ISO/IEC JTC 1/SC 29/WG 1
(ITU-T SG16)

Coding of Still Pictures

JBIG
Joint Bi-level Image Experts Group

JPEG
Joint Photographic Experts Group

TITLE: Final Call for Proposals on JPEG Pleno Holography

SOURCE: WG1

PROJECT: JPEG Pleno

STATUS: Final

REQUESTED ACTION: For publication

DISTRIBUTION: Public

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ISO/IEC JTC 1/SC29/WG1 N91020
91st Meeting, Online, 19-23 April 2021

Final Call for Proposals on JPEG Pleno Holography

Summary

JPEG Pleno aims to provide a standard framework for representing new imaging modalities, such as light field, point cloud, and holographic imaging. Such imaging should be understood as light representations inspired by the plenoptic function, regardless of which model captured or created all or part of the content.

JPEG Pleno standard tools are designed together to consider their synergies and dependencies for the whole to be effectively greater than the sum of its parts. To fully exploit this holistic approach, JPEG Pleno is not just a set of efficient coding tools addressing compression efficiency. It is a representation framework understood as a fully integrated system for providing advanced functionality support for image manipulation, metadata, random access and interaction, and various file formats. In addition, it should offer privacy protection, ownership rights, and security.

Currently four parts of the JPEG Pleno standard (ISO/IEC 21794) have been defined:

- Part 1: Framework
- Part 2: Light Field Coding
- Part 3: Conformance Testing
- Part 4: Reference Software

JPEG Pleno Holography is the first standardization effort aspiring to a versatile solution for efficient compression of holograms for a wide range of applications such as holographic microscopy, tomography, interferometry, printing and display and their associated hologram types. Key functionalities desired include support for both lossy and lossless coding, scalability, random access and integration within the JPEG Pleno system architecture, with the goal of supporting a royalty free baseline.

This Final Call for Proposals (CfP) on JPEG Pleno Holography has been issued as outcome of the 91st JPEG meeting, Online, 19-23 April, 2021. The deadline for expression of interest and registration is 1 August, 2021. Submissions to the Call for Proposals are due 1 September, 2021.

Final Call for Proposals on JPEG Pleno Holography

1. Introduction

Holograms can deliver realistic 3D viewing perception with no vergence-accommodation conflict. This is due to the fact that holography can acquire and reproduce the three-dimensional (3D) scene by representing both the amplitude and phase of light. Recently, digital holography has received considerable attention and has become popular in digital microscopy, tomography and interferometry. Moreover, holographic display and printing are attracting increasingly more interest. However, the size of digital holograms increases tremendously as their quality increases since the quality of digital holograms depends on their pixel pitch and resolution [1]. Moreover, holographic content represents significantly different signal characteristics leading to the observation that classical coding solutions designed for natural image data fail to provide acceptable compression behaviour. Hence, efficient compression is necessary to realize holographic imaging services. JPEG Pleno is the first international standardization activity targeting digital hologram compression.

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2. Scope

JPEG Pleno Holography is the first standardization effort aspiring to a versatile solution for efficient compression of holograms for a wide range of applications such as holographic microscopy, tomography, interferometry, printing and display and their associated hologram types. Key functionalities desired include support for both lossy and lossless coding, scalability, random access and integration within the JPEG Pleno system architecture, with the goal of supporting a royalty free baseline.

3. Use Cases and Requirements

This call addresses four distinct use cases:

- Holographic microscopy and tomography;
- Interferometry;
- Holographic printing;
- Holographic visualization.

Detailed information on these use cases and derived requirements are contained in JPEG Pleno Holography Uses Cases and Requirements (WG1N88015).

