

American Society of Cinematographers (ASC) Technology Committee Report



CLARK

By Curtis Clark, ASC; Daryn Okada, ASC; David Reisner; Dave Stump, ASC; Richard Edlund, ASC; Lou Levinson; Joshua Pines; Gary Demos; Jim Houston; Alan Hart; Glenn Kennel; Grover Crisp; Stephanie Argy; Peter Anderson, ASC; Lenny Lipton; David Morin; Ron Frankel

Chair: Curtis Clark, ASC

Vice-Chair: Richard Edlund, ASC

Vice-Chair: Steven Poster, ASC

Secretary: David Reisner

Introduction

Chair: Curtis Clark, ASC

As Chair of the American Society of Cinematographers (ASC) Technology Committee, I am honored and delighted that our ASC Technology Committee has been invited for the third consecutive year to provide a progress report for the *SMPTE Motion Imaging Journal*. The ASC greatly values our longstanding relationship with SMPTE that dates back to the days before the “T” was added to SMPE. More recently this historic collaboration has taken on renewed importance with an increased sense of urgency as the relentless advance of digital imaging technologies continually impacts motion picture production, post-production, and distribution workflows.

This juggernaut of digital technology development continually presents filmmakers with “disruptive” new challenges in their attempts to effectively and efficiently manage and control their images within complex workflow processes. For example, effective “look management” for cinematographers has proven especially problematic as sophisticated single-platform digital imaging tools and technologies within Digital Intermediate provide powerful new options for image manipulation that are not routinely available to the cinematographer during post finishing and not necessarily compatible with proprietary “on-set” applications. In response to this dilemma, the ASC Technology Committee developed the now widely adopted cross-platform ASC CDL (Color Decision List) which we anticipate will be passed on to SMPTE for standardization. Also, I should reference another noteworthy achievement in image workflow management: the recently released version 1.0 of A Standard File Format for Look-up Tables (LUTs) which was initiated as a joint project between our ASC Technology Committee and the Academy of Motion Picture Arts and Sciences Science and Technology Council.

As our ASC Technology Committee reaffirms its mission for this sixth year of our existence in the era of digital convergence with film, we have added two new subcommittees and a new working group that are addressing important new developments in the hybrid digital/film motion picture production workflow: Previsualization, 3-D Stereoscopic Imaging and the Data Mode Workflow task force, all of which have contributed reports on their activities for this ASC Technology Committee Progress Report.

September 2008





Message from the President

ASC President: Daryn Okada, ASC

The relentless exploration to advance the motion picture image has been an endeavor whose similar paths have engaged an ongoing dialog between the ASC and SMPTE. We are a community of artists and engineers that share a common passion, seeking technologies that will provide superior experiences for the audience. The sharing of knowledge is the conduit that enables all our dreams to evolve into reality. The ASC looks forward to continuing this journey with our friends at SMPTE.



STUMP

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 from 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 from 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 six-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 Thomas Walsh, ADG, who set-up our location when he was Art Director at “Desperate Housewives” 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 Camera and Workflow Subcommittees are currently engaged in specifying the workflows by which the material will be processed. There are a wide variety of workflows available for the variety of cameras to be tested, and the process of specifying the ultimate approach to be

used for each camera is very complex. In parallel, the Academy of Motion Picture Arts and Sciences-Science and Technology Council have begun the work of taking a set of scene-driven measurements of cameras to characterize behavior in numerically quantifiable ways. The test plan has been distributed to all of the camera manufacturers invited and the Academy has

incorporated their responses and comments into the test plan. Only a few cameras have been run through the process so far, and the work of refining the implementation of the test process is under way.

Combined, the ASC and Academy portions of the Camera Assessment Series will provide moviemakers with an opportunity to look deeply at each cam-

era and evaluate appropriate selection for a particular project.

