

American Society of Cinematographer's (ASC) Technology Committee Report



Curtis Clark, ASC

Clark's ASC credits include such artful narrative films as *The Draughtsman's Contract*, *Dominick and Eugene*, *Alamo Bay*, *Extremities*, and *Talent for the Game*. His extensive commercial cinematography projects have put him on the cutting edge, working for some of the industry's top directors and agencies. Clark currently heads the American Society of Cinematographers (ASC) Technology Committee, which examines and addresses imaging technology issues as they relate to the creation of motion pictures and cinematography. That committee worked closely with Digital Cinema Initiatives (DCI) to produce the ASC-DCI Standard Evaluation Material (StEM) used to evaluate the performance of digital projectors and other elements of digital cinema systems.



By Curtis Clark, ASC; David Reisner; Dave Stump, ASC; Lou Levinson; Joshua Pines; Gary Demos; Ana Benitez; Marty Ollstein; Glenn Kennel; Alan Hart; Don Eklund

Introduction

Chair: Curtis Clark, ASC

Steering Committee Chair: Daryn Okada, ASC

Vice-Chair: Steven Poster, ASC

Vice-Chair: Richard Edlund, ASC

Secretary: David Reisner

Throughout its illustrious 88-year history, the American Society of Cinematographers has been the primary place where the art and technology of the cinematographic process meet. Since its inception, the ASC has consistently worked with the motion picture industry to advance state-of-the-art filmmaking and to share the knowledge gained for the benefit of our industry.

Since its formation in January 2003, the ASC Technology Committee has included leading cinematographers, motion picture technologists, manufacturers, service providers, studio-production and post-production representatives, as well as production designers, editors, and producers to help identify, understand, and find solutions that address filmmakers' needs and enable them to better practice their art and craft of motion picture production in this era of radical technological transformation. The ASC Technology Committee works in collaboration with the Art Directors Guild Technology Committee, the Academy of Motion Picture Arts and Sciences Science and Technology Council, the Producers Guild of America Motion Picture Technology Council, and the Fraunhofer Institute for Integrated Circuits.

Since our 2006 Progress Report for SMPTE, the ASC Technology Committee has been increasingly active on the frontline of a range of technology developments as described in our Subcommittee reports detailed below. The following summary of key activities demonstrates our Technology Committee's central focus on viewing the various technology developments as interdependent components that are integral to workflow deployment. The success of their deployment can only be ultimately evaluated as a function of their ability to facilitate more effective and efficient production and post-production workflow implementations.

The ASC CDL (Color Decision List), which our prolifically energetic Digital Intermediate Subcommittee has been developing over the past two years, has achieved broad support from vendors of both software and hardware-based systems, along with broad support from service providers. The ASC CDL enables primary color corrections to be exchanged between different applications and facilities running on different platforms. The ASC CDL incorporates color correction data interchange via XML, CMX, ALE, and FLEx.



David Reisner

Reisner has consulted in entertainment and technology for 25 years. He is involved in all phases of the introduction of digital technology into motion picture creation, with particular emphasis on retaining creative options and maintaining image quality through the transition to hybrid and digital workflows, and the development of standards and best-practices in digital production, post-production, distribution, and exhibition.

As Secretary of the ASC Technology Committee, Reisner has had significant roles in creation of the ASC Color Decision List and ASC-DCI STEM test movie (screen credit-Test Design and Methodology). Since 2001 he has been active in SMPTE DC28, serving as officer of 28.10 Mastering, 28.8 Projection, and KMAH (d-cinema security). He was architect of one of three proposals for DCI's 4K and 2K proof-of-concept systems. Work in other industries has included plans for internet-based music and movie distribution (2000) and computer hardware and operating system software architecture.

Reisner can be contacted at dreisner@d-cinema.us or www.d-cinema.us.

The official release version 1.0 of the ASC CDL spec is scheduled to be published for open implementation by the end of June 2007.

Our Advanced Imaging Subcommittee has continued its important research work on the characteristics of trichromatic—three primary—color systems, like RGB and X'Y'Z'. It has recently tackled the challenging task of evaluating the quality and consistency of color reproduction between different vendor models of plasma, LCD, and DLP high-definition monitors.

