3D Image Processor IF-2D3D1

Overall market background

- At present, <u>3D content availability is extremely limited</u> relative to the level of excitement and interest for 3D in the market.

- <u>3D recording and conversion require a significant amount of effort and expense</u>.

In Japan:
- Typical rates for manual 2D to 3D conversion: $10,000 to $20,000 per minute.
- Typical rental fee for 3D camera equipment: $100,000 for 3 days.

- It is necessary for <u>3D content creators to possess a significant amount of skills and experience</u>.

Function I: 2D-3D converter

- ✓ Real-time conversion of 2D images to 3D stereoscopic images.
- ✓ Variable adjustment of deformation strength: Parallax and intensity (depth) can be adjusted scene by scene, while sub-intensity (three-dimensionality) can also be adjusted for each object.
- ✓ Generates stereoscopic images for both the left and right eyes.
- ✓ Enables standard HD signal (720p, 1080i, 1080p) input via the HD-SDI or HDMI terminal.
- ✓ Outputs in the same signal format as the input signal either separately as L and R channels or in a mixed format.

Function II: 3D L/R mixing

- ✓ Left and right channel signals are combined into a single signal and converted to a 3D mix format for output.
- ✓ Compatible with four 3D mix formats for monitoring: Line-by-Line, Side-by-Side, Above-Below, and Checkerboard.

Function III: 3D camera adjustment support

- ✓ Scope: Left and right channel video signals can be compared by waveform or vectorscope with simultaneous or separate display made possible.
- ✓ Split: Adjusts focus, brightness level, and white balance on the two recording cameras.
- ✓ Rotation: Inverts the left or right image.
- ✓ Frame synchronize: Enables 3D monitoring with a consumer camcorder video system or gain-lock disabled video signals.

Advantages of the IF-2D3D1

The IF-2D3D1 offers three main functions:

- Real-time 2D-3D conversion
- 3D L/R mixing
- 3D recording assistance

And thanks to these functions, the IF-2D3D1:

- Reduces costs and effort compared to recordings taken with a 3D camera.

- Easily converts 2D recordings into 3D even for special-effect scenes that are difficult to record with a 3D camera.

- Enhances efficiency in both real-time operation and post-production processing.

- What's more, eye strain and fatigue are reduced when 3D images created by the IF-2D3D1 are viewed.
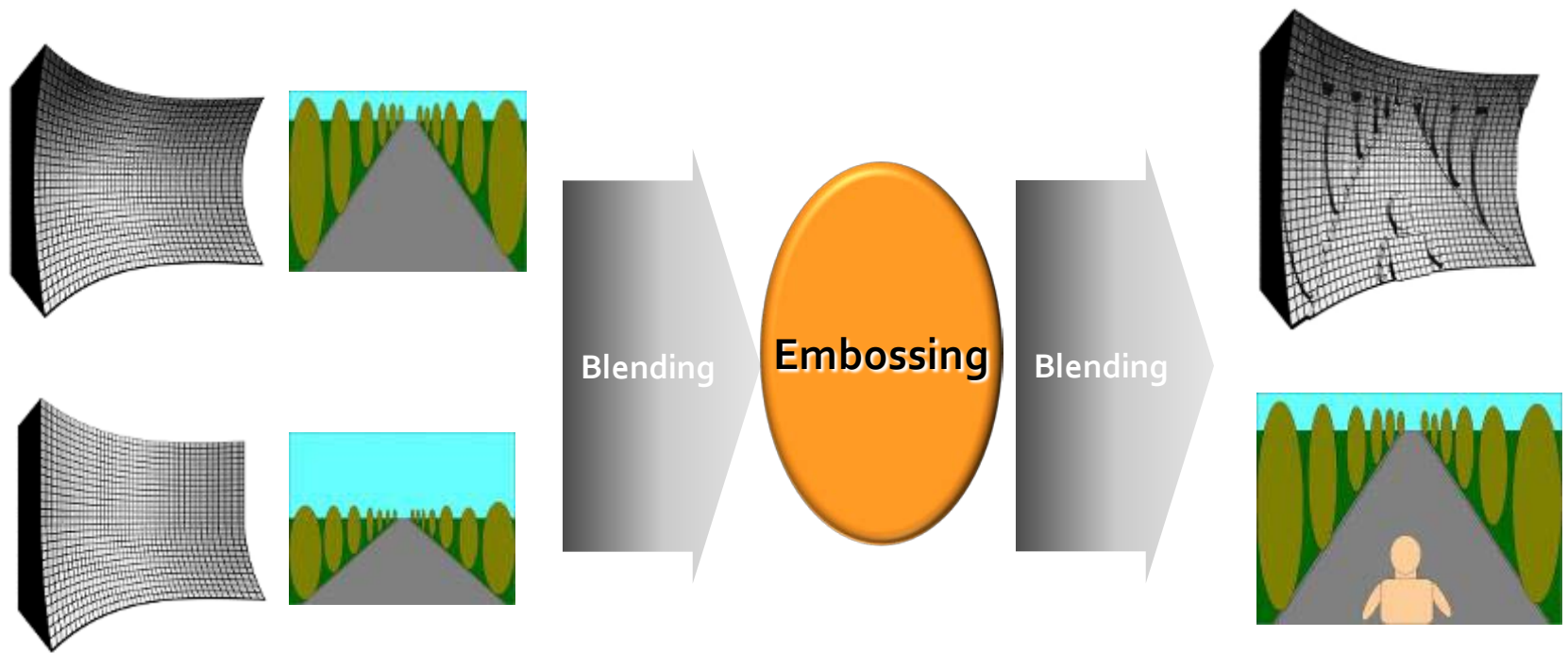
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- Real-time 2D-3D conversion using unique JVC algorithms

