# Lumagen VisionPro™

## *Video Processor, Video Upconversion & Signal Switching*

GREG ROGERS

### Reviewer's Choice

The Lumagen VisionPro™ Video Processor is the type of product that I like to review. First and foremost, it delivers exceptional performance. Second, it's an outstanding value. It provides extremely flexible scaling functions and valuable input switching that isn't included on more expensive processors. Third, it works as advertised, without frustrating bugs or design errors that compromise video quality or render important features inoperable.

*"...blends outstanding picture quality with extremely flexible scaling functions..."*

**Lumagen VisionPro™**


**Specifications:**

Inputs: Eight Programmable Inputs (BNC); Composite (Up To 8), S-Video (Up To 8), Component (Up To 4), Pass-Through (Up To 2), SDI (Optional)
Outputs: YPbPr/RGB (BNC)
Video Processing: 3:2 & 2:2 Pulldown Reconstruction, Per-Pixel Motion-Adaptive Video Deinterlacing, Detail-Enhancing Resolution Scaling
Output Resolutions: 480p To 1080p In Scan Line Increments, Plus 1080i
Dimensions (WHD Inches): 17 x 3-1/2 x 10-1/4
Price: $1,895; SDI Input Option, $400

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### Product Overview

The VisionPro ($1,895) provides two important video functions—upconversion and source switching. The versatile video processing algorithms deliver extensive control over input and output formats. Video enthusiasts and professional calibrators, can optimize the image format for each standard-definition source in a home theatre.

There are eight analog video inputs, and an optional SDI digital video input ($400). All eight analog inputs accept composite or S-video signals, or up to four inputs can be used for 480i YPbPr component video signals. Alternatively, two of the latter inputs accept YPbPr or RGBHV pass-through signals.

The VisionPro provides YPbPr or RGB output signals with a complete selection of sync options. It produces virtually any progressive video format between 480p and 1080p and also generates 1080i for CRT-based rear-projection TVs.

### Upconversion

Consumer upconverters are usually called video scalers, but there is much more to upconversion than scaling. Analog source signals must be digitized, and standard-definition interlaced video must be converted to progressive video. Then the progressive video can be scaled to create the desired number of horizontal lines per frame. If 1080i signals are required, progressive frames must be converted back into interlaced fields. Finally, the digital video fields or frames may be converted to analog YPbPr or RGB component video to drive a high-resolution projector or monitor.

Every step in the upconversion process visibly affects picture quality, and each element is addressed in the VisionPro design. It utilizes 10-bit over-sampled analog-to-digital and digital-to-analog converters to improve signal linearity and reduce video noise. A Silicon Image SiI-504 digital processor provides optimal inverse-telecine deinterlacing for film-sources and motion-adaptive deinterlacing for original interlaced-video sources. Lumagen developed its own proprietary scaling algorithms to enhance edge sharpness while virtually eliminating edge-outlining artifacts. The scaling algorithms also provide extensive image sizing and output format options.

### SDI Input

Sadly, the analog signal quality of many DVD players is rather poor. Edge outlining and ringing artifacts can severely compromise image quality, and are often worse on progressive outputs than interlaced outputs. Digital and analog filters in the digital-to-analog converter system are the main culprits. Unfortunately the problems are not limited to lower-priced players—many higher-end DVD players are the worse offenders.

Consequently, it's not surprising that DVD players with Digital Visual Interface (DVI) digital video outputs have been well received. A DVI output bypasses the digital-to-analog conversion in the DVD player to eliminate a major source of artifacts. For the same reason, video

enthusiasts were adding SMPTE 259M serial digital interfaces (SDI) to DVD players long before DVI outputs began to appear. SMPTE 259M is a professional SDI standard that transports uncompressed 480i (or 576i) YCbCr digital video signals on a single 75-ohm coax cable.

Lumagen recently added an optional SDI input to the VisionPro. This connection bypasses digital-to-analog (D/A) conversion in a DVD player and analog-to-digital (A/D) conversion in the video processor. That eliminates DVD player edge artifacts, potential noise and jitter from D/A and A/D conversions, and it maintains the full luma and chroma resolution of DVD images.