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
Chair: Joshua Pines
Secretary: David Reisner



LEVINSON

During the past year, the ASC Technology Committee DI subcommittee has continued work on the ASC Color Decision List (ASC CDL). Version 1.01 of the ASC CDL, released in August 2007, defines a set of primitive functions for basic primary color corrections and a set of formats for communicating that information in ALE, FLE_x, CMX EDL, and XML files.

The ASC CDL has been implemented by most major hardware- and software-based color corrector manufacturers and is available in the workflow of many major post facilities. Workflows incorporating the ASC CDL as part of a color management system have been used on several major feature motion pictures. When combined with appropriate display calibration and workflow, the ASC CDL has been demonstrated to provide a useful basis for implementing a robust color management system.

An in-practice example of use of the ASC CDL to communicate corrections from dailies to DI was presented live at this year's NAB Digital Cinema Summit. Some industry members have expressed interest in creating a SMPTE Standard or RDD (Registered Disclosure Document) for the ASC CDL.

There have been some instances where problems have been encountered when attempting to use the ASC CDL in a workflow. The ASC CDL correction functions have been found to be appropriate and useful and to integrate between systems successfully, but there have been some problems with communication of ASC CDL parameters or maintenance of the association of ASC CDL corrections and shots when moving through multi-vendor or multi-facility workflows. Some of those problems relate to system versions (i.e., use of an older version of a system when only the newest release supports ASC CDL) and some have been problems with interaction between systems. The DI subcommittee is aware of these problems and is pursuing identification and repair actively. One outgrowth will probably be somewhat tightened requirements, support of more rigorous testing, and possibly development of some type of verification test bed. As in all aspects of production, the best approach is to, during prep, run a test from camera through the actual post workflow being proposed, to at least final color correction and, for the careful, cautious, or paranoid, all the way to DCP (Digital Cinema Package) and film print.

As we anticipated at first release, one of the primary ASC CDL extensions that has been requested is a Saturation function. Saturation basically performs a cross-fade from color to black-and-white, with the RGB color components weighted. The subcommittee has agreed to

use the weightings found in most Rec. 709 saturation function implementations.

The next ASC CDL release will contain documentation, sample code, and images for basic self-test/verification of Saturation. Vendors participating in the DI subcommittee (and others who have asked) have already received source code for an example implementation. As was seen at this year's NAB (National Association of Broadcasters) show, some have already included the Saturation function as part of their ASC CDL implementations.

Maintenance of the connection between corrections and shots, and not letting any workflow get stuck in a "dead end" where corrections or shot/correction association is lost, are critical issues we want to address further. Changes being considered for the next ASC CDL release include an optional comment field for time-code or other

method of associating a correction with a shot; strengthening requirement that all implementations be able to read XML format (in addition to whatever other formats the vendor wishes to support); and possibly requirement that all systems be able to write XML with the time-code comment filled in. We are also working on getting ASC CDL correction reference and data into the production pipeline, at dailies for film capture and possibly on-set for digital capture.

The next release of the ASC CDL will be available at about the same time as this Progress Report. It will include the Saturation function, and possibly also the shot/time-code comment field.

ASC CDL release 1.01 is a good start that has provided a previously unavailable set of integrations through the workflow but we know the places where, in an actual implementation and use, it can get derailed. Our key

task for the coming year is to shore those up and make use in-the-field more bullet-proof.

To get a copy of the ASC CDL implementation documentation, send an e-mail to asc-cdl at theasc.com. The response will contain instructions.

For additional information, contact Joshua Pines at jzp at technicolor.com, Lou Levinson at Joe.Beats at yahoo.com, or David Reisner at dreisner at d-cinema.us.

The DI subcommittee would like to acknowledge the participation of the following vendors: Aaton, Avid, Century Dragon, DaVinci, Digital Vision/Nucoda, Descreet/Autodesk, DVS, EFILM, Evertz, Filmlight, Gamma & Density, General Products, IRIDAS, Laser Pacific, Pacific Title, Pandora, Quantel, Silicon Color/Apple, Technicolor Digital Intermediates, Thomson.