Scene detection and analysis   **Object analysis**   **3D simulation**

Blending   Embossing   Blending

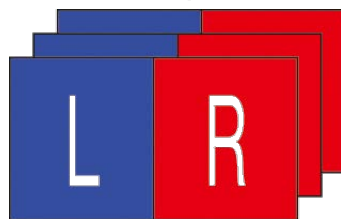2D-3D Conversion

- Converted signals that are
  <u>separated into left and right channels are</u>
  <u>combined and switched to a 3D mix format</u> for output.
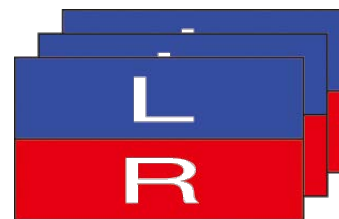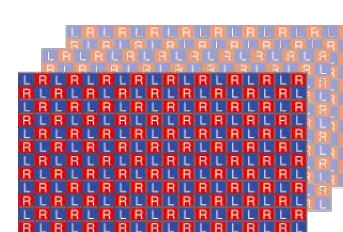
Compatible 3D mix formats:

- Line-by line
- Side-by-side
- Above-below
- Checkerboard

- Corrects misalignment in the left and right images.

- Instantaneously inverts one of the two (left or right) images.

■ Functions for correcting misalignment: Scope, Split, Frame Synchronize

Scope
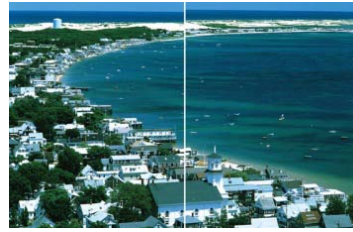
Split

■ Rotation/mirror function

This function is helpful for inverting one of the two images on a 3D camera rig. Whether the rig setup is rotated, H. mirrored or V. mirrored, the IF-2D3D1 inverts one of the two images vertically and/or laterally to the normal position and adds automatic delay to non-rotated image by one frame in order to synchronize the two images.

Rotation

The IF-2D3D1 rotation/mirror function works with most of today's 3D camera rig configurations.

Photo: © Richard Clark, President, Inter Video

3D Camera Support
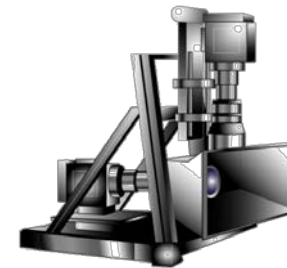
Tips: 3D processing

- The IF-2D3D1's 3D conversion function is much more sophisticated and different from the automatic 3D converter that can be found on some of the latest consumer 3D TVs.

- Production time is reduced as the IF-2D3D1 effectively converts 2D recordings — even special-effect scenes that are difficult to record on native 3D cameras — both in real-time and during post-production processing.

- **The IF-2D3D1 is a JVC professional product designed to support content creators involved in 3D video production.**

2D-3D conversion in

Actual Applications

3D Basics: Pop-up and depth theories

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Image of the left camera

Image of the right camera

Convergence recording method

Three objects will appear like the above in the left and right cameras.

Recording plane of the left camera

Recording plane of the right camera

Creator assigns the position of an object on the screen and sets the convergence point. In this case, convergence point is where the Blue square is located.

Green triangle: Appears deep into the screen.

Blue square: Appears on the surface of the screen. No 3D effect as the left and right images overlap perfectly.

Screen surface

Screen surface

Screen surface

Red circle: pops up on the screen.

Left eye   Right eye

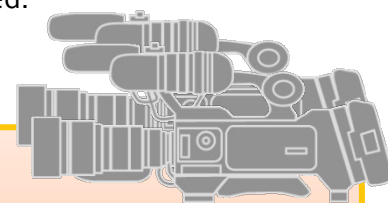Left eye   Right eye

Left eye   Right eye

- **Keystone distortion:** Depending on the angle used to create the convergence point, distortion (e.g. vertical misalignment) at the edges of images from the right camera can become noticeable even when the height of the left and right lenses corresponds. This distortion can lead to physical ailments such as headaches and eye fatigue while viewing 3D images.

