and all such patent rights.

International Standard ISO/IEC 14495-1 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology,* Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*, in collaboration with ITU-T. The identical text is published as ITU-T Recommendation T.87.

ISO/IEC 14495 consists of the following parts, under the general title *Information technology — Lossless and near-lossless compression of continuous-tone still images*:

— *Part 1: Baseline*

— *Part 2: Extensions*

Annexes A to E form a normative part of this part of ISO/IEC 14495. Annexes F to J are for information only. Annex J is only applicable to ISO/IEC 14495-1.

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INTERNATIONAL STANDARD

ITU-T RECOMMENDATION

INFORMATION TECHNOLOGY – LOSSLESS AND NEAR-LOSSLESS COMPRESSION OF CONTINUOUS-TONE STILL IMAGES – BASELINE

1 Scope

This Recommendation | International Standard defines a set of lossless (bit-preserving) and nearly lossless (where the error for each reconstructed sample is bounded by a pre-defined value) compression methods for coding continuous-tone, gray-scale, or colour digital still images.

This Recommendation | International Standard

- specifies a process for converting source image data to compressed image data;
- specifies processes for converting compressed image data to reconstructed image data;
- specifies coded representations for compressed image data;
- provides guidance on how to implement these processes in practice.

2 Normative references

The following Recommendations and International Standards contain provisions which, through references in this text, constitute provisions of this Recommendation | International Standard. At the time of publication, the editions indicated were valid. All Recommendations and Standards are subject to revision, and parties to agreements based on this Recommendation | International Standard are encouraged to investigate the possibility of applying the most recent edition of the Recommendations and Standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards. The Telecommunication Standardization Bureau of the ITU maintains a list of the currently valid ITU-T Recommendations.

2.1 Identical Recommendations | International Standards

- CCITT Recommendation T.81 (1992) | ISO/IEC 10918-1:1994, *Information technology – Digital compression and coding of continuous-tone still images: Requirements and guidelines*.
- ITU-T Recommendation T.83 (1994) | ISO/IEC 10918-2:1995, *Information technology – Digital compression and coding of continuous-tone still images: Compliance testing*.
- ITU-T Recommendation T.84 (1996)| ISO/IEC 10918-3:1997, *Information technology – Digital compression and coding of continuous-tone still images: Extensions*.
- ITU-T Recommendation T.84/Amd.1[1] | ISO/IEC 10918-3/Amd.1[1], *Information technology – Digital compression and coding of continuous-tone still images: Extensions – Amendment 1*.

2.2 Additional references

- ISO/IEC 646:1991, *Information technology – ISO 7-bit coded character set for information interchange*.
- ISO 5807:1985, *Information processing – Documentation symbols and conventions for data, program and system flowcharts, program network charts and system resources charts*.
- ISO/IEC 9899:1990, *Programming languages – C*.

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[1] Currently at the stage of draft.

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3 Definitions, abbreviations, symbols and conventions

3.1 Definitions

For the purposes of this Recommendation | International Standard, the following definitions apply.

3.1.1 $\lfloor i \rfloor$, **floor**: Indicates the largest integer not exceeding i.

3.1.2 $\lceil i \rceil$, **ceiling**: Indicates the smallest integer not exceeded by i.

3.1.3 **abs(i)**: The absolute value of i : $-i$ if $i < 0$, i otherwise.

3.1.4 **abbreviated format**: A representation of compressed image data which is missing some or all of the mapping table specifications required for decoding, or a representation of mapping tables without frame headers, scan headers, and coded image data.

3.1.5 **application environment**: The standards for data representation, communication, or storage, which have been established for a particular application.

3.1.6 **bias**: Deviation from zero of accumulated prediction errors.

3.1.7 **bit stream**: Partially encoded or decoded sequence of bits.

3.1.8 **causal template**: A set of fixed relative positions of samples (with respect to the current sample being coded) which have been previously coded according to a pre-specified scan sequence.

3.1.9 **coded image data segment**: The coded representation of one restart interval.

3.1.10 **coding**: Encoding or decoding.

3.1.11 **coding parameters**: Integers used to specify the encoding process.

3.1.12 **(coding) process**: A general term for referring to an encoding process, a decoding process, or both.

3.1.13 **colour image**: A continuous-tone image that has more than one component.

3.1.14 **columns**: Samples per line in a component.

3.1.15 **component**: One of the two-dimensional arrays which comprise an image.

