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The Index data format for the Natural Vision sample image data (Still image)

This document is created for the reference to the developers who use the sample multispectral image data provided by Natural Vision for the test of " Natural Vision data file format specification Version 2.0 s (Presented to CIE TC8-07)." The document, the sample software, and the sample multispectral image data are available at "http://www.isl.titech.ac.jp/~guchi/NVsample/". This document is provided "as is" without warranty of any kind.

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1. .nv2 format

This file explains the index format used in the Natural Vision sample data. The data format (nv2) presented to CIE TC8-07 only contains the format for profile data, because of its flexibility. The profile format can be used as similar manner to the ICC profile, or can be implemented as a part of header data in a image data file.
The sample image data provided by Natural Vision is an example implementation (.nv2 format). The format uses an index data that specifies the structure and basic information of the image data file, which is similar to AVI file.
The .nv2 format can handle video data along with audio data, but presently the discussion in TC8-07 covers only the still image format. The basic concept of the still image data of .nv2 format is shown in fig.1. In video data, the file size is sometimes too large to pack it into a single file, and the data file can be separated as in the left part of fig.1. In still image applications, all the data can be stored in a single file.

This document describes only the still image format for simplicity. The yellow markers in the tables specify the items that must be set or referred in the still image applications. The blue markers specify the items that may be used in some applications, and those items must be set appropriately by the software of writing the image file. Other items can be set to their respective default values.

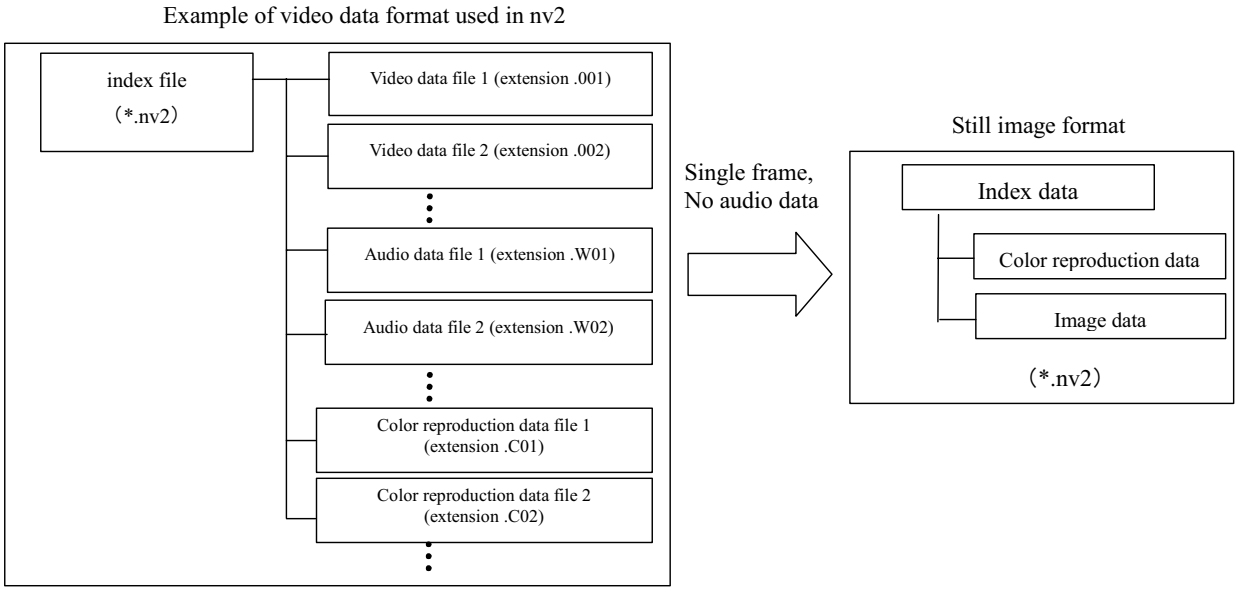

Fig.1 The relationship between the original .nv2 video data format and its adaptation to a still image.