Left camera	Right camera
	Vertical misalignment generated
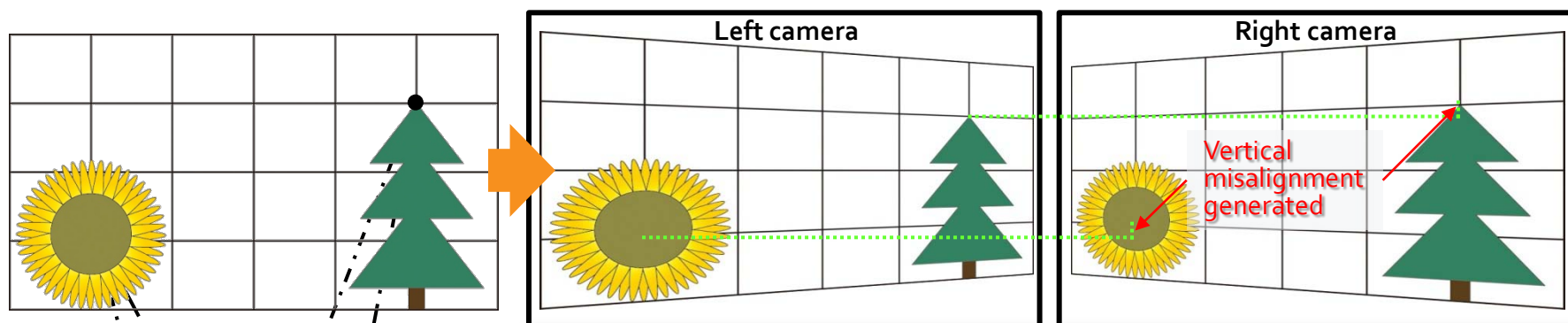
The lattice pattern represents keystone distortion that is visible on a side-by-side camera rig. This is how vertical misalignment is generated.

Convergence recording: Cameras are set inward.

Hints!

As the IF-2D3D1 is designed to create 3D images with substantial depth, the best results can be achieved by recording "pop-up" 3D images with a native 3D camera and converting 2D recordings to 3D wherever the creator wants to give images more intensity. And because there is no need to crop images for keystone adjustment with the IF-2D3D1, the full resolution of the original recordings can be maintained.
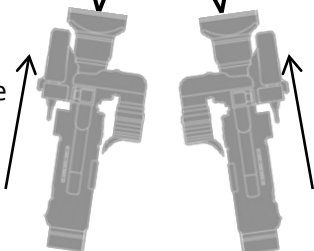
- Generally speaking, the average space between the left and right eyes of adults is about 65mm (about 55mm for children). And due to this space, visual perception between the left and right eyes differs slightly and the brain performs binocular disparity processing to attain stereopsis or depth perception from 2D images.

6~7cm

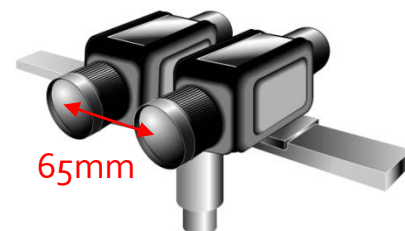- 3D video is based on this phenomenon of visual perception so conventionally, the two lenses are set with a horizontal separation of 65mm. This enables natural, balanced images to be recorded with similar binocular parallax characteristics as the human eye.

65mm

Hints

Drawbacks of typical camera rigs and the IF-2D3D1.

IF-2D3D1

- Unable to create 3D images that pop up on the screen.
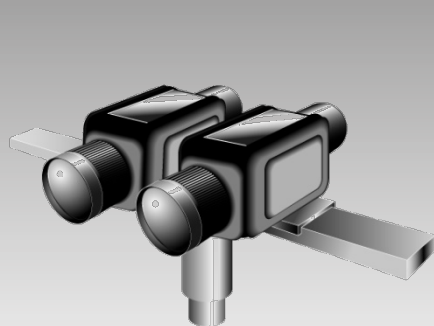
Stereo rig (side-by-side rig)

- Keystone distortion is generated and the edges of images may require trimming depending on the angle of the camera.
- Difficult to record good 3D close-up shots of objects.
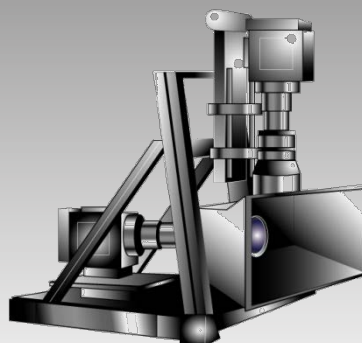
Half-mirror (beam splitter)

- The apparatus is too bulky.
- One of the two images has to be inverted.

To record superior 3D video content just as the creator envisioned, it is important to first decide on which scenes to make three-dimensional, what kind of 3D effects to apply, and select the appropriate equipment.