## Appearance

The VisionPro has a black-anodized, brushed-aluminum front panel with only three buttons and a backlit LCD status display. The all-metal case is entirely black and occupies a 17- x 10.25-inch footprint. Adapters are included for mounting in a standard 19-inch rack (2-RU, 3.5-inch height). There is no fan, so the video processor operates silently.

## Inputs And Outputs

The rear panel includes eight analog video inputs that can be configured to accept a variety of signal formats. All eight analog inputs can be designated to accept composite or S-video (Y/C) signals, or four of the inputs can be selected to accept YPbPr standard-definition interlaced component video signals. Two of the latter four inputs can also be used as pass-through inputs for YPbPr or RGBHV signals. The pass-through inputs are buffered and provide 300-MHz nominal bandwidth for high-definition video signals, but only standard-definition interlaced signals can be deinterlaced or scaled.

High quality 75-ohm BNC jacks are provided for all video inputs and outputs, which are preferable for their superior electrical and mechanical properties. Lumagen includes a selection of conversion cables and adapters to accommodate consumer video sources that use RCA or 4-pin mini-DIN connectors. Two sets of three BNC-to-RCA cables, two BNC-to-S-video cables, and three BNC to RCA adapters are provided. Additional conversion cables and adapters are available from Lumagen or other cable manufacturers.

Either YPbPr or RGBHV signals can be output (5 BNC jacks). RGB signals are configurable with separate HV or composite sync, or embedded sync on green. Embedded sync can be bi-level or tri-level. Any combination of H,V or composite sync polarities can be selected.

YPbPr signals with bi-level or tri-level sync can be produced for any format, but only 480p, 720p, 1080i, and 1080p are industry standard YPbPr formats. All YPbPr formats are output with ITU Rec. 709 high-definition color matrix encoding. So unless a display has a user selectable option to apply Rec. 709 color decoding to 480p signals, that YPbPr format should be avoided.

When the SDI option is included the AUX BNC jack becomes the serial digital video input. Otherwise, the AUX jack can be used as a TTL-level input to turn on the VisionPro or as an output to turn on another device. The VisionPro does not have a DVI output, which would complete a purely digital video path to a DLP projector.

An RS-232 connector is provided to operate the VisionPro from a personal computer or home theatre controller, or to update the firmware with new enhancements. The RS-232 serial interface commands are included in the User Manual, and firmware enhancements are documented and posted on the Lumagen Web site (www.lumagen.com).

An external power module supplies 5-volts DC through a cable to a rear panel jack. The power module includes a separate power cord to connect to the AC power line, and an LED that indicates when the module is receiving power.

## Configuration Memories

Configuration memories store all of the settings that apply to processing the video signals (pass-through signals are not processed). Each of the eight analog video inputs, plus the optional SDI input, has two configuration memories (MEMA/MEMB) that are unique for each input. By default, all configuration memories share the same output format. But the user can also choose to save independent output formats for each configuration memory.

The configuration memories are selected with the MEMA and MEMB buttons on the remote control. The dual configuration memories for each input provide a number of useful possibilities. The MEMA configuration memories could be used to store settings that are optimized for critical movie viewing in a totally dark theatre, while the MEMB memories might hold settings for viewing in a brighter, socially interactive environment. Another possibility would be to store settings optimized for film sources in MEMA and settings for live sports broadcasts in MEMB.

The VisionPro includes special modes that can automatically select MEMA for incoming NTSC signals and MEMB for PAL signals. Another related feature provides the ability to specify one output format for all incoming NTSC signals and another for all PAL signals.

COPY functions simplify setting up the configuration memories by allowing the current input settings, or output format, to be separately copied to one or all configuration memories. A SAVE command is provided to separately store each individual configuration in non-volatile memory, which will be retained when the unit is unplugged.

## Remote Control

The infrared remote control buttons are backlit and feature distinctive sizes and shapes that make it a pleasure to use in a dark theatre. Menu, OK, Exit, and cursor buttons provide intuitive navigation of the OSD (on-screen display) menu system. A numeric keypad provides direct selection of any of the nine inputs. There are also dedicated buttons for selecting the A and B configuration memories, and the 4:3 (1.33:1), LBOX, 16:9 (1.78:1) or 1.85:1 input aspect ratios.

There are also component configuration files (.ccf) for a Pronto remote control posted on the Lumagen Web site (www.lumagen. com).