DEMOS

Advanced Imaging Subcommittee

Chair: Gary Demos

Vice-chair: Jim Fancher

Vice-chair: Phil Feiner

Secretary: David Reisner

High-quality imaging, in service of creative art, requires scientific examination and engineering discipline. The Advanced Imaging subcommittee takes a science and engineering-oriented approach to understanding the behavior of current imaging systems, how current practice can be improved, and what we might do in the future in support of the moving image art form.

This year the subcommittee has been an on-call resource, assisting efforts of other groups inside and outside the ASC Technology Committee. Advanced Imaging is participating actively in the ASC Technology Committee Data Mode Workflow task force. Advanced Imaging believes that a camera "data mode" should provide access to the camera sensor's data, after only sensor-specific processing. Sensor-specific processes include bad-pixel correction and pixel-specific adjustment (e.g., to reduce fixed-pattern noise). For Bayer pattern sensors, data mode may or may not include conversion of data to an RGB array—an issue to be further examined.

Data mode data should either be in linear light or in a form that is transformable to linear light, without adding quantization noise (i.e. with enough bits), in a well-documented way. Linear light means a linear correspondence between code value and either number of photons or amount of energy striking the sensor. The term "linear" is often misused for an encoding

that applies a gamma—an exponential function—to the sensor data. The confusion of terminology often causes practical problems interpreting data correctly during post-production.

For digital imagers, linear light encoding provides one of the few methods for knowing what real-world image is actually being represented by the digital data (within sensor accuracy). Linear A/Ds in cameras currently provide 12 to 14 bits of data. The Dalsa and the Arri D-21 cameras can put out linear light directly. Viper output is transformable to linear light.

Many current digital cameras provide a log or quasi-log output (S-log, Panalog, Filmstream, etc.)—a method of expanding the dynamic range that can be represented in a given number of bits, while distributing the light levels represented by those bits in a manner somewhat like the response of camera negative film. Although this may be a good approach when no further processing will be done to the image, to maintain image consistency through different processing paths/types, it is preferable to transform to linear light—what we presently call Data Mode.

In linear light, $R = G = B$ code values can be a useful intermediate form to represent white or neutral gray (e.g., as used on computer displays). This differs from D-Cinema mastering and presentation white where R, G, and B values usually differ for calibration white or scene white. The maximum of R, G, and B at the camera sensor can be determined by the level where the highest-value color channel reaches full-well saturation—the point where an increase in photons or energy striking the cell no longer increases the code value from that color channel.

Data Mode allows preservation of hue and saturation over a wide range of exposure once the relative balance of R, G, and B such that $R = G = B$ for white and neutral gray has been established. Exposure and scene brightness may then be varied using a single-scale factor to multiply R, G, and B, preserving hue and saturation (which is embodied with the relative proportions of R, G, and B to each other).

Advanced Imaging has also been encouraging the use of spectroradiometers in light measurement. Like a set of many narrow-wavelength (i.e., pure

spectral color) spot meters, a spectroradiometer measures reflected light, in fL (foot-lamberts) or cd/m² (candelas per meter-squared, or nits) at (typically) 50 or more light wavelength bands. A spectroradiometer provides a specific characterization of the light and lighting in a scene. If color and gray swatches (e.g., a Macbeth Color Checker chart) are both measured by spectroradiometer in a scene as-lighted and as-shot and camera-captured as a “slate,” the meaning of scene data can be explicitly referenced to the physical world, whatever the camera behavior or production path.

Advanced Imaging is helping the Academy of Motion Picture Arts and Sciences Sci-Tech Council develop the process of evaluating camera test results from the Esmeralda test stage at the Academy Pickford Center. Among other things, we have been doing extensive spectroradiometry of the test charts under the daylight and tungsten lighting setups and also helping with the analysis of the resulting Data Mode RGB camera data.