Ideal usage of the IF-2D3D1: Super zoom

- It is not appropriate to record in 3D using two cameras with a zoom ratio of more than 100X as this will cause a phenomenon known as "flattening".

Solution

Record in 2D and convert images with the IF-2D3D1 to achieve video content with three-dimensionality. These images will appear as close-ups because the object's intensity is created using the Sub-intensity function, which is not contingent on camera-to-subject distance.

Tips: Flattening

Record an object with a thickness of 40cm that is 100m away from the camera.

The 40cm-thick object will appear as thin as 2cm when the viewing distance (viewer's eye to the screen) is less than the recording distance (camera to the subject).

40cm object appears as thin as 2cm!

Recording distance 100m

Viewing distance 5m

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- In order to achieve three-dimensionality when recording with distant mountains or cityscapes in the background, it is necessary to record images by widening the distance between the two lenses, an operation that is known as hyperstereo. By using hyperstereo, it becomes possible to achieve three-dimensionality in objects but the overall scenery would appear very small due to the phenomenon called "miniaturization".

Solution

Using the IF-2D3D1 will ensure the creation of natural-looking video content with three-dimensionality as it is possible to convert 2D images into 3D without being affected by the focal length of a lens or the relative distance to an object.

Tips: Miniaturization

Binocular parallax

As binocular parallax gets wider, the scenery will appear smaller.

Normal average stereo-base: Approx. 65mm

To optimally record scenery, it is theoretically required to widen stereo-base by more than 2 meters.

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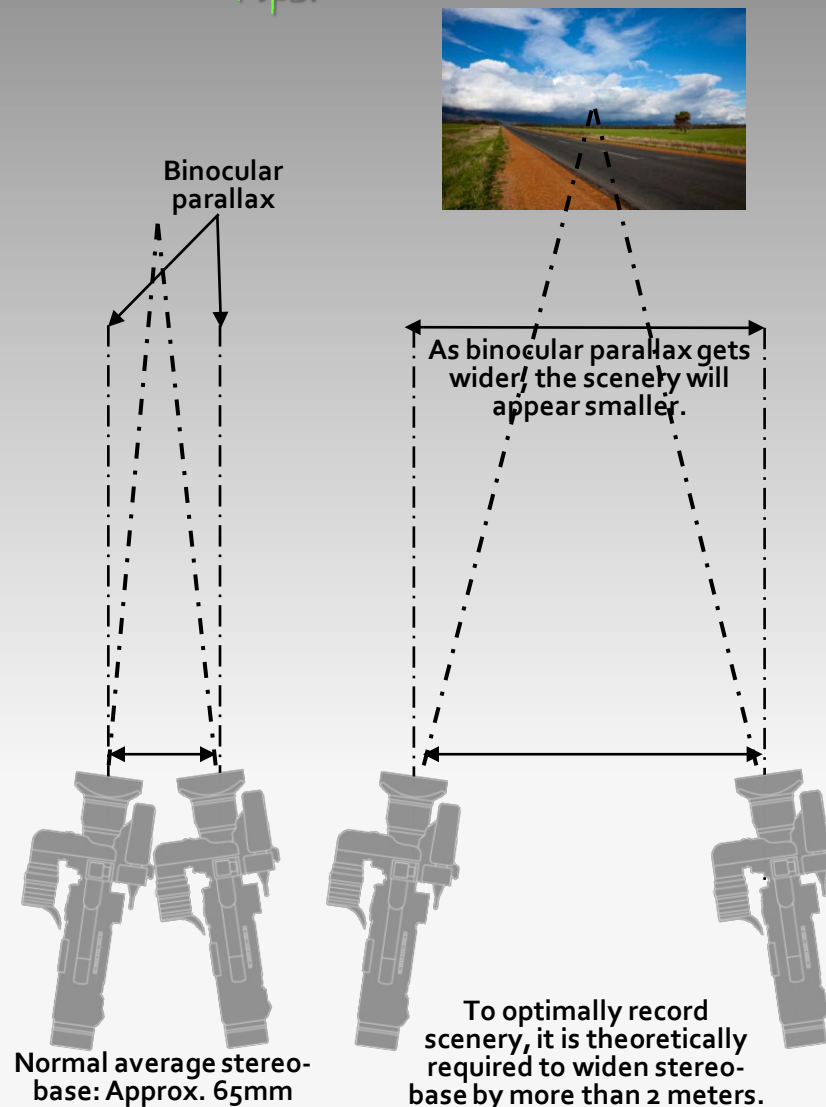
- When a recording is made in 3D with the background in the distance and an object in the near foreground simulta-neously, the human eye is capable of viewing the object in the foreground in 3D but not the background scenery. This is because when the distance between the subject in the foreground and background is very deep, the parallax widens significantly.

Solution

By adjusting its Parallax function, the IF-2D3D1 can set the background's divergence angle to create a background without images displaced outward, which is known as "excessive divergence".

Tips: Fusion deterioration

In this case, human eye cannot view the background in 3D...