## OSD Menus

The most commonly used VisionPro features are arranged into four menu groups—IN, OUT, MISC, and SAVE. Some additional setup functions are not included in the OSD menus, and must instead be accessed by entering a short numeric sequence on the remote control. That simplifies the on-screen menu structure and prevents a user from making inadvertent changes to basic setup parameters.

## Input Features

The IN menu functions can be individually calibrated for each input source. The PDSTL and ENHNCE settings in the ADJ submenu should be made prior to adjusting black level, contrast, color saturation, and hue in the COLR submenu.

PDSTL (pedestal or setup) should be set to match the nominal black level (0 or 7.5 IRE) of each input signal. The standard for composite and S-video signals is 7.5 IRE in North America. The black level for YPbPr signals is usually 0 IRE, which follows the EIA/CEA 770.2 standard, but it may be 7.5 IRE on older DVD players. Some DVD players include an option for “no setup,” “dark,” or “enhanced-black,” which all refer to black at 0 IRE.

ENHNCE expands the lowest 2 IRE of the input signal. I would normally turn the ENHNCE feature off (it is enabled by default), but it may be useful with some non-CRT based displays that can’t produce totally dark black levels.

The other ADJ submenu items are SIZE, Y/C-DLY, SHARP, and SYNC. SIZE provides adjustments to scale and position the incoming image with respect to the output frame. It is valuable because image position

errors are common from many sources. It can also be used to remove an annoying line of vertical blanking interval data (visible as white dashes) at the top of an image.

The Y/C-DLY adjustment delays the luma signal relative to the chroma signal by ±7 steps at 0.25-pixel per step. The SHARP adjustment provides four settings. The default setting is 0, which provides the most level frequency response.

The SYNC item only appears when using pass-through signals. Incoming RGB sync signals can either be processed to automatically match the polarity of internally generated sync signals, or simply buffered without altering polarity. This is an important feature because many displays use separate configuration settings based on the polarity of incoming sync signals.

The TYPE submenu configures appropriate inputs to accept composite, S-video, component, or pass-through signals. The NAME submenu permits the input configuration memories to be assigned names with four or less characters. The COPY item provides the ability to copy the IN group settings between configuration memories.

## Output Features

The OUT menu provides precise adjustment of the video output format. The RES submenu specifies the number of active scan lines, the vertical frame rate, the horizontal line rate, the output size and position, and the screen aspect ratio. The latter can be set from 1.33:1 to 2.35:1 in 0.01 increments.

The GBAR submenu adjusts the intensity of the gray sidebars (0-49 IRE) when displaying a 4:3 image on a wider screen. There is also a sidebar-pan feature that is enabled with a numeric key sequence. Every few minutes it moves a 4:3 image slightly left or right to minimize differential phosphor aging ("burn-in").

The LEVL submenu permits an output black-level pedestal (7.5 IRE setup) to be turned on or off. This should normally be set to 0 IRE unless it is necessary to match the signals from another source that also drives the display.

The MODE submenu provides a versatile set of options that associate the output format with incoming signal formats. The COPY submenu permits the output format to be copied to other configuration memories.

## Other Menu Features

The MISC submenu provides the ability to enable or disable on-screen status messages, lock configurations to prevent changes, set the power up state, enter a user defined power-on message, and change the AUX connector function (unless the SDI option is present).

The MISC submenu also enables test patterns. Red, green, blue and gray fields, gray windows, and crosshatch test patterns are included. The intensity of each pattern can be adjusted in 10-IRE increments from 10-100 IRE.

The SAVE submenu provides a command to save the current configuration in non-volatile memory, and an UNDO command that restores the configuration that was overwritten by the last SAVE command. The FCTRY command sets all parameters to the factory defaults without overwriting the non-volatile memory.

## Input Aspect Ratio

If the aspect ratio of a source is not the same as the screen aspect ratio, scaling is required to display a picture with correct proportions. In most cases, a projector or monitor provides the necessary scaling. But aspect ratio scaling in some fixed-pixel projectors and display panels may be considerably less than optimal, and some early HD-capable rear projectors only display 480p signals correctly when they are received in a 16:9 format.

The VisionPro includes Input Aspect Ratio scaling so a display need only receive and process video frames in its native screen aspect ratio. For most home theatre displays the screen will be 1.78:1 (16:9), but the VisionPro can be set to output

## Interlaced Video Artifacts

The purpose of converting interlaced video to progressive video (deinterlacing) is to eliminate interlaced video artifacts. The most objectionable interlaced video artifacts are inter-line flicker (line twitter), jagged edges, and motion combing.

