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SONY HVR-V1

24P HDV CAMCORDER

FEBRUARY 2007

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In early November, a Sony product manager delivered a pre-production HVR-V1 HDV camcorder, one of seven then floating around the country. The camera came bubble-wrapped in an aluminum camera case covered with Japanese shipping stickers. It lacked a serial number placard (instead, it had a yellow label-maker label saying simply "PV ENGINEERING, TOKYO"), an instruction manual, and an A/V cable. Although the mechanical fit and finish were up to Sony's usual standards, the firmware and performance were a wee bit inconsistent, so this first look will focus more on the camera's design, operation, and unique imager, and less on performance measurements.

Design and operation

Take the notable aspects of the HVR-Z1 (a big three-CCD HDV camcorder, reviewed May '05 DV) and the HVR-A1 (a small single-CMOS HDV camcorder, reviewed July '06 DV), mix them together, pour them into a PD170-shaped mold, and you have the V1. It's the first three-chip HD camcorder I've used that has the handling of a three-chip DV camcorder. At 3 pounds 6 ounces, it's 2 ounces lighter than my PD150 (the PD170's look-alike predecessor), and dimensionally it's almost an exact match. One big change: the side handgrip is placed farther forward on the V1 than on the PD150/PD170, so the fore/aft balance of the camera is perfect, and, as with the PD170, the camera is narrow enough that you won't overstress your wrist keeping horizons level. Both the handgrip and the underside of the carrying handle are lined with elastomer resin for a sure grip. It feels almost like suede and positively invites handling.

The 20x lens has free-spinning servo zoom and focus rings, just like the PD170; selector buttons on the rear panel for white balance, gain, and shutter speed, just like the PD170; a bayonet-mount sunshade with lever-operated shuttered lens cap, just like the PD170; and a handle-mounted audio control pod with dual XLR inputs and a fitting for a short shotgun mic, just like the PD170. But the resemblance stops there. The PD170's iris wheel is positioned amidships, but the V1 moves it to just behind the zoom ring, with the auto/manual push button just above it and the momentary auto-focus push button just below. This tight grouping of shooting controls puts them readily within reach of your focusing hand, so you won't need to do as much blind groping as on the PD170. In my opinion, this is the best Handycam control layout Sony has done.

Three assignable buttons are arrayed along the aft end of the lens barrel, just above the three-position ND filter switch. Below, two buttons switch between manual and auto-focus modes, and turn on the view-magnifying expanded focus mode first seen on the FX1 and Z1 (and, as with those cameras, it can't be used when tape is running).

The body-mounted 3.5-inch flip-out LCD has slightly fewer pixels than the LCD on the Z1, but not enough fewer to notice-and the V1 inherits the Z1's eye-level viewfinder. The LCD opens to reveal transport controls, three more assignable buttons, and other controls. Beneath the LCD, a panel swings down to expose HDMI and USB connectors and a Memory Stick slot. The Z1's Status Check and Picture Profile (custom preset) buttons have relocated to the left rear side of the V1.

The audio pod has separate level controls for each channel and uses chromed flip switches in place of the slide switches on the PD170. Both XLRs are switchable between line and mic levels, and 48-volt phantom power is available.

PD150, HVR-V1, and HVR-Z1 compared.

The right-side handgrip, having moved forward, displaces input/output (I/O) connectors to the right rear corner of the camera. The V1 has angled attachment points for analog, FireWire, and power cables. They don't stick straight out, so they're less likely to snag on things. The V1 uses the now-familiar flattened D connector for a component analog breakout cable and a 4-pin FireWire connector. A rounded D connector accommodates a composite/S-Video/analog audio breakout cable. If you don't have one of the special cables, you can't get video out of the V1, as the V1 has no RCA or Y/C connectors on the body itself. The power connector accepts the same flattened plug used with many other Sony Handycams and still cameras, and the battery can be charged on the camera.

LCD in All-scan mode: all readouts shown (iris on auto, gain, shutter, and audio on manual), daylight with +7 warming, and histogram.