Our Digital Display Subcommittee is incorporating the important work done by the Advanced Imaging Subcommittee into its practical task of mapping the color calibration of digital displays for production and post-production, including both monitors and projectors while defining the display requirements for each step in the workflow process from pre-visualization to dailies, previews, DI and final film, digital, and home video deliverables.

Our new Non-Theatrical Display Subcommittee is investigating image reproduction issues pertaining to the new array of HD consumer flat panel displays (plasma, LCD, DLP), as well as evaluating Blu-ray and HD-DVD input sources generated from HD masters.

Our Metadata Subcommittee has been specifying requirements and proposing recommendations for interoperable metadata exchange in motion picture workflow and defining the essential metadata language suitable for cinematographers and other production artists. It is working closely with AMPAS Sci-Tech Council in pursuing these objectives and its work is being coordinated with the SMPTE RP 210 metadata initiative.

Our Camera Sub-committee has continued to refine the proposed Camera Assessment Series (CAS), which is being closely coordinated with the work done by AMPAS Sci-Tech Council. It is also continuing to define vital cinematographer user requirements that are influencing design specs for the new generation of digital motion picture cameras.

Our Workflow Subcommittee is closely collaborating with the Camera Subcommittee in planning the ASC component of the CAS shoot and also establishing workflow implementation for the results. In addition, members from the Producers Guild Workflow Committee will assist in producing and coordinating the shoot. The ADG Technology Committee is collaborating on the CAS project by providing art direction. An important objective of our Workflow Subcommittee is to establish best practice recommendations and guidelines for practical workflow implementation.

Our Digital Preservation Subcommittee continues to explore the immensely challenging options being proposed for archiving and preservation.

During the past year, our Technology Committee has embarked on groundbreaking publication projects, including a three-part series of special supplements for the *American Cinematographer* magazine in conjunction with the Art Directors Guild Technology Committee, which explores the impact digital imaging technologies are having on the creative collaboration process between the cinematographer, production designer, visual effects supervisor, and the directors with whom they work. Also, our new Digital Primer project is being readied for publication.

Looking forward our Technology Committee is planning two new Subcommittees that will address two increasingly prevalent and important additions to digital motion picture workflow: pre-visualization (both 2-D and 3-D) and 3-D stereoscopic production.



Dave Stump

Stump began his career in film in the late 70s, first as a TV producer for several cable shows and then at ABC where he helped put together a late night TV show called "Completely Off the Wall." He worked on a number of pictures with Clive Donner then worked for Francis Coppola in his camera department at Zoetrope Studios, working on all Zoetrope pictures from "One from the Heart" until the Studio moved to San Francisco. He also worked on "The Day After" TV miniseries, which won a VFX Emmy Award. Stump worked as a director of photography for Roger Corman, as a visual effects supervisor at Cannon Films on *Runaway Train*, and on several other films. He directed photography and supervised visual effects for *Introvision*, a process projection company. In the early 80s, he worked as the head cameraman for Apogee Productions and directed photography for John Dykstra. In 1991, Stump started a rental company, Motion Control Rental Services, which grew into the model for Visual Effects rentals in Hollywood. He continued to work as a freelance cameraman and VFX supervisor. He has worked as director of photography, visual effects director of photography, and visual effects supervisor on numerous large motion pictures and television productions and earned another Emmy nomination and an Academy Award for Scientific and Technical Achievement.

Camera Subcommittee

Chair: Dave Stump, ASC

Vice-Chair: Richard Edlund, ASC

The ASC is still engaged in the planning stages on a program called the ASC Camera Assessment Series (CAS)—a repeatable series of shots typical of those common in feature motion pictures, to show the characteristics and performance of the various digital cameras available for use in cinema. We have extended invitations to numerous manufacturers and/or rental companies to participate in the tests, and every attempt will be made to conduct the CAS in a fair, unbiased and impartial way.

The ASC Camera Assessment Series will create a library of standard material from different cameras (including 35mm film stocks) that are available for use in large-screen cinema. Every attempt will be made to obtain the maximum performance out of each camera system—to give each camera its best opportunity to perform at the highest level possible—in order to determine each system's effectiveness for digital presentation and for output to film. Our aim is to give members of the community of cinematographers a resource to use in evaluating cameras for their task at hand, and to generate an evolving data set for the benefit of cinematographers and other members of the motion picture production industry trying to decide which of the many camera systems available to use on any particular project.