Interlaced video is composed of a sequence of fields, where each field contains only the odd or the even horizontal lines of picture information. In the 480i-interlaced format, each field contains 240 active (visible) lines of picture information. When the fields are sequentially displayed on a CRT monitor, we perceive that the odd and even lines create a picture with twice the horizontal lines of a single field. To avoid wide-area flicker a new field is displayed approximately 60 times per second.

Inter-line flicker occurs along horizontal edges because the top or bottom edge of an object appears to lie on an odd line in one field, and an even line in the next field. As odd and even fields are alternately displayed, the edge appears to move up and down by one line in the picture. Since odd fields and even fields are each displayed approximately 30 times per second, the edge appears to blink on and off, or bob up and down, at a 30 Hz rate. This is commonly called line-twitter.

Line twitter is not limited to the edges of objects. It can appear wherever there are high-contrast horizontal lines in an interlaced image. The addition of slow vertical motion increases the twittering as horizontal lines or edges move up or down across field lines.

Inverse-telecine deinterlacing can eliminate line twitter from interlaced film-sources, and motion-adaptive deinterlacing can reduce line twitter from original interlaced-video sources. But to reduce line twitter on interlaced displays, vertical filtering is applied in video cameras and film-to-video DVD transfers to soften (blur) horizontal edges. For that reason, deinterlacing 480i video can never produce the full vertical resolution that would otherwise be possible from an unfiltered 480p source.

Jagged edges (jaggies) along diagonal lines are an unavoidable consequence of a discrete line or pixel structure, but interlacing exacerbates jaggies. Segments along a diagonal edge will appear to flicker on and off because they lie in different interlaced fields. If there is slow vertical movement the jaggies may appear to strobe or move (running jaggies).

Interlaced combing occurs when an object is in motion. Our eyes tend to track the object, particularly on a wide screen. Since the object appears at different locations in the odd and even fields, we perceive the odd and even scan lines separately, rather than integrating them into a complete picture. Vertical and diagonal edges of moving objects may appear like teeth in a comb, because each field has only half the scan lines of the frame. Even when objects aren't in motion, a small component of vertical jitter in the picture may cause our eyes to lock onto the fields and see scan lines as individual fields rather than frames. This is more likely on larger screens, where the scan line spacing is greater.

The remedy for interlace artifacts is to deinterlace the video and display progressive frames. Then by scaling the video to have more horizontal lines per frame, the visibility of the individual lines, and jaggies along diagonal edges, can be reduced or eliminated. ■

frames that represent any aspect ratio from 1.33:1 to 2.35:1 in 0.01 increments.

The remote control provides four Input Aspect Ratio buttons. Select 4:3 to correctly display full-frame 4:3 images in the center of a wider screen. Select 16:9 to display widescreen movies that are available in the 16:9 ("anamorphic") DVD format or LBOX for other widescreen movies.

The 1.85:1 selection provides a special mode to display film material that was vertically stretched to convert a 1.85:1 film aspect ratio to the 16:9 DVD format. However, this doesn't apply to all 1.85:1 films using the 16:9 DVD format. The aspect ratio conversion is sometimes accomplished by cropping the width of the picture by 4 percent, or by including 4 percent more of the image height on the DVD than was seen at the cinema.

CRT front projectors include analog sizing to display multiple aspect ratio formats, in which case the VisionPro input aspect ratio scaling isn't required, but it may still be useful. It is more convenient to set up and maintain a CRT projector to display a single frame format than multiple formats. Although analog sizing is technically advantageous, in practice the reduced effort or cost to maintain only a single display format may encourage improved projector calibration, and consequently better picture quality.

## Zoom

The Zoom function enlarges the image by 15 percent or 33 percent. The latter will fill the height of a 1.78:1 (16:9) screen with a 2.40:1 widescreen movie image, but a significant portion of the film frame will be lost on each side. The remote control's up/down cursor buttons adjust Zoom when a menu is not on screen. The Zoom factor can be changed to produce 5 percent increments by entering a numeric sequence from the remote control.