600mm parallax!

Divergence angle: 11 degrees!

Calculation formula for divergence angle of 11°

$$\theta=atan(l/L)x180/\pi \ (deg)$$

L=0.6m

l=30m

θ=11°

30 meters from the object to the background = 600mm binocular parallax.

3 meters from the camera to the object

Man figure is positioned at the screen surface

Record with 600mm binocular parallax stereo-base

The human eye cannot perceive images in 3D when the divergence angle exceeds 4 degrees. As seen in the calculation formula on the right, the same can be said when θ exceeds 4 degrees.

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- When 3D recordings are made on unstable locations such as on an airplane or helicopter, vertical misalignment is likely to occur. And when these images are viewed, eye strain and fatigue can result.

- The flattening and miniaturization phenomena are also likely to occur simultaneously.

Solution

In such situations, we recommend using the IF-2D3D1 to convert 2D images into 3D to not only save time and money but also ensure that video content is produced just as the creator envisioned.

Tips: During airborne recordings

It is not realistic to use two separate lenses for airborne recordings as the lenses tend to vibrate individually. It is much more economical and time saving to record in 2D and convert the images to 3D with the IF-2D3D1.

- More than 10 sets of cameras are likely to be used to adequately cover live events such as sports, etc., and the cost of converting all these rigs into 3D compatible equipment is simply not reasonable.

- The flattening phenomenon is likely to occur when the camera is positioned tens of meters away from the main subject while recording in 3D.

- Recording live events in 3D with two 100X zoom ratio lenses is also unrealistic.

Conventional 3D rig system (half-mirror type)
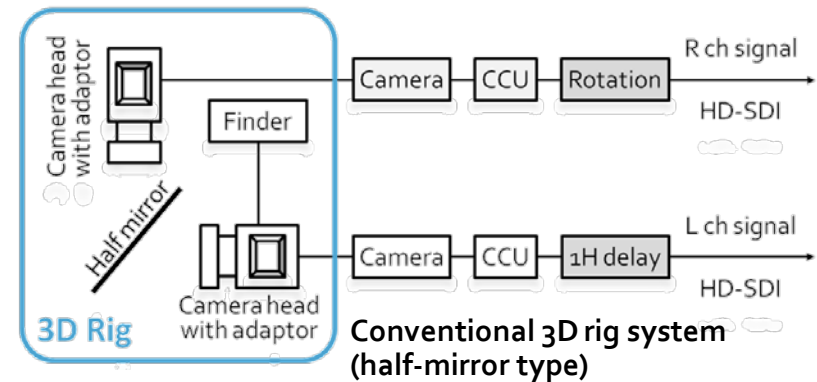
Solution

Take the main cameras, three to five of them, and create a native 3D camera system. Or combine a conventional 2D camera with the IF-2D3D1 to create a system that enables real-time, on-site recording with 2D-3D conversion to help reduce both running costs and time.
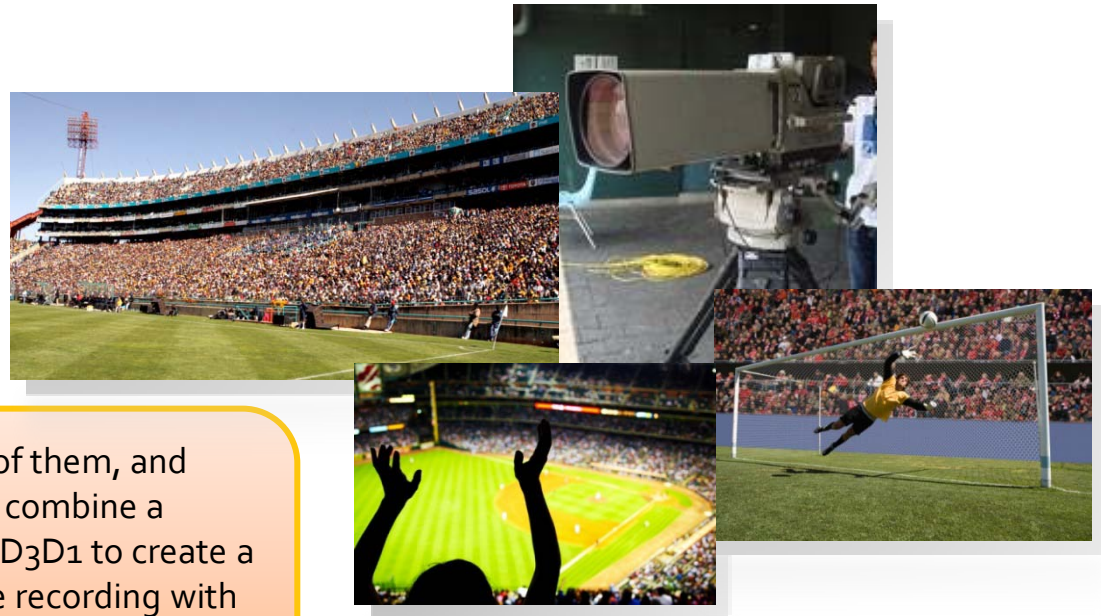
Many of today's 3D video and film productions use subtle 3D effects that most viewers cannot distinguish whether it is conventional 2D or 3D. What's more, the method of adding depth to overall scenes is currently more popular than "pop-up" images that appear to leap out of the screen. In order to enjoy 3D film/video for prolonged periods, the concept of 3D creation with greater intensity and depth is becoming essential to create 3D content that is easy on the eyes. JVC's IF-2D3D1 is designed with this purpose in mind as it allows content creators to freely adjust and set the depth of any scene optimally.