Data Mode Workflow Task Force

Chair: Curtis Clark, ASC

Vice-chair: Glenn Kennel

Vice-chair: Phil Feiner

As professional cinematographers and as supporting post-production specialists, it is our objective to strengthen our filmmaking tools as new digital motion picture cameras and data mode workflows are introduced. To maintain image integrity, the Data Mode Workflow task force will identify image reproduction parameters that impact image quality, along with practical production and post-production workflow implementations that best enable and deliver efficient, uncompromised images in both film and digital formats.

The Data Mode Workflow task force will generate a set of Best Practice Recommendations for the industry that assists in the practical implementation of end-to-end data workflow for image acquisition, post-production, and finishing.

Requirements for Dailies:

- Editorial needs—timecode, sync sound, camera/scene information, no later than next day availability.



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- Production review—verify sharpness (focus, makeup, set decoration), exposure and color fidelity, sortable by camera and scene, no later than next day availability.
- Executive review—check continuity, performances

Requirements for Digital Intermediate (Finishing):

- Automatic generation of scan/conform lists from EDLs
- Automatic assembly of select takes
- Capability to render select takes to highest quality
- Access to RAW camera data

Requirements for Image Integrity, Monitoring, and Look Management:

- Capability of disabling or modifying camera processing
- Defined translation from RAW data to linear, 709 video and printing density color spaces
- Defined camera color response characteristics



STUMP

Metadata Subcommittee

Chair: Dave Stump, ASC
Jim Houston

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.

This year, the Metadata subcommittee has been particularly effective in this area, hosting a joint meeting along with the Academy’s Science and Technology Council to define a common format for interchange of color Look-Up Tables (LUTs). Many of the leading manufacturers of hardware and software LUT technologies participated. The Academy and ASC common LUT format provides an XML- based file format for storing matrices, 1-D, and 3-D LUTs. The draft specification, “A Common File Format for Look-Up Tables,” proposes a structure, processing model, and implementation for exchange of LUTs and was compiled from the meeting discussions by Jim Houston, chair of the Image Interchange Framework subcommittee of the Academy. The paper was issued at this year’s NAB Digital Cinema Summit, and provides a draft XML schema within which it is hoped that color LUTs can easily be transported between devices such as on-set color management boxes, LUT-capable monitors, color correctors, and recording devices.

In addition, 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.

Digital Display Subcommittee

Co-chair: Glenn Kennel
Co-chair: Alan Hart



KENNEL

The most significant change since our last report is the demise of the Sony BVM D24 and BVM D32 CRT monitors. While these monitors are still in use, there are no longer replacement CRTs available.

In the post-production world, the imminent loss of a trusted device is causing us to diligently seek a replacement. So far, industry consensus has not coalesced around one technology to replace the CRT, therefore each business must make display choices for cinema and HD post-production that best support workflow and conform to SMPTE standards. We need a device with:

- Wide viewing angle
- Accurate color primaries
- Good black reproduction
- Accurate grayscale tracking
- 1920 x 1080 or 2048 x 1080 resolution
- Multi-Standard HD and SD capability
- Stable performance
- Affordable cost

Modern VideoFilm selected the Panasonic 10 series professional plasma display. MVF has found that it is possible to accurately calibrate this device for critical post-production processes with repeatable and accurate color achieved on a daily basis. The introduction of large high-resolution displays at the earliest stages of the post-production chain has improved the image quality for all deliverables.

Several promising display technologies were demonstrated at NAB this year, including OLED, deliverable for small screen sizes from Sony, SED from Canon, 4K LCD by Astro, and Panasonic's P3 phosphor prototype plasma. Will these new devices find sufficient market to cause them to move out of the laboratory or into the mainstream? This is a difficult task in the best of times.

Digital cinema theaters equipped with large screens and professional digital projectors are the gold standard venues for the creation of films, but the number of theaters is restricted, due to space and cost considerations. Low-cost projectors using both LCD and DLP technology have improved to the point that they are a viable consideration for some professional applications. For example, Laser Pacific is using the Panasonic AE2000 projector in their aIM field dailies system.