The CAS is being designed to be consistently repeatable as new cameras become available. After the first round of shooting, we will create a cut-by-cut formula for a roughly 6-minute digital "movie" to present the results from each camera. Each movie will present a consistent set of shots such as one might encounter in making a movie, TV show, or commercial. The shoot will be conducted on sets on Wisteria Lane from the popular TV series "Desperate Housewives," thanks to the generosity of the show's staff, including Art Director Thomas Walsh, ADG, and Co-Executive Producer George Perkins. Shots will also be done at night locations around Los Angeles.

The CAS shoot and post will be conducted in the presence of ASC cinematographers and with the active participation of the manufacturers and rental houses that know the cameras best. The shoot will be meticulously documented in writing, including all camera settings, menus, light readings, etc. and will include any and all technical notes and documentation of the procedures used in creating each movie as a metadata addendum. The shoot will be conducted with equivalent focal length lenses for each format of camera (actual lens length will depend on the camera's imager size). The CAS materials will be refreshed on an ongoing basis, roughly twice a year, in accordance with the development and evolution of the cameras and hardware available for testing.

In parallel, the Academy of Motion Picture Arts and Sciences—Science and Technology Council will soon be taking a set of scene-driven measurements of each camera to characterize behavior in numerically quantifiable ways. The test plan has been distributed to all of the camera manufacturers invited, and the Academy is currently fielding their responses and comments, to be incorporated into the test plan. Combined, the ASC and Academy portions of the Camera Assessment Series will provide moviemakers with an opportunity to look deeply at each camera and evaluate appropriate selection for a particular project.



Lou Levinson

Levinson received a MFA from the School of the Art Institute of Chicago in the spring of 1979, having worked his way through school as a tape op and colorist. After graduating, he joined Columbia Pictures Videocassette services, running and helping maintain the first flying spot scanner installed in the midwest. In September 1980, he was hired as a colorist at Modern VideoFilm, becoming the thirteenth employee. Thirteen years later, with MVF over 200 employees, Levinson left to become a colorist at the MCA/MEI Telecine Research Center, working in what was the third HD telecine room on the planet. In 1998 he left for Post Logic Studios, where he is senior colorist. A longtime ASC associate member, Levinson has been on the ASC Technology Committee since its inception and is currently the chair of the Digital Intermediate subcommittee.

The CAS results will be archived for use by members of the American Society of Cinematographers and the membership of the Academy of Motion Picture Arts and Sciences. It will be viewed and treated with the respect demanded by those institutions.

Digital Intermediate Subcommittee

Chair: *Lou Levinson*

Vice-Chair: *Joshua Pines*

Secretary: *David Reisner*

The DI subcommittee has been concentrating its energies on making the ASC CDL, or color decision list, a reality. The ASC CDL is a way of moving basic color correction information between platforms as a way of transporting "looks" from set through to DI and deliverables. We have a previously agreed upon a set of definitions for the color correction operations and have spent the last year coming to agreement among the vendors on the method for passing the information accurately between platforms. The vendors have agreed to support our proposed xml schema and at least one of the following other exchange protocols:

- comment fields in a cmx list
- moved as part of ALE file
- moved as part of Flex file

We have agreement for protocols for the above exchanges from the involved vendor group.

We have been working with edit vendors, most notably Avid, to insure that the CDL info can pass through the editorial process untouched.

There have been a number of demonstrations of the functionality of the CDL, and even some proof of concept demonstrations running on onset tools and laptops.

We saw several ASC CDL compliant systems at NAB '07 and expect to see them running in the real world in the near future, possibly as soon as IBC.

We at the ASC Technology Committee would like to thank all those vendors and others who have put in so much energy to get us to this point.

For any SMPTE members that are curious about what we've done or may want to participate in some way, please contact Joshua Pines at jzp@technicolor.com or Lou Levinson at JoeBeats@postlogic.com.

Advanced Imaging Subcommittee

Chair: *Gary Demos*

Vice-chair: *Phil Feiner*

Vice-chair: *Jim Fancher*

Secretary: *David Reisner*

The Advanced Imaging subcommittee looks both at and beyond current practice in our production and imaging processes. The subcommittee takes a more rigorous science and engineering-oriented approach to understanding the behavior of current imaging systems and what we might want to do in the future in support of the moving image art forms, as well as how current practice can be improved.