Video content with excessive amounts of 3D effects can cause physical ailments such as headaches, nausea, eye strain, etc. and may be detrimental to health if viewed for prolonged periods. This is especially true for scenes with considerable amounts of parallax, rapid transitions, and fast-moving action. It is recommended that content creators refrain from adding too much 3D effects for such scenes during production.

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- For stereoscopic images, it is important to be familiar with the size of the final display for the projected 3D film/video as pop-up imagery and intensity will be affected by display size.

- Even if 3D effects are set optimally on a compact studio monitor, the same results cannot be achieved if the size of the living room monitor that people use to view 3D film/video is larger than the studio monitor.

- To help replicate the living room viewing environment, JVC makes available the GD-463D10 46-inch Xpol-type LCD monitor to facilitate 3D video/film confirmation during production.

- The monitor can be viewed with lightweight and cost-effective passive-type circular polarizing filter glasses for stereoscopy, making it ideally suited for the long-hours of film/video production.

HD/SD SDI 1 and 2 for Mixing

INPUT			LR mixer	Output — 3D MIX FORMAT: SIDE-BY-SIDE H	ABOVE-BELOW	LINE-BY-LINE	CHECKERBOARD	HD/SD SDI: MIX	INDIVIDUAL	HDMI: MIX	INDIVIDUAL	LR mixer ADJUST: SPLIT MODE	ANAGLYPH MODE	LR-SEQ. MODE	SCOPE*2: PARA._W.F.M.	PARA._V.S.	IN1_W.F.M./IN2_W.F.M.	IN1_V.S./IN2_V.S.	BAL._W.F.M.	BAL._V.S.	LR INVERT	ROTATE	H_MIRROR	V_MIRROR	FRAME SYNCHRO.*3
HD/SD SDI 1 (L) and HD/SD SDI 2 (R) Y/Cb/Cr=4:2:2 (for mixing)	1080	60p*1	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
		50p	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
		30p*1	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
		25p	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
		24p*1	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
		24psF	●	●	●			●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
		60i*1	●	●	●			●	●	●	●	●	●	●	●	●	●	●	●	●	●	●*4	●	●	●
		50i	●	●	●			●	●	●	●	●	●	●	●	●	●	●	●	●	●	●*4	●	●	●
	720	60p*1	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
		50p	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

*1 The unit is compatible with frame rates of 1.00 and 1/1.001 both when the input signal is 60 Hz, 30 Hz, or 24 Hz. (60 Hz: compatible with 59.94 Hz and 60.00 Hz, 30 Hz: compatible with 29.97 Hz and 30.00 Hz, 24 Hz: compatible with 23.97 Hz and 24.00 Hz)

*2 The scope function does not work when input signals are incompatible with the selected 3D mix format though the SCOPE button lights up.

*3 The frame synchronizer cannot synchronize frames if the 1.00-frame-rate signal and 1/1.001-frame-rate signal are input. Unify the frame rate of input signals to 1.00 or 1/1.001.

*4 The bottom scanning line of the rotated image is processed into black when using the rotation function.

INPUT			2D-3D converter	Output: 3D MIX FORMAT				Output: HD/SD SDI		Output: HDMI		2D-3D converter ADJUST										
				SIDE-BY-SIDE H	ABOVE-BELOW	LINE-BY-LINE	CHECKERBOARD	MIX	INDIVIDUAL	MIX	INDIVIDUAL	PARALLAX	INTENSITY	SUB INT.	PARALLAX ANA	INTENSITY ANA	SUB INT. ANA	PARALLAX LRS	INTENSITY LRS	SUB INT. LRS	MEMORY-1	MEMORY-2
HD/SD SDI 1 (L) or HD/SD SDI 2 (R) Y/Cb/Cr=4:2:2 (for 2D-3D 60i*1 conversion)	1080	60p*1	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
		50p	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
		30p*1	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
		25p	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
		24p*1	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
		24psF	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
		60i*1	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
		50i	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	720	60p*1	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
		50p	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

*1 The unit is compatible with frame rates of 1.00 and 1/1.001 both when the input signal is 60 Hz, 30 Hz, or 24 Hz. (60 Hz: compatible with 59.94 Hz and 60.00 Hz, 30 Hz: compatible with 29.97 Hz and 30.00 Hz, 24 Hz: compatible with 23.97 Hz and 24.00 Hz)