## Optimal Formats For Every Display

The fundamental purpose of a scaler is to change (scale) the number of horizontal video lines in each video frame. If there are too few horizontal (scan) lines in a CRT-based display, we see the vertical gaps between the lines and a jagged stair-step appearance (jaggies) along diagonal edges. Scalers are also required for fixed-pixel displays because each row of pixels in the display device must ultimately be driven by one horizontal video line. Hence, the number of active (visible) horizontal lines in each video frame must be scaled to match the native resolution of each fixed-pixel display.

The VisionPro provides eight preset output formats—480p, 540p, 600p, 720p, 768p, 840p, 1080p, and 1080i. The format designates the number of active horizontal lines in each frame. The preset formats will be adequate in many applications, but the VisionPro can also produce any format from 480p to 1080p in single-line increments. For instance, you can match a plasma display panel with a 1024 pixel vertical resolution by specifying 1024 lines per frame. The preset formats can be selected by entering a numeric sequence or any format can be set in the OUT/VRES menu.

Most HD-capable rear projectors accept only a few formats—normally 480p and 1080i, and sometimes 540p or 720p. But CRT front projectors are usually compatible with a wide range of scan formats. Although 720p or 768p is a good choice for 7-inch and 8-inch CRT projectors, it may not be optimum, and most 9-inch CRT projectors perform best with formats between 840p and 1080p. Optimum performance is normally obtained when each horizontal scan line just touches the line above and below it. This is the "sweet spot," or "golden" display format for CRT projectors. The VisionPro's ability to exactly specify the number of active scan lines per frame permits each CRT front projector to operate at its optimum "sweet spot."

Contrary to popular belief, that alone will not increase the brightness of the display, but it allows a CRT projector to be calibrated to produce a brighter picture without degrading gray scale performance. The maximum picture brightness and optimum gray scale tracking are tradeoffs that should be calibrated by a professional with appropriate instrumentation.

The service menu provides a special feature to improve gray scale calibration. The red, green, and blue signal gains can be independently adjusted at 20, 30, 50, 80, and 100 IRE to optimize the color temperature at those levels. This is particularly useful with CRT projectors, which often have a bluish color temperature in the middle of the brightness range. The adjustment resolution was increased from 100 to 1000 steps in a recent firmware enhancement.

## Output Format Adjustments

The VisionPro provides other output format adjustments in addition to the number of active lines per frame. These include output SIZE and position (POS), horizontal line rate (HRATE), and vertical frame rate (VRATE).

The POS adjustments reposition the output image horizontally and vertically within the total scan lines of the frame. The SIZE adjustments scale the image to occupy more or fewer scan lines, and more or fewer pixels per scan line, without changing the total number of scan lines in the frame, or the total number of pixels per line.

The HRATE value (along with the VRATE value) determines the total scan lines per frame, which includes the active scan lines plus additional black lines for the vertical retrace interval. When the VRES (active scan lines) value is altered the HRATE value is automatically changed to maintain an acceptable vertical retrace interval. Hence, there is no reason to alter the HRATE setting unless a display specifically requires a particular timing that is different from the automatic setting.

The VRATE setting specifies the number of video frames displayed per second. The North American broadcast standard is 59.94 (60/1.001) frames-per-second (FPS), although ATSC standards also permit 60 FPS. The VisionPro factory default value is set to 59.94 FPS. Nevertheless, slight timing differences produce a dropped frame about once every 10 minutes. Although this would rarely be noticed, Lumagen has implemented a genlock function (for 59.94 Hz NTSC and 50 Hz PAL rates), which ensures that one frame is output for each incoming field. Lumagen's genlock implementation produces slightly non-standard output formats that may not work with every display. For that reason the genlock function can be enabled or disabled through a numeric key sequence.

The VRATE setting can be adjusted from 48-75 FPS in 0.01 steps for all formats (rates up to 120 FPS at 600p), but I can't envision a reason to use any setting other than 59.94 FPS. Higher settings force repeated frames, and lower settings result in dropped frames. For movie viewing it would be desirable to display each 24 FPS film frame exactly 3-times at 72 FPS (actually 71.93 FPS) to create smoother motion, but there is no provision to ensure that each deinterlaced film frame will be repeated exactly 3-times. Instead, 60-percent of the time a 4-2 pattern will result rather than a 3-3 pattern, which makes judder worse rather than better.