The menu system is a blend of PD170 and Z1 menus, and will be familiar to anyone accustomed to either camera. Like the Z1, the V1 offers three levels of peaking display in white, yellow, or red-but unlike the Z1, the V1 can display peaking and zebra at the same time. The V1 adds a real-time histogram display, as found on the A1, making exposure setting more certain. Focus can be displayed in meters or feet. For the first time on a Sony Handycam, you can set up the display to show aperture, shutter, gain, and white balance settings even when they're automatically controlled (a small "A" appears next to the readout), so you're never in the dark as to what the camera is doing-for a control freak like me, that alone is almost enough to make me replace my other Sony cameras with V1s.

The menu offers both Black Stretch and Black Compress settings, as well as a three-level manual knee, plus automatic knee. Along with normal and two CineFrame gammas, the V1 adds CineFrame Matrix, an alternate color rendition that Sony claims mimics a particular film stock. The Contrast Enhancer setting pulls up shadows and midtones in predominantly low-key scenes, adding a bit of snap to otherwise flat pictures. It has no effect on highlights that I saw, and kicks in only when most of the image is dark. An added bonus: if you press in the menu wheel while in outdoor white balance, you can tweak the color temperature by Ã‚Â±7, with higher numbers going warmer.

Menu settings and Picture Profiles can be saved to Memory Stick, and a V1 will jam-sync timecode over FireWire from another V1, a Z1, or other cameras.

Most of these features, along with progressive capture and XLR audio, are not available on the V1's consumer counterpart, the HDR-FX7.

CMOS imagers and 24p

The V1 uses three 1/4-inch CMOS sensors in place of the more-common 1/3-inch CCDs. The CMOS sensors are completely free from vertical smear and draw less power than CCDs, and their architecture allows for some interesting tricks.

The pixels on the sensors are oriented on the diagonal: think of the holes in a chain-link fence, and you'll understand their layout (see the diagrams at http://bssc.sel.sony.com/BroadcastandBusiness/minisites/HDV1080/HVR-V1U/). The active area consists of 1080 staggered rows of 960 photosites each. It's as if the even rows were pixel-shifted compared to the odd rows. Each row, however, is sampled 1920 times: each photosite is sampled by itself and a sample is taken in between photosites, combining information from the two photosites on either side and the ones immediately above and below. In essence, each scan line comprises two sets of interleaved sample types: 960 pin-sharp samples and 960 more diffuse samples averaging the four surrounding photosites. Sony claims that this gives the V1 full 1920 x 1080 resolution. What I saw was impressive, but don't throw away your CineAltas just yet.

The CMOS imager also allows true progressive scan, at both 24p and 30p rates. The 24p is recorded and output as 60i using the standard 2:3 pulldown. The 24p is a true 24 fps mode that evenly samples 24 frames per second, not the pseudo-24p CineFrame mode from earlier Sony HDV cameras. I had no problem capturing the V1's 24p as 60i using Final Cut Pro 5.0.4, converting the clip to DVCPRO HD, and then extracting the original 24 frames per second using Cinema Tools. (Cinema Tools refuses to work on raw HDV clips, hence the conversion to DVCPRO HD. I also used Apple Intermediate Codec and uncompressed formats successfully.) The recovered 24p clip showed perfectly even timing between frames with no temporal syncopation: it's really 24p. The shutter speed defaults to 1/48 second, 1/24, and 1/40 (but not 1/32), and higher and lower speeds can be dialed in.

Sony is working with NLE vendors to allow real-time 2:3 pulldown extraction during capture. Vegas may already support it.

The CMOS sensor allows scanning from a reduced area at higher than normal speeds. The V1 exploits this with Smooth Slow Recording: the camera captures 3 seconds of 640 x 360 pixel video (or 6 or 12 seconds of 512 x 320 pixel video) to an internal memory buffer at 240 fps, for a 4x slow-mo. It then up-converts these small pix to DV(CAM) or HDV depending on format settings, and records them to tape. The resulting clips are a bit soft and show some compression artifacts. Although they won't intercut cleanly with full-res material, they're perfectly suited for motion analysis work-the system's symbology for Smooth Slow Recording shows a stylized golfer, the target market for the many low-res, high-speed shooting schemes available on various camcorders.