3.1.16 **compressed data**: Either compressed image data or parameter specification data or both.

3.1.17 **compressed image (data)**: A coded representation of an image, as specified in this Recommendation | International Standard.

3.1.18 **compression**: Reduction in the number of bits used to represent source image data.

3.1.19 **context**: Function of samples in the causal template used to determine the coding of the present sample.

3.1.20 **context modelling**: Procedure estimating a probability distribution of prediction error from the context.

3.1.21 **continuous-tone image**: An image whose components have more than one bit per sample.

3.1.22 **decoder**: An embodiment of a decoding process and a sample transformation process.

3.1.23 **decoding process**: A process which takes as its input compressed image data and outputs a reconstructed image.

3.1.24 **encoder**: An embodiment of an encoding process.

3.1.25 **encoding process**: A process which takes as its input a source image and outputs compressed image data.

3.1.26 **frame**: A group of one or more scans through the data of one or more of the components in an image.

3.1.27 **frame header**: A marker segment that contains a start-of-frame marker and associated frame parameters that are coded at the beginning of a frame.

3.1.28 **Golomb coding**: A special case of Huffman coding matched to geometric distributions.

3.1.29 **(local) gradient**: Either a vector of differences between values of samples in the causal template, or each difference separately.

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Table H.1 – Example of minimum SPIFF file format

Parameter	Description	Values
MN	Magic number	X'FFD8FFE8'
HLEN	Length of header, 32 bytes	X'0020'
IDENT	Identifies 'SPIFF'	X'535049464600'
VERS	Version number (2.0)	X'0200'
P	Profile ID (not specified)	X'00'
NC	Number of components (3)	X'03'
HEIGHT	Height (2048)	X'00000800'
WIDTH	Width (3072)	X'00000C00'
S	Colour space (uncalibrated RGB)	X'0A'
BPS	Bits per sample (8)	X'08'
C	Compression type (JPEG-LS)	X'06'
R	Resolution units (dpi)	X'01'
VRES	Vertical resolution (300 dpi)	X'0000012C'
HRES	Horizontal resolution (300 dpi)	X'0000012C'
variable	Zero or more directory entries, comprising a header (X'FFE8'), a length count (2 bytes), an identifier (4 bytes), and contents (variable)	*varies, can be omitted*
EMN	EMN for End of Directory tag	X'FFE8'
EODLEN	EOD length, including SOI (8)	X'0008'
EODTAG	EOD tag identifier (1)	X'00000001'
SOI	Start of image	X'FFD8'
variable	*Image data*	*varies*
EOI	End of image	X'FFD9'

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Annex I

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(This annex does not form an integral part of this Recommendation | International Standard)

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Annex J

Patents

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J.1 List of patents

The following patents are claimed to be of relevance for the implementation of this Recommendation | Standard. It is the understanding of ISO/IEC JTC1 SC29 that the organisations listed below have agreed to allow payment free licensing of the patents mentioned in this Annex for use in connection with this Recommendation | Standard, subject to certain conditions which are available on request from the sources listed. Prospective licensees are advised to contact the respective organisations for details.

Hewlett-Packard Company

US 5,680,129, October 1997, Hewlett-Packard Company, Weinberger (M.) et al.: System and Method for Lossless Image Compression.

US 5,764,374, June 1998, Hewlett-Packard Company, Seroussi (G.) et al.: System and Method for Lossless Image Compression Having Improved Sequential Determination of Golomb Parameter.

Contact address for patent information
Hewlett-Packard Company.
Corporate Legal Department, Intellectual Property Section
1501 Page Mill Road, Palo Alto, California 94304-1126, USA
Tel: +1 (650) 857 4660
Fax: +1 (650) 857 5487

Mitsubishi Electric Corporation

[Family patents for the following may also be filed outside Japan.]

Japanese Patent, 1251403, February 1985, Mitsubishi Electric Corp., Ono (F.) et al. : Image Encoder and Decoder.

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Japanese Patent, (8-63117, pending), March 1996, Mitsubishi Electric Corp., Kimura (T.) et al. : Image Encoder and Decoder.

Contact address for patent information
Mitsubishi Electric Corp.
Intellectual Property Licensing Department
2-2-3 Marunouchi, Chiyoda-ku, Tokyo 100, Japan
Tel : +81 (3) 3218 3465
Fax : +81 (3) 3218 2474

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