This year we have actively continued our work on the characteristics of trichromatic—three primary—color systems, like RGB and X'Y'Z'. Most trichromatic



Joshua Pines

Pines is currently in charge of imaging and color science at Technicolor Digital Intermediates, which provides the motion picture industry with digital color correction processes for theatrically released films. He joined Technicolor after more than 10 years at Industrial Light & Magic (ILM), where he supervised the company's film scanning/recording department from its inception, working extensively with both traditional and digital cinema technologies. He started his career teaching film courses at the Cooper Union in New York City after earning his degree in electrical engineering there. He began working in visual effects at MAGI in 1982 during their work on *Tron*. Pines led the computer graphics division at R/Greenberg Associates, and supervised film effects and film recording at Degraf/Wahrman before working for ILM. He is a member of the Academy of Motion Picture Arts and Sciences, an associate member of the ASC, and has credits on numerous feature films.

systems in use today define their primaries and color characteristics using xy coordinates, which are part of the color system based on the 1931 CIE two-degree standard observer. For example, the standard color "horseshoe" diagram used almost universally to illustrate color gamuts is a representation of the 1931 CIE gamut. Essentially all monitors are calibrated using xy measurements. While 1931 CIE is broadly used, it does not represent color matching functions that would be formulated today and contains known errors.¹ Some are numerically small but some are significant. The relevance of these errors for basic research and for daily practice are still subject to examination.²

These problems may cause a particular set of CIE coordinates to represent visually different colors to different observers, although there is evidence from experts in color science and from their investigations that inter-personal variations may be significant and may be more of an issue for color matching than known errors within CIE 1931. For example, a well-respected colorist who participates in our subcommittee sometimes sees the same trichromatic stimulus as different colors with his right and left eyes. Several colorists in the same room are almost guaranteed to perceive trichromatic colors differently. What combination of inter- and intra- observer variations and 1931 CIE errors account for these experiences?

The places where the known spectral errors occur in CIE 1931 may or may not be relevant for any given display emission spectrum. We sought to investigate whether these known errors affect our use of the CIE 1931 color matching functions given the particular set of displays and the Standardized Evaluation Material mastering spectra we used as source. We hope these results will suggest results that may be found with other source material and other displays.

We have done several rounds of testing intended to examine some of the practical effects of 1931 CIE. Testing starts with source material of known spectra. We have primarily used the ASC-DCI StEM (Standard Evaluation Material) RGB master. StEM was color corrected at the USC ETC (Entertainment Technology Center) theater by Alan Daviau, ASC, Doug Delaney, and Jim Houston. Josh Pines, David Reisner, and Jim Fancher took spectral measurements of the projector, screen, and viewing environment used for mastering. We also used XYZ averages from 25 GretagMacbeth Color Checker charts, provided by Lars Borg.

For each round of tests we collected a half-dozen modern flat panel displays. In Round 1, conducted at Post Logic and hosted by Lou Levinson, we also measured the traditional industry reference Sony BVM CRT monitor. Round 2 software and display measurement techniques were improved markedly by experience in Round 1. The LCD and plasma displays measured were all based on panels manufactured for consumer displays, which limited inputs to 8-bits per color component.

Gary Demos, Jim Fancher, Denis Leconte, Youngshik Yoon, and Jack Holm conducted, and Ann Rajacich produced, Round 2 on the Stella stage at the Academy of Motion Picture Arts and Sciences Pickford Center, hosted by the Academy Sci-Tech Council. The stage is a large room with black and gray walls and was kept dark during measurements. Monitors were placed along one wall for measurement with only one monitor powered on at a time. Each monitor was measured with Photo Research SpectraScan 701S, 705, and 715 spectroradiometers, and a SpectraDuo 680 spectroradiometer and photometer, positioned side-by-side about 8 ft from the display being measured, at a visually



Gary Demos

Demos has spent his career working with the physics of light in motion pictures, together with corresponding mathematical and computational analysis. He was integrally involved with the first generation of digitally simulated scenes—CGI—for motion pictures. Demos worked with Information International Inc. from 1974 to 1981. He co-founded and was senior technology executive at Digital Productions from 1981 to 1986, and Whitney/Demos Productions from 1986 to 1988. He founded DemoGraFX in 1988, working in integer-DCT-based digital image compression for moving images, and with image processing and image formats for high-definition and beyond. Since 2004, Demos has been working independently on Wavelet-based and Optimal-Filter-based moving image compression.