The key to using any display device is having an accurate measurement tool to characterize display performance. Most post-production companies use spectroradiometers from Photo Research to assess display technology and keep displays within the desired tolerance. These instruments are costly, but it is impossible to use low-cost display technology for professional work without the proper tools. The value proposition is still very attractive—one expensive instrument and many affordable displays.

Rensselaer Polytechnic has created the darkest material ever made—a carbon nanotube coating that absorbs light like a black hole. This new development may be an enabling technology for improvements in displays and lenses (<http://news.rpi.edu/update.do?artcenterkey=2393>).

Next year will mark the first full year without the use of a CRT monitor for most post-production processes, the demise of analog over-the-air television, the launch of at least one broadcast IP network, and the increasing availability of content as files.



CRISP

Digital Preservation Subcommittee

Co-chair: Grover Crisp

Co-chair: Garrett Smith

The Digital Intermediate (DI) workflow processes, which have become predominant in the production and post-production environment, continue to present the most challenging issues for preservation. There are several key components to developing conservation programs to preserve the data produced out of the DI workflow: how the data itself should be preserved, developing policies and procedures for long-term storage and retrieval, ensuring there will be no loss or degradation to the data, creating migration plans to newer platforms. These and other issues are key components to preserving the data from digitally-created or mastered motion pictures.

Over the last couple of years, the creation of digitally-generated black-and-white color separation masters, or digital separations, using data derived from the DI, has become a relatively common practice, at least for the major studio productions. For many decades, the most reliable way to protect against fading in a color film, and to guard against normal deterioration or damage through printing, has been to manufacture black-and-white separation masters from the original color negative. Creating digital separations, specifically if manufactured at a facility other than the originating DI facility, accomplishes a couple of goals. First, it confirms that the archived data can be successfully retrieved and read back, a verification of the integrity of the data already moved from servers to data tape. Second, digital separations provide another physical element for long-term safekeeping, in addition to the original camera negative or whatever recorded out negatives may have been created. Although only one aspect in the preservation of a motion picture, the manufacture of separation masters is still considered a key component of a comprehensive film preservation program.

Still at risk on several fronts are the independent productions for which the content owners either do not have the financial means for archiving data or creating separation masters, or they simply are not aware of the implications of not capturing the data in any archived format from the DI facilities. There are also many companies, and even studios, who may be taking receipt of archived data on magnetic data tape and are vaulting the tapes without having tested the integrity of the data, which can prove to be a huge mistake. Since everything qualitatively downstream from the DI process is determined by the quality of the original data, from creating HD masters to the recorded out negatives or making separations, it is important that the archived data be problem-free. Many content owners have experienced issues downstream from the DI process that relate directly to the data, and without properly archived data to begin with, there will be nothing available to help fix the problem.

Although how the data derived from the DI process should be written to tape and archived is still in a debatable situation, since there are no clear standards in place it is also the data itself that can be critically malfunctioning. Content owners have found considerable problems in receiving and retrieving data. There are often missing frames, corrupted files, or other issues that prevent the data from being successfully retrieved and archived. Not testing the data upon receipt can lead to immediate loss of information, let alone loss for the future.

The files delivered from the DI facilities now are often captured on LTO3 or LTO4 data tapes, though there are still other data tape types prevalent, including DTF, AIT, and SAIT, among others. Since there is not yet an agreed-to standard for how the DI data is archived, magnetic data tape has become a kind of default standard just by its ubiquitous nature. Legitimate questions surrounding the viability of magnetic data tape technology for long-term storage specifically of DI data, as well as storage on hard disk drives or Firewire drives or any other alternative methodologies, may continue for some time.