## Shared Enhancements

The Lumagen Vision ($995) and VisionPro share the same video processing algorithms and key integrated circuits. I reviewed the Vision in Issue 72, May 2003, shortly after it was introduced. Since the Vision review, both products have been enhanced with performance improvements and additional features via firmware upgrades that are available from the

Lumagen Web site. The remote control described in this review is also new, and can be purchased from Lumagen for the Vision.

One of the more significant firmware enhancements is a vertical filter that improves the Chroma Upsampling Error (CUE) that is present in the MPEG decoder of many DVD players. The filter also improves the video quality of original interlaced-video sources that suffer from a similar type of chroma upsampling problem.

There have also been new features to automatically switch between an S-video and pass-through input for satellite/cable boxes that auto-switch SD/HD outputs, sidebar-panning to help CRT and plasma displays avoid image retention problems ("burn-in"), genlock (discussed earlier), and individual input size, position and zoom settings for each input-aspect ratio.

Other improvements include a reduction in video delay (now 3 to 4 frames), additional output size and position range for displays with excessive overscan, additional resolution for the grayscale/gamma calibration feature, adjustable H-sync width for display compatibility, and improvements to avoid black-level differences between sources with or without Macrovision.

## Resolution And Scaling

The VisionPro provides exceptional scaling performance when its Sharpness control is set to the default (0) position. Its scaling algorithms maintain excellent sharpness, while avoiding visible edge outlining or ringing artifacts when scaling horizontal and vertical line patterns with standard video edge transitions from an AccuPel HDG-3000 Calibration Generator (www.accupel.com). Even when the generator is set to produce much faster edges, there is only an insignificantly faint halo on vertical lines, which is barely visible when standing close to the screen. Therefore, the VisionPro won't add edge artifacts to the output of DVD players that seek to maximize sharpness and resolution by pushing video filtering beyond standard frequency limits.

Horizontal resolution is excellent for all output formats. The 540p and 1080i formats exhibit excellent modulation depth (contrast between the closely spaced black and white lines) and no aliasing on the AccuPel pixel-burst patterns. Slight aliasing is visible on some output formats, but the modulation depth remains extremely good on the 6.75 MHz single-pixel burst lines. The vertical resolution is also consistently excellent. There is no loss of vertical resolution when deinterlacing (480i to 480p) static patterns, and vertical scaling creates only modest softening along horizontal edges for other formats.

The Sharpness control should be left at the default (0) setting. Otherwise, it adds band-pass peaking centered at about 2.6 MHz to the horizontal frequency response, which produces outlining (halo) around vertical and diagonal lines.

The S-video inputs have better than usual chroma response. The 1.0 MHz color stripes on *Video Essentials*' Snell & Wilcox test pattern were reproduced with nearly equal brightness using S-video or YPbPr inputs. At 1.5 MHz the S-video response was still quite good, but less than the YPbPr chroma resolution.

Composite video signals should never be used in a home theatre because the inevitable cross-color and cross-luminance artifacts can be avoided by using component or S-video signals from digital video sources. The VisionPro is not immune to these problems when driven with composite video signals. The *AVIA Guide To Home Theater* resolution pattern generated severe cross-color (rainbows) on the 3.0-4.1 MHz diagonal line patterns, and the Snell & Wilcox pattern from *Video Essentials* produced cross-luminance (dot-crawl) within the color stripes. There was also luma smear on diagonal edges that produced a softer picture than the S-video or YPbPr inputs.

## Pass-Through Input

I tested the pass-through input with the 720p and 1080i Sharpness patterns from the AccuPel HDG-3000. There is no visible edge ringing or outlining artifacts, even with the generator's fastest edge transitions.

## Deinterlacing

The VisionPro uses the Silicon Image SiI-504 Digital Video Processor to provide ideal inverse-telecine deinterlacing for film sources and motion-adaptive deinterlacing for original interlaced-video sources.

Successful inverse-telecine deinterlacing depends on accurately detecting the 2-3 field pulldown pattern that is used to convert film to interlaced video and smoothly handling breaks in that cadence at edit points. The VisionPro did an excellent job of handling the transitions between the film and video segments of *Video Essentials*' "Montage Of Images." There were no glitches or flashes of line combing at any transition. It also performed flawlessly on all of the DVD movies that I viewed over a period of several months.