Demos has authored dozens of technical papers and is the inventor of numerous patents. He received an Academy Scientific and Engineering award along with John Whitney Jr. "For The Practical Simulation of Motion Picture Photography by Means of Computer Generated Images" (1985), shared another for his work in digital film scanning (1995), and shared a Technical Achievement award for work in digital compositing systems (1998). In 2006, Demos received the Academy Gordon E. Sawyer Oscar for lifetime technical achievement.

estimated perpendicular. (Preliminary examination of data suggests this did not create significant variation between radiometers.) Radiometers were aimed at the same spot on the display with aid of a laser target.

We started with basic display set-up, setting the lower-left white square on a GretagMacbeth Color Checker to our reference brightness—approximately 25 fL—and color temperature—5500K—both within limits imposed by display adjustments.

We then collected spectral, XYZ, and xy measurements on each display at a range of gray values—full white to lowest black where meaningful variation was observed on each display (typically 255, 192, 128, 96, 64, 32, 16, 12, 8)—and on R, G, and B color primaries from full value to a similar low level.

We provided each display's collected spectral measurements to software developed by the subcommittee, with particular contributions from Gary Demos, Denis Leconte, Josh Pines, Doug Walker, and Mark Fairchild. The software used source image RGB data and primary spectra from original mastering to estimate the intended displayed spectra. The software then used the color matching function being tested (1931 CIE 2-degree, 2006 CIE 2 degree 35-year-old observer data, etc.) to translate those spectra into a trichromatic representation (X'Y'Z', LMS, etc.), then back from the trichromatic value to a "canonical" spectra. Finally, each display's primary spectra were used to estimate an RGB value that, on that display, would closely match the canonical spectra. During the translation process, colors out of gamut for a particular display were either clipped or mapped to "flagging" (obviously wrong) colors. If a color matching function was sufficiently accurate in the areas under test, we hoped to see images that matched well from display to display and that matched our original source well, in each case within differences in size, apparent brightness, etc.

Most of the LCD displays use a similar backlighting system (CCFI) and have similar basic spectra, but one LCD system used a different backlight source and the plasma display is an entirely different technology. We have just started analyzing the results of the Round 2 testing, but on the StEM stills used, matching between displays appeared to be good.

Note that any candidate color matching functions can be tested against source (in this case StEM at the ETC Theater) spectra and presentation spectra for red, green, blue (and optionally for black). The resulting candidate color matching function's RGB for such spectral reproduction can be compared against the RGB from 1931 CIE color-matching functions.

We also did a visual 1931 CIE comparison test for the Macbeth Color Checker charts, using XYZ tristimulus data as input. Measurements were only available for the chart's color patches, not for the off-black surround/framing. When the mapped color patches were displayed assuming zero code value black surrounds, they looked quite different on the different displays and also quite different from the standard and special large Macbeth charts we had in the same room illuminated with blue gel tungsten lighting (flat D55 illumination). When we by eye lifted the level of the surround on two displays, the visual match became quite good. The match on the displays with the unlifted sutrounds was also good, if you focused fixedly on a single color at a time.

1. H. S. Fairman, M. H. Brill, and H. Hemmendinger, "How the CIE 1931 Color-matching Functions were Derived from Wright-Guild Data," *Color Research and Application*, 22: 11-23 (1997).
2. J. J. Vos, "Colorimetric and Photometric Properties of a 2-deg Fundamental Observer," *Color Research and Application*, 3: 125-128 (1978).



Ana B. Benitez

Benitez is a senior member, technical staff, at Thomson Corporate Research in Burbank, CA. She is currently working on metadata standards and systems for the media and entertainment industry. Benitez received a telecommunications engineer degree from the Polytechnic University of Catalonia (UPC) in Barcelona, Spain, in 1996. She later received a master's and PhD from the department of electrical engineering at Columbia University in New York, where she attended from 1996 until 2004.