The Science and Technology Council of the Academy of Motion Picture Arts and Sciences produced a document this past year entitled "The Digital Dilemma." It served as an excellent

summary of the ongoing issues related to DI data preservation in the industry, and we look forward to their continuing study. The Council's current work on

the Image Interchange Framework and the ASC's work on developing methodology for the Color Decision List should both have a positive impact on

archiving and preservation of data for the future.

Enlightenment Subcommittee

Chair: Richard Edlund, ASC
Stephanie Argy

The mission of the Enlightenment subcommittee is to make the projects and accomplishments of the ASC Technology Committee accessible and comprehensible to the ASC membership and to a much wider audience.

The activities of the ASC Technology Committee have been having a powerful impact on the day-to-day work of cinematographers and other film and television professionals through its interaction with equipment manufacturers and service providers, but many of those affected are unaware of exactly what is going on with the committee, or how significant the work has been. There has been no simple way for ASC Members who are not participating directly in ASC Technology Committee activities to keep track of what is being done.

To build a bridge between the Committee and the outside world, and to try and spark an engaging, ongoing virtual conversation about new technical developments, the Enlightenment subcommittee is pursuing a two-pronged approach. First, with the guidance of the various subcommittee chairs, we are developing articles and other coverage that will show how the work of the ASC Technology Committee has already affected the nature of pre-production, production, post-production, distribution and exhibition. We will use current real-world movies as examples, including interviews with cinematographers, production designers, and other pertinent collaborators. Regularly published articles in *American Cinematographer* will be intended for a wide, mainstream audience, and the goal is to show how the ASC Technology Committee developments are not merely theoretical, but are in fact already changing the way in which the industry functions.

Second, for those who would like to delve more deeply into the issues covered by the articles or into the latest topics being addressed by the subcommittees, we will help enhance the content in the Technology Committee's section of the ASC website. Items available online will include summaries of committee and subcommittee meetings, white papers, and any other sort of supporting materials that might prove helpful to those trying to expand their technical expertise.

As the subcommittee responsible for gathering information and getting it out to the wider world, we are very interested in hearing ideas and suggestions, as well as news about projects using technology in innovative ways. Any SMPTE member who would like to contribute or participate can contact Richard Edlund, edlund at cinenet.net or Stephanie Argy, steph at mentalslapstick.com.



EDLUND



ANDERSON

3-D Subcommittee

Chair: Peter Anderson, ASC

Chair: Lenny Lipton

The committee's mission: *Through the auspices of the ASC Technology Committee, the 3-D subcommittee is tasked with educating the members of the ASC in the art, craft, and technology of three-dimensional filmmaking.*

The first ASC 3-D event (coincident with the formation of the ASC's 3-D subcommittee) was held on June 12, 2007 and was titled: "The Stereoscopic Cinema Production Pipeline, Part I." It was sponsored by Real D and held at the Clarity Theater in Beverly Hills.

Josh Greer, President of Real D, and Curtis Clark, ASC, Chairman of the ASC Technology Committee, made the opening remarks. Lenny Lipton was the moderator and talked about Real D cinema technology.

These presentations were supported by PowerPoint presentations and the screening of 3-D film clips.

Steve Schklair, of 3ality discussed on-the-fly camera rectification, especially important for zooming and presented clips from the "U23D" concert film, just completing post.

Andrew VanPernis, and Matt DeJohn of In-Three, described the basics of the In-Three planar to stereo conversion process. The "dimensionalizing" process requires knowledge of stereography even when shooting in 2-D in order to maximize the effects.

Matt Cowan, CSO of Real D, talked about color technology as applied to the Real D process. Color timing issues are of interest because 3-D movies are projected at below SMPTE recommended light levels.

Rob Engle, Stereoscopic Supervisor of Sony Pictures Imageworks talked about creating stereoscopic images from CG assets, a process he is familiar with for films including *The Polar Express*, *Open Season*, and *Monster House*.