2. Definitions and abbreviations

(a) The integer numbers used in the index data and image data are coded by little-endian (LSB first).
(b) The integer numbers used in the color reproduction data are coded by big-endian (USB first). This is because the color reproduction data format is based on the ICC profile format specification.
(c) The image data is referred by "Video (image) data" in this document.
(d) The profile data specified by " Natural Vision data file format specification Version 2.0 s (Presented to CIE TC8-07)" is referred as "color reproduction data" in this document.
(e) Data types are defined in the "Natural Vision data file format specification Version 2.0 s (Presented to CIE TC8-07)." In addition, following data types defined in the table 1 are used in this document. Those data types are used in Microsoft Windows.

Table 1 Additional data types used in index data.

Data type	Size in bytes	Description
ASCII	1	equivalent to char
FOURCC	4	4 ASCII characters
RECT	16	struct { LONG left; LONG top; LONG right; LONG bottom; };

3. Index data format overview

Table 2 shows the data structure of index data used in .nv2 file. The index data is placed at the top of the image file. The index data consists of Index header, tag table, and tag data. Tag data are aligned on 4-byte boundary, by adding padding bytes (NULL) when needed.

Table 2 Index data format

Index header (48byte)	Four character code ('NAVC')
	Version('02000000h')
	struct MainHeader
Tag table	The number of tags
	’vhdr’, the address and the size of "Video(image) data header,"
	’chdr’, the address and the size of "Color reproduction data header,"
	’mvi ’ the file path, the address, and the size of video(image) data
	’mci ’, the file path, the address, and the size of color reproduction data
	’cpr ’, the file path, the address, and the size of copyright info data
Tag data	'vhdr'
	Video(image) data header (identifier, the number of data, StreamHeader, extended BITMAPINFO structure)
	'chdr'
	Color reproduction data header (identifier, the number of data, StreamHeader, COLORINFOstructure)
	'mvi '
	File path for the video(image) data 1, its size, its start address
	'mci '
	File path for the color reproduction data 1, its size, its start address
	'cpr '
	Copyright information, Creator information

4. Index header format

The index header format is shown in table 3.

For still image applications, dwWidth and dwHeight must be set to appropriate values, and other items can be set to default values.

Table 3 Index header

Byte offset	Item name	Size	Type	Content
0	FileSignature[4]	4	ASCII	'NAVC'
4	Version[4]	4	uInt8Number	2.0.0(02000000h)
8	dwMicroSecPerFrame	4	DWORD	Not used in still image(00000000h)
12	dwMaxBytesPerSec	4	DWORD	Not used in still image(00000000h)
16	dwFlags	4	DWORD	Not used in still image(00000000h)
20	dwTotalFrames	4	DWORD	1 in still image (01000000h)
24	dwInitialFrames	4	DWORD	0 in still image (00000000h)
28	dwStreams	4	DWORD	The number of streams in the file. For example, a file with an image and a color reproduction data has two streams (02000000h).
32	dwSuggestedBufferSize	4	DWORD	Suggested buffer size for reading the file. If it is not specified, set 0 as default value.
36	dwWidth	4	DWORD	Width of image data. (identical to biWidth in struct ExtendedBitmapInfo in Table 6)
40	dwHeight	4	DWORD	Height of image data. (identical to the absolute value of biHeight in struct ExtendedBitmapInfo in Table 6)
44	DwReserved[4]	4	-	Reserved

5. Tag tables

The number of tags (NTags) contained in this index data is depicted at the top of the tag table, followed by the set of ID, DataPosition, and DataSize of all tags, as shown in table 4. The set of ID, DataPosition, and DataSize is repeated as many as NTags. The tag ID's used in the still image data are defined in the table 5.

Table 4 Tag table

Byte offset	Item name	Size	Type	Content
0	NTags	4	uInt32Number	The number of tags in this index data
4	ID	4	ASCII	Tag identifier (No.1) shown in table 4.
8	DataPosition	4	uInt32Number	Byte offset to the data specified by the tag (No.1).
12	DataSize	4	uInt32Number	The size of the data specified by the tag (No.1).
16	ID	4	ASCII	Tag identifier (No.2) shown in table 4.
20	DataPosition	4	uInt32Number	Byte offset to the data specified by the tag (No.2).
24	DataSize	4	uInt32Number	The size of the data specified by the tag (No.2).
		•	•	•
		•	•	•

Table 5 Tag ID's in the index data

Tag name	Tag ID	Description
Video (image) data header tag	vhdr (76686472h)	Video (image) data header (StreamHeader, Extended BITMAPINFO structure)
Color reproduction data header tag	chdr (63686472h)	Color reproduction data header tag (StreamHeader, COLORINFO structure)
Video (image) data reference tag	mvi (6d766920h)	Size and offset of video (image) data
Color reproduction data reference tag	mci (6d636920h)	Size and offset of color reproduction data
Copyright information tag	cpr (63707220h)	Copyright and creator information

6. Tag data

The tag data used in the still image format are, video (image) data header tag, color reproduction data header tag, video (image) data reference tag, color reproduction data reference tag, and copyright information tag are described in the following. Tag data are located at the address specified in the corresponding tag table of table 4.