Marty Ollstein

Ollstein is currently president of Crystal Image Productions and plays an active leading role in the film industry's transition to digital technology. Inspired by his extensive work with optical filters working as a cinematographer, he invented and developed Crystal Image software, the first digital tool to precisely emulate optical filter effects. As Chair of the Digital Primer Subcommittee on the ASC Technology Committee, he has written the Digital Primer Overview, and is developing the in-depth Digital Primer Manual.

A Fellow of SMPTE, Ollstein

Metadata Subcommittee

Co-chair: Dave Stump, ASC

Co-chair: Ana B. Benitez, ana.benitez@thomson.net

The ASC Technology Committee has a unique tradition and ability for bridging the creative, technological, and business communities in the advancement of the art and science of motion picture production. Therefore, the ASC Metadata Subcommittee is providing a forum for relevant parties to discuss and contribute to new metadata technologies.

The ASC Metadata Subcommittee is specifying requirements and recommendations for interoperable metadata technologies in motion pictures and defining the essential metadata language suitable for cinematographers and other production artists. Robust metadata technology will revolutionize motion picture production by enabling, enhancing and preserving the creative intent of cinematographers and other artists, in perpetuity.

Current activities at the ASC Metadata Subcommittee are focused on understanding current metadata practices, support and needs for the part of the workflow that is dearest to cinematographers, Acquisition. For this purpose, we have invited and talked to camera assistants, camera manufacturers, and metadata equipment designers, among others. We are also reviewing numerous hardware and software systems for compliance in this area.

The aim of the current work is to define and propose a metadata schema that captures the essential information that needs to be collected during acquisition and passed downstream to dailies, VFX, and editorial, among others. We plan to finalize the acquisition metadata schema with feedback from other artist communities and map the result to existing standards such as the SMPTE RP210 Metadata Dictionary.

Although the current focus is on acquisition metadata, we are aware of the role that well-defined metadata technologies can play across the entire motion picture industry. In the future, we plan to undertake and cover other parts of the workflow.

Digital Primer Subcommittee

Chair: Marty Ollstein

Vice-Chair: Levie Isaacks, ASC

The Digital Primer is designed to make the work of the ASC Technology Committee understandable and accessible to the ASC membership—and ultimately, to the industry at large.

The first task of the Digital Primer Subcommittee was to provide a basic foundation to all the aspects of digital technology that relate to digital motion picture production. Cinematographers embarking upon the new digital workflow need a clear, practical guide to help them identify the decisions they must make, and provide them enough information to maintain quality and preserve their creative intent. With the support of subcommittee member specialists in each field, Chair Marty Ollstein completed writing the Digital Primer Overview. It contains both a comprehensive step-by-step description of the new hybrid film/digital workflow, as well as indexed reference sections that explain the principal concepts and terminology used in the digital realm.

is committed to educating cinematographers on the expanding potential of new digital technology. He teaches in many venues, including Kodak Cinematography Workshops, the Budapest DOP Masterclass, Poland's Camerimage Festival, and seminars for professional cinematographer associations, including the BSC, AFC, and HSC.



Glenn Kennel

Kennel heads the feature film group at Laser Pacific, which provides end-to-end services including dailies, previews, digital intermediate, video mastering, and digital cinema packaging. Previously in product and business development roles with Kodak and Texas Instruments, he helped to define, develop, and evangelize products and services for digital film post-production, distribution, and exhibition. Kennel also chairs the SMPTE DC28.20 Distribution working group.

A comprehensive Glossary of digital terms was developed by Ollstein with Levie Isaacks, ASC, to further expand the scope and accessibility of the Primer Overview. Discussions are now under way to determine the best format in which to publish the Digital Primer Overview and make it available to the widest possible audience. This "Primer" has been reviewed by a wide variety of digital experts and cameramen, who found the material accurate, clear, and useful to cinematographers working with digital images. Valuable contributions offered by some of the reviewers have been integrated into the text.

The next task of the subcommittee is the development of in-depth chapters on each phase of the digital workflow, which will result in The Digital Primer "manual"—a comprehensive text on digital motion picture production. Members of each subcommittee will contribute to the chapters covering their area of expertise. The substance of the text will be drawn from the groundbreaking work being done by the ASC Technology Committee, and will include theory, technological advances, product developments, and best-practice recommendations.