4. Timeline

The intended timeline for the evaluation of the proposals is the following:

7-10/7/2020	88th WG1 meeting: Draft Call for Proposals issued.
5-9/10/2020	89th WG1 meeting: 2nd Draft Call for Proposals issued
15/1/2021	Report on objective and subjective quality evaluation for anchors available.
18-22/1/2021	90nd WG1 meeting: review of anchor evaluation results and fine-tuning of evaluation procedures. 3rd Draft Call for Proposals issued.
19-23/4/2021	91st WG1 meeting: review of anchor evaluation results and agreement on final test set and evaluation procedures. Issue amendment to Call for Proposals regarding final content, bitrates and metrics. Final Call for Proposals issued.
07-13/7/2021	92nd WG1 meeting: status evaluation of Call for Proposals, organization of the evaluation procedure and practical arrangements.
1/8/2021	Deadline for expression of interest and registration – send email to the people listed in Section 8.
1/9/2021	Deadline for submission of decoder software, algorithm description and design, bitstreams and decoded & reconstructed test material.
15/10/2021	Report on objective and subjective evaluation of proposals and anchors available.
16-22/10/2021	93rd WG1 meeting: Assessment of technical proposals and objective/subjective evaluation results (attendance of proponents to the meeting is required).

The intended timeline for the standardization process is as follows:

January 2022	WD
October 2022	CD
April 2023	DIS
October 2023	FDIS
April 2024	IS

5. Submission Composition and Requirements

5.1. Submission Elements

This CfP invites proponents to submit technology contributions that fulfill the scope, objectives, requirements and use cases therein. Proponents are expected to present their proposals at the 93rd WG1 meeting. Proponents are also reminded that they are expected to contribute to the standardization process, as described in Section 5.4, and attend meetings and present their findings.

5.2. Submission Registration and Delivery

A submission shall consist of the elements specified in ANNEX A. All document to be submitted should be uploaded to the WG1 document registry. For all other elements, instructions will be provided after the expression of interest and registration. Those proponents without access to the registry should contact the WG1 members listed in Section 8.

5.3. IPR Conditions (ISO/IEC Directives)

Proponents are advised that this call is being made in the framework and subject to the common patent policy of ITU-T/ITU-R/ISO/IEC and other established policies of these standardization organizations. The persons named below as contacts can assist potential submitters in identifying the relevant policy information.

5.4. Contribution to Standardization

Proponents are informed that based on the submitted proposals, a standard specification will be created. If they submit a proposal and (part of) the proposed technology is accepted for inclusion in the standard, they will hence have to attend subsequent WG1 meetings and contribute to the creation of the different standard documents. Within this process, evolution and changes are possible as several technologies may be combined to obtain a better performing solution.

6. Evaluation Conditions and Processes

The committee plans to select technologies to be included in the standard based on satisfying the requirements and evaluating the results obtained through the evaluation procedure documented in JPEG Pleno Holography Common Test Conditions (CTC) 4.0 (WG1N91013).

The subjective and metrological evaluation results will be the primary attribute for the decision-making process.

7. Royalty-free Goal

The royalty-free patent licensing commitments made by contributors to previous standards, e.g. JPEG 2000 Part 1, have arguably been instrumental to their success. JPEG expects that similar commitments would be helpful for the adoption of a JPEG Pleno Holography standard.

8. Contacts and Participation

If you are interested in this activity, you can subscribe to the email reflector: jpeg-holo,
by visiting http://listregistration.jpeg.org or in case of problems contacting lists@jpeg.org.

Further information can be obtained by contacting :

Touradj Ebrahimi (JPEG Convener)
Email: Touradj.Ebrahimi@epfl.ch

Fernando Pereira (JPEG Requirements Subgroup Chair)
Email: fp@lx.it.pt

Peter Schelkens (JPEG Pleno Coding & Quality Chair)
Email: peter.schelkens@vub.be

References

[1] D. Blinder et al., Signal processing challenges for digital holographic video display systems, Signal Proces. Image Commun. 70 (2019), 114–130.

ANNEX A – SUBMISSION REQUIREMENTS

The process to evaluate proposals will be done following the timeline defined in Section 4. The successive deliverables are further defined hereunder. In addition to documents and binaries to be submitted, proponents are reminded that they are expected to contribute to the standardization process, as described in Section 5.4.

