

# SMPTE STANDARD

## Dynamic Metadata for Color Volume Transform — Application #3



### Table of Contents

|   |    |
|---|----|
| Foreword.....   | 2  |
| Intellectual Property.....  | 2  |
| Introduction.....   | 2  |
| 1 Scope.....  | 4  |
| 2 Conformance Notation.....   | 4  |
| 3 Normative References.....   | 4  |
| 4 Terms and Definitions.....  | 5  |
| 4.1 Transfer Function.....  | 5  |
| 4.2 Input Image Essence.....  | 5  |
| 5 Application Identification.....   | 5  |
| 6 Targeted System Display.....  | 5  |
| 6.1 Introduction.....   | 5  |
| 6.2 Targeted System Display Signal Format.....  | 5  |
| 6.3 Targeted System Display Default Values.....   | 7  |
| 7 Referenced-Based Color Volume Remapping.....  | 7  |
| 7.1 Introduction.....   | 7  |
| 7.2 Color Component Ordering.....   | 7  |
| 7.3 Metadata Color Coding Workspace.....  | 7  |
| 7.4 Pre-Matrix Tone Mapping (1D LUT).....   | 9  |
| 7.5 Color Remapping Matrix (3x3 scalar).....  | 9  |
| 7.6 Post-Matrix Tone Mapping (1D LUT).....  | 9  |
| 8 Application Constraints.....  | 10 |
| 8.1 Metadata Set.....   | 10 |
| 8.2 Time Interval Constraints.....  | 11 |
| 8.3 Processing Window Constraints.....  | 11 |
| Annex A Mapping of Application #3 to the Generalized Color Volume Transform Model (Informative) . | 12 |
| Annex B Color Volume Transform Method Description (Informative).....                              | 13 |
| Annex C Bibliography (Informative).....   | 15 |

## Foreword

SMPTE (the Society of Motion Picture and Television Engineers) is an internationally-recognized standards developing organization. Headquartered and incorporated in the United States of America, SMPTE has members in over 80 countries on six continents. SMPTE's Engineering Documents, including Standards, Recommended Practices, and Engineering Guidelines, are prepared by SMPTE's Technology Committees. Participation in these Committees is open to all with a bona fide interest in their work. SMPTE cooperates closely with other standards-developing organizations, including ISO, IEC and ITU.

SMPTE Engineering Documents are drafted in accordance with the rules given in its Standards Operations Manual.

SMPTE ST 2094-30 was prepared by Technology Committee 10E.

## Intellectual Property

SMPTE draws attention to the fact that it is claimed that compliance with this Standard may involve the use of one or more patents or other intellectual property rights (collectively, "IPR"). The Society takes no position concerning the evidence, validity, or scope of this IPR.

Each holder of claimed IPR has assured the Society that it is willing to License all IPR it owns, and any third party IPR it has the right to sublicense, that is essential to the implementation of this Standard to those (Members and non-Members alike) desiring to implement this Standard under reasonable terms and conditions, demonstrably free of discrimination. Each holder of claimed IPR has filed a statement to such effect with SMPTE. Information may be obtained from the Director, Standards & Engineering at SMPTE Headquarters.

Attention is also drawn to the possibility that elements of this Standard may be subject to IPR other than those identified above. The Society shall not be responsible for identifying any or all such IPR.

## Introduction

This section is entirely informative and does not form an integral part of this Engineering Document.

The Color Volume Transform Application #3 uses content-dependent, dynamic metadata generated through the comparison of input image essence graded using a mastering display having characteristics such as High Dynamic Range (HDR) and Wide Color Gamut (WCG), with a reference image essence graded using a mastering display having the characteristics of a different color volume, such as Standard Dynamic Range (SDR). This Application is therefore called "Reference-based Color Volume Remapping". Herein, the mastering display used for grading the reference image essence is identified as the Targeted System Display.

Color Volume Transform Application #3 uses Pre-Matrix Tone Mapping (1D LUT), Color Remapping Matrix (3x3 scalar), and Post-Matrix Tone Mapping (1D LUT) processing blocks as conceptualized in the generalized Color Volume Transform Model described in SMPTE ST 2094-1.

The dynamic metadata for Application #3 is made using two image essence color grades, as when new image essence is originated and mastered in HDR and WCG and is also mastered in Standard Dynamic Range (SDR) for legacy video distribution; or when library image essence that already exists as an SDR grade is remastered to produce a grade in HDR and WCG.

An example use case is a content creator producing both an “HDR grade” master for HDR home video distribution made using a reference mastering display having a peak luminance of 1000 candelas per square meter and Rec. ITU-R BT.2020 color gamut, and an “SDR grade” master for legacy SDR home video distribution made using a reference mastering display having a peak luminance of 100 candelas per square meter and Rec. ITU-R BT.709 color gamut. These two graded masters are used as the input to a tool that generates the dynamic metadata for the Application #3 Reference-based Color Volume Remapping system. This dynamic metadata can then be delivered with the “HDR grade” image essence so it can be used by a downstream SDR rendering device to provide a color volume transform so that the displayed image closely matches the artistic intent expressed in the “SDR grade” image essence.

Application #3 also supports the use case where the dynamic metadata is generated as part of the content creator’s color grading session used to produce an “SDR grade” master from the “HDR grade” master.

The Reference-based Color Volume Remapping dynamic metadata related to the processing blocks described above can be carried in compressed image essence encoded under the Rec. ITU-T H.265 High Efficiency Video Coding (HEVC) standard by using the Colour Remapping Information (CRI) Supplemental Enhancement Information (SEI) message defined in Rec. ITU-T H.265.

The metadata set associated with Reference-based Color Volume Remapping is specified in Section 8.1.

## 1 Scope

This standard specifies Dynamic Metadata for Color Volume Transform Application #3, Reference-based Color Volume Remapping. It is a specialization of the content-dependent transform metadata entries and processing blocks of the generalized color volume transform model defined in the SMPTE ST 2094-1 Dynamic Metadata for Color Volume Transform – Core Components standard.

## 2 Conformance Notation

Normative text is text that describes elements of the design that are indispensable or contains the conformance language keywords: "shall", "should", or "may". Informative text is text that is potentially helpful to the user, but not indispensable, and can be removed, changed, or added editorially without affecting interoperability. Informative text does not contain any conformance keywords.

All text in this document is, by default, normative, except: the Introduction, any section explicitly labeled as "Informative" or individual paragraphs that start with "Note:"

The keywords "shall" and "shall not" indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted.

The keywords, "should" and "should not" indicate that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited.

The keywords "may" and "need not" indicate courses of action permissible within the limits of the document.

The keyword "reserved" indicates a provision that is not defined at this time, shall not be used, and may be defined in the future. The keyword "forbidden" indicates "reserved" and in addition indicates that the provision will never be defined in the future.

A conformant implementation according to this document is one that includes all mandatory provisions ("shall") and, if implemented, all recommended provisions ("should") as described. A conformant implementation need not implement optional provisions ("may") and need not implement them as described.

Unless otherwise specified, the order of precedence of the types of normative information in this document shall be as follows: Normative prose shall be the authoritative definition; Tables shall be next; then formal languages; then figures; and then any other language forms.

## 3 Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this engineering document. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this engineering document are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

SMPTE ST 428-1: 2006, D-Cinema Distribution Master — Image Characteristics

SMPTE ST 431-1: 2006, D-Cinema Quality — Screen Luminance Level, Chromaticity and Uniformity

SMPTE RP 2077:2013, Full-Range Image Mapping

SMPTE ST 2084:2014, High Dynamic Range Electro-Optical Transfer Function of Mastering Reference Displays