Phil McNally, Stereoscopic Supervisor of DreamWorks discussed stereo from inception and the CG production pipeline. McNally (Captain 3-D) was the 3-D supervisor on two Disney films, *Chicken Little* and *Meet the Robinsons* and he is now at DreamWorks training their creative people. Starting in 2009 all of DreamWorks theatrical animated features will be stereoscopic.

A panel/audience discussion followed the presentations, moderated by Lenny Lipton.

The second ASC 3-D event, "The Stereoscopic Cinema Production Pipeline, Part 2", took place on October 15, 2007, with Lenny Lipton serving as moderator and opening remarks by Curtis Clark, ASC.

These presentations were again supported by PowerPoint presentations and the screening of 3-D film clips.

Chris Ward, President of Lightspeed Design, Inc., described a systematized visual pipeline for digital stereoscopic 3-D filmmaking. His team designed a "beamsplitter" rig which incorporates a metadata output suitable for aiding in post-production.

Sean Philips, President of Gemini 3-D, described his new VistaVision side-by-side camera in a talk about 3-D cameras and techniques for the giant screen. Sean has worked on many Imax films and also converted some of those shows for Real D cinemas.

Steve Schklair, founder and CEO, 3ality Digital Systems, talked about electronic rectification as applied to 3-D camera design, which is de rigueur for live-action direct feeds to electronic cinemas.

Eric Brevig, director of *Journey to the Center of the Earth 3D*, talked about stereoscopic filmmaking from the director's point of view. Eric has a long history of 3-D work for theme park shows. For this show, the Pace "beam-splitter" 3-D rig was employed.

Peter Anderson, ASC moderated a panel discussion and the speakers took questions from the audience.

On January 15, 2008, the subcommittee, with the generous cooperation of Steve Schklair of 3ality Digital, helped organize a pre-release screening of the "U23D" film at the Mann's Chinese theater in Hollywood. Steve Schklair and Peter Anderson, ASC, the show's 3-D Director of Photography, held a brief discussion after the screening.

In the spring, at the ASC Clubhouse, Lenny Lipton presented a PowerPoint giving some background history on the 3-D cinema.

This committee is continuing to develop ongoing presentations as relevant 3-D productions and technologies become available. It will continue to develop and present outstanding relevant seminars and screenings. Through these presentations, the subcommittee will help educate the cinematographers and related creative people in understanding the issues involved in this new medium and help the parties present and discuss 3-D production and pipeline issues.

The committee believes that in this time of transition, by many, from film-based to electronic cinematography, 3-D technology offers an additional opportunity to help cinema distinguish itself from the other media competing for the public's attention. The electronic projection of feature films allows for the successful display of stereoscopic films that are beautiful to behold, and the 3-D digital cinema process is be-

coming as dependable as projecting scope.

The technology is now at hand to place the three-dimensional stereoscopic cinema on a solid basis and with the filmmakers' creative efforts to ensure the public's acceptance.

In the century-old history of the cinema, a number of innovations have been introduced such as sound, color, and widescreen, all of which caused (from a historical perspective) some dislocation, and all of which have become an accepted part of the cinema's armamentarium. Given the high degree of visual literacy and awareness of today's creative filmmakers, we believe the transition to 3-D stereoscopic filmmaking can add immeasurably to the artistic development of the cinema.

Previs Subcommittee

Co-chair: David Morin

Co-chair: Ron Frankel

Secretary: Georgia Scheele



MORIN

The ASC-ADG-VES Joint Technology Subcommittee on Previsualization, is an unprecedented joint effort of the American Society of Cinematographers (ASC), the Art Directors Guild (ADG), and the Visual Effects Society (VES), to discuss and explore the new relationships developing around the field of Previsualization.