6.1 Video (image) data header

Tag ID: 'vhdr'(76686472h)

Table 6 Video (image) data header tag

Byte offset	Item name	Size	Type	Content
0	Tag ID	4	ASCII	Four character ID for this tag: 'vhdr'
4	Number of data	4	uInt32Number	The number of data. 1 for still image.
8	fccType	4	FOURCC	'vids' (video (image) data)
12	fccHandler	4	FOURCC	Not used. Default = '0000'
16	dwFlags	4	DWORD	Not used in still image(00000000h)
20	wPriority	4	DWORD	Not used in still image(00000000h)
24	wdInitialFrames	4	DWORD	Not used (00000000h)
28	dwScale	4	DWORD	Not used in still image(00000000h)
32	dwRate	4	DWORD	Not used in still image(00000000h)
36	dwStart	4	DWORD	Not used in still image(00000000h)
40	dwLength	4	DWORD	1 in still image(01000000h)
44	dwSuggestedBufferSize	4	DWORD	Suggested buffer size for reading the file. If it is not specified, set 0 as default value.
48	dwQuality	4	DWORD	-1 in this format (FFFFFFFFh)
52	dwSampleSize	4	DWORD	Not used in still image(00000000h)
56	rcFrame	16	RECT	Destination rectangle for the image. To display the whole image, set this rectangle to the coordinates corresponding to the rectangle specified by the dwWidth and dwHeight of table 2; i.e., 0, 0, dwWidth, dwHeight.

72	biSize	4	DWORD	Specifies the number of bytes required by the structure (biSize-dwPlanesFlags). In this version, it is fixed to 68 (44000000h).
76	biWidth	4	LONG	Width of image data (pixels)
80	biHeight	4	LONG	The height of the image (pixels). If biHeight is positive, the image is a bottom-up bitmap and its origin is the lower-left corner. If biHeight is negative, the bitmap is a top-down bitmap and its origin is the upper-left corner.
84	biPlanes	2	WORD	The number of bands.
86	biBitCount	2	WORD	The number of bits / pixel in total of all bands
88	biCompression	4	DWORD	The type of compression, = 0 in this version
92	biSizeImage	4	DWORD	The size of image in bytes.
96	biXPelsPerMeter	4	LONG	Not used (00000000h)
100	biYPelsPerMeter	4	LONG	Not used (00000000h)
104	biClrUsed	4	DWORD	Not used (00000000h)
108	biClrImportant	4	DWORD	Not used (00000000h)
112	dwPitch	4	DWORD	Horizontal size of a single band of the image in bytes, adjusted to a unit of 8 pixels. For example if biWidth=N and bits / pixel / band = B, dwPitch = floor(N/8 + 1)*B
114	dwMemFlags	4	DWORD	Channel arrangement: 0: pixel-interleaved, 1:plane interleaved.
120	dwIpFlags	4	DWORD	0: Progressive or 1: Interlace. Naturally, a still-image uses progressive format (1).
124	dwScFlag	4	DWORD	The type of image signal. 0: Input device signal, 1: spectral reflectance/transmittance, 2: spectral radiance, 3: colorimetry,
128	dwCcFlag	4	DWORD	Whether the image signal is corrected (1) or uncorrected (raw)
132	dwSgTypeFlag	4	DWORD	Image data type. 0: uInt8Number 1: uInt16Number 2: uInt32Number 3: s7Fixed8Number 4: s15Fixed16Number
136	dwPlanesFlags[N]	4	DWORD[N]	N=1 in this version. Set default value: dwPlanesFlags[0] = 0.