Each step of the workflow will be covered—from Pre-Production and Look Management through to the final Digital Intermediate grading session, as well as the Mastering and Archiving of the finished production. The exciting work on Pre-Visualization technique, being done in collaboration with the Art Directors' Guild (ADG), will be described along with the new developments in Look Management software tools. The Technology Committee's commitment to improving workflow and communication by creating universal, interoperable formats will be a common theme throughout the Digital Primer, particularly in the areas presenting Workflow strategies and Metadata standards. The ASC-CDL is a prime example of this effort. As the CDL becomes integrated into more and more programs, it becomes a "universal" language, and sets an example for the entire industry for sharing and collaboration.

The chapter on Camera will include useful information on each digital production camera, including valuable insights that will emerge from the Camera Assessment Series tests being done by the ASC and the Academy Sci-Tech Committee. The new chapter being developed for the Cinematographer's Manual on Digital Camera Prep, detailing the many new prep issues facing the camera crew in digital production, will also be integrated into the full version of the Digital Primer.

The Primer Subcommittee also participated in a recent Producer's Guild (PGA) seminar on Digital Workflow, using the case study of *Superman Returns*. Committee members provided definitions and explanations of key digital concepts and image characteristics. A future collaboration with the PGA is planned, focusing on digital "artifacts"—recognizing and understanding the particular flaws and errors that can appear in digital images.

Digital Display Subcommittee

Co-chair: Glenn Kennel, gkennel@laserpacific.com

Co-chair: Alan Hart, ahart@mvfinc.com

During the last year, the Digital Display subcommittee has supported the activities of the Digital Intermediate and Workflow groups. This included mapping the color calibration and metadata for the filmmaking process and defining the display requirements for each step in the process from pre-visualization to dailies, previews, DI and final film, digital and home video deliverables. Manufacturers and service providers are starting to step up to provide integrated solutions, but there are still many proprietary solutions and missing links. The ASC Color Decision List is a key part of the solution.



Alan Hart

Hart started his television career in 1967 with KCET Channel 28, the PBS station in Los Angeles. He served as chief engineer from 1975 to 1978. In 1978 he joined RCA and was involved in videodisk technology before joining Modern VideoFilm in 1981, where he serves as executive vice president, engineering, responsible for all technical resources. The company is actively involved in Digital Intermediate services for feature films, HD television post-production for television shows, and feature film mastering for home video, and broadcast television applications. Modern VideoFilm currently has 500 employees in four facilities.

A member of SMPTE since 1975, Hart has served as Chair of the Hollywood Section, two years on the Board of Managers, two terms as National Governor, and is a SMPTE Fellow. He is a past president of the Society of Television Engineers and served on the Academy of Television Arts and Sciences Technical Emmy committee for approximately 14 years.

Meanwhile, the Advanced Imaging group has completed their first assessment of new digital monitoring technologies. The venerable Sony BVM D24 and BVM D32, while still the industry standard reference for mastering and color correction, has clearly started to show its age when compared with the newest consumer displays. Images viewed from an HD DVD or Blu-ray source on a full resolution consumer display may show noise and artifacts that were not perceived as a problem on our current reference display. Will the newest Sony reference display bring both color accuracy and resolution? Time will tell, but I think screen size is a major contributor to how much information we receive and 24 in. may be too small to allow us to see images in the same way as the consumer. Do we need to re-think the definition of a professional display?

Digital dailies are influenced by the display, source media, and the transform used to match the image to the display. It's an 8-bit world in the land of the consumer and clearly we do receive very high-quality 8-bit images in our homes. How do we capitalize on consumer technology to serve us for dailies distribution and viewing?

Fortunately, the recent work by the Advanced Imaging sub-committee has shown we can create very similar images on different display devices. It is our intent this year to bring parts of the puzzle together so we have performance data from both monitor and projector test systems to use as a guide when configuring systems for this purpose.

It is gratifying to see Filmlight and others bringing toolsets to market that allow us to move images between different display technologies so we can maintain the creative intent from the set to the post house and back. We will incorporate some of this technology in our test systems.