It is much more difficult to deinterlace original video sources, since the images originate as interlaced fields and not progressive frames. Unlike inverse-telecine deinterlacing for film sources, there are no ideal motion-adaptive deinterlacing algorithms, and there are inevitable tradeoffs between jaggies, line twitter, and picture softening depending on image content and the specific processing algorithms that are used.

On the "Montage Of Images," the VisionPro does an exceptional job with the zoom and pan shots of the bridge structures and the difficult zoom into the leafy tree. Jaggies appear along the frozen branch and the waving American flag, but the picture is sharper than deinterlacers that render those images without jaggies.

Sports broadcasts are the toughest challenge for video-source deinterlacing. I watched several basketball games and the VisionPro fared well. There was a good balance between minimizing jaggies along the on-court lines and logos, and only slight picture softening. I preferred the VisionPro to upconverters with fewer jaggies, but softer pictures.

## Viewing Impressions

I used a Runco IDP-980 Ultra CRT Front Projector to evaluate picture quality using a variety of VisionPro output formats. Lumagen also provided a modified Panasonic DVD-RP91 DVD player with an SDI output to evaluate performance with the SDI digital video interconnect.

The Lumagen scaling algorithms are very impressive. Aside from some slight image softening on formats other than 480p, there are virtually no visible artifacts from inverse-telecine (film-mode) deinterlacing or scaling.

When driven with analog video signals the VisionPro displays the same impressive performance that the Lumagen Vision did in Issue 72. Color decoding accuracy is virtually perfect, and the YPbPr chroma bandwidth produces excellent color detail. The 10-bit A/D converters provide excellent digitizing linearity to render superb shadow-level detail without contributing visible luma or chroma noise in dark scenes. I also verified the excellent small-signal linearity and low noise using the 1-10 IRE patterns from the AccuPel HDG-3000 generator.

The VisionPro's digital-to-analog conversion system is exceptionally free of edge ringing and outlining artifacts. Combined with its excellent scaling, it can render pictures with superb clarity and image definition. But it is critical that the DVD player's digital-to-analog conversion system provide signals that are free of edge artifacts to realize the full benefits of the VisionPro.

Video system performance can get even better when the VisionPro is supplied with digital signals through the optional

SDI input. Eliminating the DVD player's digital-to-analog conversion completely eliminates that source of edge artifacts that degrade picture definition. The SDI connection also eliminates sampling jitter during analog-to-digital conversion, which can result from noise on the DVD player's analog signals. Sampling jitter blurs fine details and reduces picture definition.

The improvements you will see with an SDI connection obviously depend on the quality of your analog signals. Compared with the best analog DVD player signals, the differences in image definition are subtle, but the serial digital video interface is superior. The difficult to render haystacks at the beginning of Star Trek: Insurrection have never looked clearer. The rock formations at the opening of *Indian Jones And The Last Crusade*, and the rough textures in the Cairo scenes of *Raiders Of The Lost Ark*, are also examples that exhibit better definition.

The SDI connection also eliminates any loss of luma or chroma bandwidth during analog and digital signal conversions. The loss of luma bandwidth is often insignificant, but the reduction in chroma bandwidth during the DVD player's D/A conversion is visible on many DVDs. Although there is no difference in color accuracy, the difference in chroma resolution is visible throughout *The Fifth Element*. Small color details are slightly brighter and clearer using the SDI input instead of the YPbPr input. Even more apparent is the improved clarity of intricate color patterns in Mike Myer's coat and the strands of yarn in Heather Graham's dress during the London street scene in *Austin Powers: The Spy Who Shagged Me*.

With black levels very carefully calibrated, I didn't perceive a noticeable difference in contrast or shadow detail using the SDI input. However, this depends on the analog small-signal performance of the DVD player.

I also tested the pass-through input with 720p and 1080i HDTV broadcast signals. There was no visible degradation of picture quality that I could detect.

## Summary

The Lumagen VisionPro provides exceptional performance, features and value. It blends outstanding picture quality with extremely flexible scaling functions and includes input switching for eight analog video sources. The SDI option adds a digital video input, which eliminates several DVD player problems that can degrade picture quality. The VisionPro will satisfy video enthusiasts and professional installers, who want to optimize the image format for each standard-definition source in a home theatre.