6.2 Color reproduction data header
Tag ID: 'chdr' (63686472h)

Table 7 Color reproduction data header

Byte offset	Item name	Size	Type	Content
0	Tag ID	4	ASCII	Four character ID for this tag: 'chdr'
4	Number of data	4	uInt32Number	The number of data. 1 for still image.
8	fccType	4	FOURCC	'cprs' (color reproduction data)
12	fccHandler	4	FOURCC	Not used. Default = '0000'
16	dwFlags	4	DWORD	Not used (00000000h)
20	wPriority	4	DWORD	Not used (00000000h)
24	wdInitialFrames	4	DWORD	Not used (00000000h)
28	dwScale	4	DWORD	Not used in still image
32	dwRate	4	DWORD	Not used in still image
36	dwStart	4	DWORD	Not used in still image
40	dwLength	4	DWORD	1 in still image(01000000h)
44	dwSuggestedBufferSize	4	DWORD	Suggested buffer size for reading the file. If it is not specified, set 0 as default value.
48	dwQuality	4	DWORD	-1 in this format (FFFFFFFFh)
52	dwSampleSize	4	DWORD	Not used in still image(00000000h)
56	rcFrame	16	RECT	Not used (0,0,0,0)
72	fccType[4]	4	FOURCC	Device/Profile class signiture defined by ICC Profile Specification Ver. 4.0.0 p15 Profile/Device Class signature. This version format uses any of Input Device profile = 'scnr', Display Device profile = 'mntr', or ColorSpace Conversion profile = 'spac'. fccType = 'scnr' for the image captured by multispectral imaging device.
76	dwMaxProfileSize	4	DWORD	In still image format, the size of the profile in bytes. (In video appl., maximum profile size when plural profile data are recorded.
80	dwIntervalKeyFrame	4	DWORD	Not used in still image.
84	lBrightness	4	u16Fixed 16Number	Estimated maximum luminance of the image.

6.3 Video (Image) data reference
Tag ID: 'mvi ' (6d766920h)

Table 8 Video (Image) data reference

Byte offset	Item name	Size	Type	Content
0	Tag ID	4	ASCII	Four character ID for this tag: 'mvi '
4	RelativityPath[256]	256	ASCII	Not used in still image format
260	DataSize	4	uInt32Number	The size of image in bytes.
264	DataPosition	8	uInt64Number	The byte offset to the image data from the beginning of the file.

6.4 Color reproduction data reference
Tag ID: 'mci ' (6d636920h)

Table 9 Color reproduction data reference

Byte offset	Item name	Size	Type	Content
0	Tag ID	4	ASCII	Four character ID for this tag: 'mci '
4	RelativityPath[256]	256	ASCII	Not used in still image format
260	DataSize	4	uInt32Number	The size of color reproduction data in bytes.
264	DataPosition	8	uInt64Number	The byte offset to the color reproduction data from the beginning of the file.

6.5 Copyright information
Tag ID: 'cpr ' (63707220h)

Table 10 Copyright information

Byte offset	Item name	Size	Type	Content
0	Tag ID	4	ASCII	Four character ID for this tag: 'cpr '
4	CopyRight[128]	128	ASCII	Copyright information
132	Author[128]	128	ASCII	Creator information

7 Example of index data

Table 11 shows an example of index data. This example is the hexadecimal dump of the sample multispectral image "macbeth_4.nv2," which is a 16-band image of GretagMacbeth ColorChecker, in 512x512 pixels. In this sample file, the color reproduction data is attached at the bottom of the file.

Table 11 Example of dump data. The color of characters represents the corresponding data in the same row.