HDMI input

INPUT				2D-3D conv.	3D MIX FORMAT SIDE-BY-SIDE H	ABOVE-BELOW	LINE-BY-LINE	CHECKERBOARD	HD/SD SDI MIX	HD/SD SDI INDIVIDUAL	HDMI MIX	HDMI INDIVIDUAL	PARALLAX	INTENSITY	SUB INT.	PARALLAX ANA	INTENSITY ANA	SUB INT. ANA	PARALLAX LRS	INTENSITY LRS	SUB INT. LRS	MEMORY-1	MEMORY-2
HDMI	Video	1080	60p*1	•	•	•	•	•	•*2	•*2	•	•	•	•	•	•	•	•	•	•	•	•	•
			50p	•	•	•	•	•	•*2	•*2	•	•	•	•	•	•	•	•	•	•	•	•	•
			30p*1	•	•	•	•	•	•*2	•*2	•	•	•	•	•	•	•	•	•	•	•	•	•
			25p	•	•	•	•	•	•*2	•*2	•	•	•	•	•	•	•	•	•	•	•	•	•
			24p*1	•	•	•	•	•	•*2	•*2	•	•	•	•	•	•	•	•	•	•	•	•	•
			60i*1	•	•	•			•*2	•*2	•	•	•	•	•	•	•	•	•	•	•	•	•
			50i	•	•	•			•*2	•*2	•	•	•	•	•	•	•	•	•	•	•	•	•
		720	60p*1	•	•	•	•	•	•*2	•*2	•	•	•	•	•	•	•	•	•	•	•	•	•
			50p	•	•	•	•	•	•*2	•*2	•	•	•	•	•	•	•	•	•	•	•	•	•
	PC*3	WUXGA		•	•	•	•				•	•	•	•	•	•	•	•	•	•	•	•	•
		UXGA@60		•			•				•	•	•	•	•	•	•	•	•	•	•	•	•
		WSXGA+@60		•							•	•	•	•	•	•	•	•	•	•	•	•	•
		SXGA@60		•	•	•	•				•	•	•	•	•	•	•	•	•	•	•	•	•
		WXGA@60		•	•	•	•				•	•	•	•	•	•	•	•	•	•	•	•	•
		XGA@60		•	•	•	•				•	•	•	•	•	•	•	•	•	•	•	•	•
		SVGA@60		•	•	•	•				•	•	•	•	•	•	•	•	•	•	•	•	•
		WVGA@60		•	•	•	•				•	•	•	•	•	•	•	•	•	•	•	•	•
		VGA@60		•	•	•	•				•	•	•	•	•	•	•	•	•	•	•	•	•

*1 The unit is compatible with frame rates of 1.00 and 1/1.001 both when the input signal is 60 Hz, 30 Hz, or 24 Hz. (60 Hz: compatible with 59.94 Hz and 60.00 Hz, 30 Hz: compatible with 29.97 Hz and 30.00 Hz, 24 Hz: compatible with 23.97 Hz and 24.00 Hz)

*2 No output when HDCP is used.   *3 VESA/CVT-RB compliant (except for WVGA@60)

Video input/output

	INPUT SELECT			OUTPUT PRESET		Output terminal (video)		
		LR INVERT	2D-3D	SDI OUT SELECT	HDMI OUT SELECT	HD/SD SDI 1 (L)	HD/SD SDI 2 (R)	HDMI
When using 2D-3D converter	HD/SD SDI IN 1 (L)	—	OFF	—	—	HD/SD SDI IN 1 (L) throughout		
			ON	INDIVIDUAL	INDIVIDUAL	HD/SD SDI IN 1 (L) 3D-converted left-channel signal	HD/SD SDI IN 1 (L) 3D-converted right-channel signal	HD/SD SDI IN 1 (L) 3D-converted left-channel signal[*1]
				MIX	MIX	HD/SD SDI IN 1 (L) 3D-converted mixed signal	HD/SD SDI IN 1 (L) 3D-converted mixed signal	HD/SD SDI IN 1 (L) 3D-converted mixed signal
	HD/SD SDI IN 2 (R)	—	OFF	—	—	HD/SD SDI IN 2 (R) throughout		
			ON	INDIVIDUAL	INDIVIDUAL	HD/SD SDI IN 2 (R) 3D-converted left-channel signal	HD/SD SDI IN 2 (R) 3D-converted right-channel signal	HD/SD SDI IN 2 (R) 3D-converted left-channel signal[*1]
				MIX	MIX	HD/SD SDI IN 2 (R) 3D-converted mixed signal	HD/SD SDI IN 2 (R) 3D-converted mixed signal	HD/SD SDI IN 2 (R) 3D-converted mixed signal
	HDMI IN	—	OFF	—	—	HDMI IN throughout		
			ON	INDIVIDUAL	INDIVIDUAL	HDMI IN 3D-converted left-channel signal	HDMI IN 3D-converted right-channel signal	HDMI IN 3D-converted left-channel signal[*1]
				MIX	MIX	HDMI IN 3D-converted mixed signal	HDMI IN 3D-converted mixed signal	HDMI IN 3D-converted mixed signal

*1 A 3D-converted video signal from the HD/SD SDI IN 1 (L) terminal comes out of the HDMI OUT terminal when OUTPUT PRESET is set to INDIVIDUAL during 2D-3D conversion.