A.1 Proposal overview

The proposal overview shall include:

- A high-level description of the proposal including block diagrams of encoder and decoder.
- Arguments on why the proposal is meeting the requirements.

Accepted formats for the submission are Word and PDF. Presentations can be in Powerpoint or PDF.

A.2 Binary encoder/decoder executables and scripts

Proponents need to submit separate encoder and decoder executable programs (statically linked Linux executables with all required libraries and system dependencies), configurable via command line or configuration file. Binaries should preferably be optimized software meeting the performance requirements described above in order to speed up the evaluation process.
Proponents can choose to use executable compression or similar tools to prevent reverse engineering or disassembly of the submitted executable files.
Proponents shall provide the command-line parameters intended to be used for encoding/decoding, and shall provide scripts to run their executable in the objective evaluation framework detailed below. More information on the evaluation framework, along with a list of test material and target bitrates is provided in JPEG Pleno Holography CTC 4.0 (WG1N91013).

A.3 Codestreams, decoded material and results

Proponents need to submit the final test material processed by their coding system:

- Codestreams for the test images listed in JPEG Pleno Holography CTC 4.0 (WG1N91013).
- The corresponding decoded holograms for subjective evaluation.
- Encoding-decoding evaluation results, according to the objective quality evaluation described in JPEG Pleno Holography CTC 4.0 (WG1N91013).

A.4 Algorithm and design description

Each proposal shall include a description that provides a detailed description of the proposed algorithm and codec design. This description shall be in Word document and PDF format. The presentation shall clearly explain how the proposed algorithm meets the requirements described above: quality, complexity, and additional features. Providing insufficient details might jeopardize the adoption of the proposed technology.

A.5 Technical documentation

If (part of the) the proposal has been selected to be part of the upcoming standard, a technical description of the selected technology shall be provided. This includes:

ANNEX 1 Description of operations, as described in algorithm and design description.
ANNEX 2 Coded bitstream syntax.
ANNEX 3 Coding process (encoding and decoding) methodology.

The description shall include all necessary processing (including performance optimizations) that are used to create the bitstream in a bit-exact manner.

A.6 Complexity analysis

Proponents are invited to submit an evaluation of the complexity of their algorithm. Such evaluation shall include:

1 Encoder/decoder runtimes as measured on the test images, as a percentage of the JPEG 2000 anchor applied on the hologram plane, see JPEG Pleno Holography CTC 4.0 (WG1N91013).
2 A detailed block diagram of the proposed encoder/decoder showing the algorithmic blocks and flow of the data.
3 An explanation of the achievable parallelism of the algorithmic blocks for both the encoder and the decoder.
4 Information on the target hardware platform(s) for the proposed solution.
5 All information available at the time of submission showing the performance of the encoder and decoder once implemented in software (including overall encoding/decoding time, encoding/decoding time per algorithmic block, memory usage).

A.7 Verification model source code

Proponents agree to release source code to serve as (part of) a Verification Model (VM), written in a high-level language, such as C or C++, if parts of their technology are selected in the evaluation process. Source code shall be documented and understandable. All libraries used by the source code shall be either public or provided in source code form with ISO/IEC and ITU-T compliant terms.

Please note that JPEG Pleno Holography is part of the larger JPEG Pleno suite, which encompasses also a file format architecture (ISO/IEC 21794-1). Hence, proponents are expected to develop their software within the JPEG Pleno Reference Software (ISO/IEC 21794-4), which is publicly available on the following site: https://gitlab.com/wg1/jpeg-pleno-refsw, according Best Practices guidelines.

Make files or project files need to support compilation on at least Linux. The compiled decoder should correctly decode any codestream generated by the submitted encoder executable binary. Moreover, the compiled decoder and the submitted decoder executable binary shall both generate the exact same output.