Dump data	Description
4e 41 56 43 02 00 00 00 00 00 00 00 00 00 00 00 N A V C	Index Header (48byte) 'NAVC' version:0200
00 00 00 00 01 00 00 00 00 00 00 00 02 00 00 00	dwTotalFrames=1 dwStreams=2
00 00 80 00 00 02 00 00 00 02 00 00 00 00 00 00	dwSuggestedBufferSize=8388608 dwWidth=512, dwHeight=512
05 00 00 00 76 68 64 72 70 00 00 00 8c 00 00 00 . . . . v h d r p	Number of Tag =5, 'vhdr' Address=112(70h), Size=140(8Ch)
63 68 64 72 fc 00 00 00 58 00 00 00 6d 76 69 20 c h d r . . . . X . . . m v i	'chdr ' Address=252(FCh) Size=88(58h), 'mvi '
54 01 00 00 10 01 00 00 6d 63 69 20 64 02 00 00 T . . . . . m c i d . . .	Address=340(0154h), Size=272(110h) 'mci ', Address=612(264h)
10 01 00 00 63 70 72 20 74 03 00 00 04 01 00 00 . . . . c p r t	Size=272(110h), 'cpr ', Address=884(374h), Size=260(104h)
76 68 64 72 01 00 00 00 76 69 64 73 30 30 30 30 v h d r . . . . v i d s 0 0 0 0	'vhdr', Number of data=1, 'vids' fccHandler='0000'
00 00 00 00 00 00 00 00 00 00 00 00 e9 03 00 00	dwScale=1001(3e9h)
30 75 00 00 00 00 00 00 01 00 00 00 00 00 00 00 0 u	dwRate=30000(7530h), dwStart=0 dwLength=1, SuggestedBufferSize=0
ff ff ff ff 00 00 00 00 00 00 00 00 00 00 00 00	dwQuality=-1(FFFFFFFFh) dwSampleSize=0,
00 02 00 00 00 02 00 00 44 00 00 00 00 02 00 00 . . . . . D	rcFrame=0,0,512,512 Size=68(44h), width=512,
00 fe ff ff 10 00 00 01 00 00 00 00 00 00 80 00	height=-512 planes=16, BitCount=256 SizeImage=8388608(800000h)
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	Not used (NULL)
00 40 00 00 00 00 00 00 00 00 00 00 00 00 00 00 . @	dwPitch=16384(4000h), pixelwize(0) Progressive(0), CapturedData(0)
00 00 00 00 01 00 00 00 00 00 00 00 63 68 64 72 . . . . . c h d r	uncompensated(0), uInt16Number(1) dwPlanesFlags=0, 'chdr'
01 00 00 00 63 70 72 73 30 30 30 30 00 00 00 00 . . . . c p r s 0 0 0 0	Number of data=1, 'cprs' fccHandler='0000'
00 00 00 00 00 00 00 00 e9 03 00 00 30 75 00 00 . . . . . 0 u . .	dwScale=1001(3e9h), dwRate=30000(7530h)
00 00 00 00 01 00 00 00 00 00 00 00 ff ff ff ff	dwStart=0, dwLength=1, dwQuality=-1(FFFFFFFFh)
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	dwSampleSize=0, rcFrame=0,0,0,0
00 00 00 00 73 63 6e 72 b8 f4 01 00 1e 00 00 00 . . . . s c n r	'scnr', MaxProfileSize=128184 (1F4B8h), dwIntervalKeyFrame=30
43 1a 00 00 6d 76 69 20 00 00 00 00 00 00 00 00 C . . . m v i	maxLuminance=6723cd/m^2(1A43h) 'mvi ',
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	256 bytes zero padding
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
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00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
00 00 00 00 00 00 00 00 00 00 80 00 78 04 00 00 . . . . x . . .	ImageDataSize=8388608(800000h) Address=1144(478h)
00 00 00 00 6d 63 69 20 00 00 00 00 00 00 00 00 . . . . m c i	'mci ' 256 bytes zero padding
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
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00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
00 00 00 00 00 00 00 00 b8 f4 01 00 78 04 80 00 . . . . x . . .	ColorRepDataSize=128184(01F4B8h) Address=8389752(800478h)
00 00 00 00 63 70 72 20 4f 6c 79 6d 70 75 73 20 . . . . c p r O l y m p u s	'cpr ' Copyright information in 128bytes
4f 70 74 69 63 61 6c 20 43 6f 2e 4c 54 44 00 00 O p t i c a l C o . L T D . .	
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	

. . . .	
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
. . . .	
00 00 00 00 00 00 00 00 4e 61 74 75 72 61 6c 56	Creator information in 128bytes
. . . . N a t u r a l V	
69 73 69 6f 6e 50 72 6f 6a 65 63 74 00 00 00 00	
i s i o n P r o j e c t	
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
. . . .	
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
. . . .	
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
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00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
. . . .	
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
. . . .	
00 00 00 00 00 00 00 00 98 00 8d 00 a4 00 75 00	Image data starts here
. . . . u .	
8d 00 90 00 87 00 97 00 a7 00 aa 00 95 00 7e 00	
. . . . ~ .	
a5 00 99 00 88 00 8c 00 b3 00 90 00 a4 00 98 00	
. . . .	