Video input/output

INPUT SELECT		LR INVERT	2D-3D	OUTPUT PRESET		Output terminal (video)		
				SDI OUT SELECT	HDMI OUT SELECT	HD/SD SDI 1 (L)	HD/SD SDI 2 (R)	HDMI
When using LR mixer	HD/SD SDI IN 1 (L)	NORMAL	—	INDIVIDUAL	INDIVIDUAL	HD/SD SDI IN 1 (L)	HD/SD SDI IN 2 (R)	HD/SD SDI IN 1 (L)*1
		INVERT				HD/SD SDI IN 2 (R)	HD/SD SDI IN 1 (L)	HD/SD SDI IN 2 (R)*1
	HD/SD SDI IN 2 (R)	NORMAL	—	MIX	MIX	MIX		MIX
		INVERT				MIX-INVERT		MIX-INVERT

*1 A video signal from the HD/SD SDI IN 1 (L) or HD/SD SDI IN 2 (R) terminal comes out of the HDMI OUT terminal when OUTPUT PRESET is set to INDIVIDUAL during LR mixing.

Audio signals input/output

	INPUT SELECT			OUTPUT PRESET		Output terminal (video)		
		LR INVERT	2D-3D	SDI OUT SELECT	HDMI OUT SELECT	HD/SD SDI 1 (L)	HD/SD SDI 2 (R)	HDMI
When using 2D-3D converter	HD/SD SDI 1 (L) HD/SD SDI 2 (R) HDMI (When selecting one of the above)	—	OFF	MIX/ INDIVIDUAL	MIX/ INDIVIDUAL	Throughout		
			ON	INDIVIDUAL	INDIVIDUAL			
				MIX	MIX			
When using LR mixer	HD/SD SDI (L) HD/SD SDI (R)	NORMAL	—	INDIVIDUAL	INDIVIDUAL	HD/SD SDI 1 (L)	HD/SD SDI 2 (R)	HD/SD SDI 1 (L)
		INVERT				HD/SD SDI 2 (R)	HD/SD SDI 1 (L)	HD/SD SDI 2 (R)
		NORMAL		MIX	MIX	HD/SD SDI 1 (L)	HD/SD SDI 2 (R)	HD/SD SDI 1 (L)
		INVERT				HD/SD SDI 2 (R)	HD/SD SDI 1 (L)	HD/SD SDI 2 (R)

Input/output formats of audio signals

Input format of embedded audio signal

HD/SD SDI IN	IEC60958 PCM 48 kHz 8ch
HDMI IN	IEC60958 PCM 48 kHz 2-8ch
	Dolby Digital (AC3) 5.1ch compatible DTS 5.1ch MPEG2-AAC stereo 2ch

Output format of embedded audio signal

HD/SD SDI OUT	IEC60958 PCM 48 kHz 8ch
HDMI OUT	IEC60958 PCM 48 kHz 2ch
HD/SD SDI OUT HDMI OUT	IEC60958 PCM 48 kHz 2-8ch IEC60958 PCM 48 kHz 2ch
HD/SD SDI OUT	No output available
HDMI OUT	Dolby Digital (AC3) 5.1ch compatible* DTS 5.1ch* MPEG2-AAC stereo 2ch*

*Throughout output

Specifications

			Model name	IF-2D3D1
General			Power requirements	AC 120 V - 240 V, 50 Hz/60 Hz
			Rated current	0.2 A
			Power consumption	10 W (approx.)
			Dimensions (W × H × D)	430 mm × 48.5 mm × 248.5 mm (17" × 2" × 9 7/8")
			Mass	2.5 kg (5.5 lbs) (excluding accessories)
Input / Output	Input terminals	HD/SD SDI		BNC terminals 0.8 V (p-p) x 2
		HDMI		1 (version 1.3 compliant)
	Output terminals	HD/SD SDI		BNC terminals 0.8 V (p-p) x 2 BNC terminals 0.8 V (p-p) x 2 (Re-clock out)
		HDMI		1 (version 1.3 compliant)
	Audio	HD/SD SDI		HD/SD embedded audio 1-2G 8 channels (48 kHz)
		HDMI		Linear PCM 8 channels (48 kHz)
	External control			RS-232C terminal (D-sub 9 pin) x 1
Others	Operation environment			Temperature: 5°C - 35°C, humidity 20% - 80% (No condensation) (Operational environment may vary depending on the condition of the installation place.)