ISO/IEC TR 23002-9:2024-07 (E)

Information technology - MPEG video techn ologies - Part 9: Film grain synthesis technology for video applications

Contents

Page

Foreword v

Introduction vi

1 Scope 1

2 Normative references 1

3 Termsanddefinitions 1

4 Abbreviated terms 2

5 Conventions 2
5.1 General 2
5.2 Arithmetic operators 2
5.3 Bit-wise operators 3
5.4 Assignment operators 3
5.5 Relational, logical and other operators 3
5.6 Range notation 4
5.7 Mathematical functions 4
5.8 Order of operations 4

6 Overviewoffilmgraintechnologies 5
6.1 General 5
6.2 Film grain technical characteristics 5
6.3 Film grain modelling 7
6.4 Film grain use cases and applications 8
6.5 Film grain workflow 8

7 Film grain synthesis 10
7.1 General 10
7.2 General description of film grain synthesis 10
7.2.1 General 10
7.2.2 Grain pattern template generation 11
7.2.3 Randomization 12
7.2.4 Local adaptation 15
7.2.5 Deblocking 17
7.2.6 Blending 17
7.3 Examples of film grain synthesis using the frequency filtering model 17
7.3.1 SMPTE RDD 5 17
7.3.2 Variants based on SMPTE RDD 5 19
7.4 Examples of film grain synthesis using the autoregressive model 20
7.4.1 FGC SEI message based autoregressive model 20
7.4.2 AFGS1 model 21
7.5 Example of film grain synthesis supporting both the frequency filtering and autoregressive models 24
7.5.1 General 24
7.5.2 Film grain template generation 24
7.5.3 Randomization 24
7.5.4 Local adaptation 24
7.5.5 Deblocking 25

7.5.6 Blending 25

8 Film grain analysis 25
8.1 General 25
8.2 Denoising and image analysis 26
8.2.1 Denoising 26
8.2.2 Edge and texture analysis 26
8.3 Determination of grain scaling function 27
8.3.1 General 27
8.3.2 An example of FGC SEI message scaling factor estimation 27

8.3.3 An example of AFGS1 scaling factor estimation 31
8.4 Determination of cut-off frequencies for frequency filtering model 31
8.4.1 General 31
8.4.2 An example of FGC SEI message cut-off frequency estimation 32
8.5 Determination of autoregressive model coefficients 33

9 Film grain metadata 33
9.1 General 33
9.2 Film grain characteristics SEI message 34
9.2.1 General 34
9.2.2 Interpretation of FGC SEI message syntax 34
9.3 AFGS1 metadata 36
9.3.1 General 36
9.3.2 Interpretation of AFGS1 metadata syntax 36

Annex A (informative) Example implementations of the derivation of x/y offset 39

Annex B (informative)Exampleimplementationsoffilmgrainsynthesistechnologies 41

Bibliography 47