Like other CMOS camcorders, the V1's chips use a rolling shutter, sampling scan lines sequentially instead of capturing the entire frame at once. Still frames taken from fast pans show tilted vertical lines-just like stills grabbed from a tube camera's clips or photographs taken with still cameras using vertical focal-plane shutters. The 1x playback of such pans on CRTs look better than CCD camera pans do, because CRTs are also sequentially scanned, but all-at-once displays may make the V1's pix look distorted. (Of the two LCDs I use, the Panasonic BT-LH1700W scans like a CRT: the Z1 CCD pans look tilted and the V1 CMOS pans look normal. The HP L2335 buffers the image and displays it all at once: the Z1 pans look normal and the V1 pans show tilt.) Fast-moving objects can look distorted in extracted stills, though I have yet to see anything objectionable in moving video. If you're considering a V1 for film-out, you'll want to test this aspect of the camera's imaging and see if it suits your needs.

Performance

The V1 hasn't shipped yet (at least, not as of the time I wrote this), so it's too early to generate hard data on how it performs. Still, what I saw may be of interest, with the caveat that the released version of the camera may or may not behave like the prototype I worked with.

The zoom ring is a free-spinning ring like the one on the PD170, instead of the indexed, hard-stopped ring on the Z1. While this means the V1 gives up focal length markings and the repeatability of the Z1's and HVX200's zooms, it does allow the zoom ring and zoom rocker to be active at the same time. The prototype's zoom ring lacked the instant responsiveness of the PD150 I use-there was a slight lag between turning the ring and seeing movement, a delay I put down to pre-release firmware (I hope).

Sensitivity on the V1 is rated at 4 lux, compared to 3 lux on the Z1. I found the prototype to be roughly one and a half stops slower than the Z1, two stops slower than the Panasonic HVX200, and three stops slower than the standard-definition PD150 and Panasonic DVX100.

Dynamic range and noise on the prototype looked roughly comparable to those of the Z1, but I'm withholding detailed judgments until a shipping version of the camera is available for test.

Resolution looked surprisingly good, both on test charts and on real-world material. One telling factor is that sharpness can be dialed down on the V1 without the picture going to mush, as it will on the Z1.

In interlaced mode, when dual-row readout is involved, each output scan line is the sum of two adjacent scan lines on the sensors (see http://www.adamwilt.com/TechDiffs/FieldsAndFrames.html). Recall that the even lines are pixel-shifted with respect to the odd lines, so in effect you're getting 1920-pixel sampling (plus 1920 softer, four-photosite in-between samples). Images were noticeably more detailed than similar

images from the Z1. Equally importantly, the V1 shows much less aliasing than the Z1 or the HVX200.

In progressive mode, it's more of a mixed bag. Dual-row readout isn't used, so each output scan line is the sum of 960 sharp samples and the interposed 960 soft samples. Sharpness is still high, but aliasing is more evident; test charts and side-by-side tests with a Z1 and an HVX200 (both with 960 samples per scan line) show aliasing atop the sharper signal. The aliasing is at the same frequency as on the Z1 and HVX, but much less prominent, since the in-between samples fill in some of the missing information, albeit somewhat less crisply. The result is a sharp 960 x 1080 image mixed with a softer, offset 960 x 1080 image. It may not be possible to pick a single resolution figure and declare that the camera's limit.

Vertically, this same alternation of sharp and soft samples leads to an image that looks like a 1080-line image at times, a 540-line image at other times, and something in-between the rest of the time, especially when gentle vertical motion is present. It's hard to describe, really. Test charts show a clean 800+ lines vertically on static pictures, but near-horizontal lines show more vertical aliasing than might be expected, although it's a subtle effect.

The zone plates on a DSC CamAlign chart indicate that the V1's predominant aliasing is in the diagonal direction. The V1, with its 45-degree tilted pixels, is not the camera to choose for detailed shots of chain-link fences.

Overall, the raw resolution of the prototype V1 surpasses that of either the Z1 or the Panasonic HVX200, and may even challenge Canon's crisp XL H1. I'm eager to test the final, shipping version.

Conclusion

Sony squeezed out some features in the quest to put HDV into a PD170-sized package: analog-in recording, 50 Hz/60 Hz switchability, low-light capability, and standard video connectors on the camera body. But the result is a compact, lightweight Handycam that shoots sharp, clean HDV while offering the best laid-out controls found on a small Sony, and true progressive capture to boot. Rolling shutter will be an issue for some, but overall, the V1 looks like a worthy addition to the choices available to HDV shooters.

Adam Wilt (www.adamwilt.com) writes DV's Technical Difficulties column when he isn't too busy testing cameras and writing broadcast industry utility software.