Will some consumer and all professional display devices soon be able to use a user-defined 3-D LUT? Cost-effective accurate display technology depends on this feature being available to professional users. It will be a challenging year to test and refine our image-monitoring choices.

Non-Theatrical Display Subcommittee

Chair: Don Eklund, Don_Eklund@spe.sony.com

It was recognized several years ago that digital cinema screens placed new demands on film mastering, but offered new opportunities to display content without many of the problems typical of theatrical presentation. The digital projector has in fact, become a standard and indispensable tool for film mastering.

In the last few years, high-quality digital display products have become readily available to consumers at affordable prices. Consumer displays and set-ups emphasize a different set of characteristics than displays and set-ups used in professional mastering of motion pictures or high-definition video releases. Usually operated far out of professional specifications, the high-brightness, high-contrast, and high-frequency response of the newest breed of consumer digital displays can reveal image qualities in the source signal that are not visible on industry standard professional CRT-based displays. Under typical home viewing conditions, a growing number of consumers now have a day-to-day display that provides a more critical view of HD sources than what is in popular use in the facilities that master these sources.



Don Eklund

Eklund is executive vice president, advanced technologies at Sony Pictures Home Entertainment, a division of Sony Pictures Entertainment (SPE). He oversees the development of the Blu-ray disc authoring system and its integration within the existing Digital Authoring Center at SPE. He also conducts evaluations of new entertainment technologies and formats, such as UMD video. He is closely involved with content security initiatives for the SPE Digital Policy group, while representing SPE within the copy protection alliance Advanced Access Content System (AACCS) and the Hollywood studio joint venture Digital Cinema Initiatives, LLC (DCI).

Having worked in the audio/video industry for the past 20 years, Eklund joined Sony Corp. in 1988 as a field engineer supporting the launch of a number of products, including the DASH 48 track, Minidisc, and Super Bit Mapping. Prior to joining SPE, he worked for JVC Electronics.

Filmmakers also have new tools available in the form of digital cinematography, new film stocks, and all the devices and systems that comprise the digital intermediate process. It is natural to assume that better displays and better production tools will lead to better consumer experiences. And in fact, often this is the case, but not always...

While VHS made an acceptable consumer picture and was satisfactory for more than 15 years, DVD created a more discriminating consumer. The audio and video presentation on DVD is sometimes criticized for characteristics that, while sometimes intended, can often be traced to the master. Move forward 10 years from the first release on DVD and we can now deliver 6 times more picture information to the consumer in a packaged media format such as Blu-ray or HD-DVD. HD packaged media has the power to literally bring the film closer to the viewer. The best consumer displays, properly calibrated, at an optimum viewing distance (the same viewing angle as in the theater), and in an appropriate viewing environment can provide an enveloping experience that fully realizes the potential of high definition. When viewed in HD, some of the objections to characteristics of an aforementioned DVD can now be recognized for what they are, a decision by the filmmaker to use the medium in a particular way to tell a story. On the other hand, characteristics are also revealed in HD that are not intended and take the viewer's attention away from the story and into a technical detail.

As we watch films made today, rich with special effects and with all the benefits of the technologies mentioned above, it can be demonstrated that technical and production properties of films have become somewhat less consistent in recent years. We have found that traditional filmmaking and video transfer continue to give good results, while films that benefit from all the newest technology and tools occasionally have shot-to-shot or scene-to-scene variability that can momentarily surprise the viewer.

It can be argued that quality consumer displays, or professional displays that can duplicate consumer display characteristics, have a place in the color correction and post-production quality control process and should be considered a viable tool. Raising awareness of potential issues through the use of such displays and taking into consideration how issues translate to consumer products is a worthy pursuit given the growing importance of the home viewing market.

A number of post-production facilities have already begun to test consumer displays for evaluating HD masters.

There are several complications in using consumer-based products in professional environments:

- Model year changes mean that it is not practical to standardize on a brand and model of device for any length of time.
- Consumer devices rarely are provisioned for professional signal formats.
- Products are not built to professional criteria and may have variable performance, even within a particular model.

The benefit in accepting the complexity of adopting non-professional devices for picture evaluation are clear; the consumption of content in the home is an important economic factor in entertainment, and creating an exceptional HD experience is a technologically achievable goal.