Previsualization (also called Previs for short) is a collection of processes developed over the last 25 years by a pioneering group of artists-entrepreneurs, to aid in the production of movies. The initial idea behind Previsualization was to harness the power of post-production 3-D computer animation software to assist with pre-production design and technical planning. Previsualization gained its first stronghold within visual effects, where it was utilized in tasks such as testing motion control moves or determining the size and placement of blue screens. More recently, Previsualization has evolved into a tool to help develop and test story ideas. Sets, locations, props and 3-D representations of the actors are built within the Previs environment, creating an interactive virtual world that can be viewed from any angle and through any lens. The result is a process that combines visual narrative and technical accuracy, allowing the project's creative team to make informed decisions early in the production process. Today, Previsualization has grown into a field that increasingly touches every aspect of production and helps foster inter-departmental collaboration.

Practically, the activities of the subcommittee are divided in to three broad segments:

- 1) Education—where case studies and demonstrations highlight how previs has been done so far.
 - 2) Previs Today—where the subcommittee is set to clarify best practices and definitions of previsualization.
 - 3) Previs 2020—where the subcommittee will explore the future evolution of previs within the virtual production space at large.
- The Previs subcommittee has been meeting on a monthly basis since April

2008. The group consists of a strong cross-section of previs practitioners and representatives from the three founding associations.

THE AUTHORS



CURTIS CLARK, ASC Curtis Clark's 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.



DAVID REISNER has consulted in entertainment and technology for 25 years. His work emphasizes image quality, creative flexibility, and best practices in digital and hybrid production, post-production, distribution, and exhibition including color management; hybrid imaging workflow and DI; mixed gamut monitoring/viewing, production, and delivery environments; security; testing; interoperability; and standards.

As Secretary of the ASC Technology Committee and DI, Workflow, and Advanced Imaging subcommittees, Reisner has had significant roles in creation of the ASC Color Decision List (ASC CDL) and ASC-DCI Standard Evaluation Material (StEM) test movie (screen credit—*Test Design and Methodology*). Since 2001, he has been an officer of SMPTE DC28 groups, including 28.10 Mastering, 28.8 Projection, KMAH/SKM Security and Key Management, and Test Materials. He is secretary and vice chair of the Inter-Society Digital Cinema Forum (ISDCF). He was architect of one of three proposals for DCI's 4K and 2K proof-of-concept systems. Reisner's work in other industries has included early technical and business plans for internet-based music and movie distribution, and computer hardware and software architecture.



DAVE STUMP, ASC began his career in film in the late 1970s, 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 until the studio moved to San Francisco. Stump also worked on "The Day After" TV miniseries, which won a VFX Emmy Award.

In 1991, Stump started a rental company, Motion Control Rental Services, which grew into the model for visual effects (VFX) 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 also earned an Emmy nomination and an Academy Award for Scientific and Technical Achievement.



RICHARD EDLUND, ASC established his reputation winning four Oscars for the visual effects in *Star Wars*, *The Empire Strikes Back*, *Raiders of the Lost Ark*, and *Return of the Jedi*, and a nomination for *Poltergeist*. He has received six additional Oscar nominations, three Academy Scientific and Engineering Awards, an Emmy, and two BAFTA Awards.

In 1983, Edlund founded a VFX company called Boss Film Studios, which produced effects for 30-plus movies, including *Ghostbusters*, *2010*, *Die Hard*, *Ghost*, *Poltergeist 2*, *Cliffhanger*, *Batman Returns*, *Alien 3*, *Species*, *Multiplicity*, and *Air Force One*, achieving ten Academy Award nominations. Following Boss, Edlund supervised *Bedazzled*, *Angels in America*, *The Stepford Wives*, and *Charlie Wilson's War*.

Edlund is a Governor of the Academy and Chair of its Scientific & Technical Awards Committee. He was Chair of its VFX Branch for its first 11 years. He currently serves on the boards of the ASC and the VES. Recently, Edlund was honored with the Academy's A. Bonner Medal of Commendation and the ASC's Presidents Award.



LOU LEVINSON received an M.F.A. from the School of the Art Institute of Chicago in the spring of 1979, having worked his way through school as a tape operator and colorist. After graduating, he joined Columbia Pictures Videocassette services, where he helped to maintain the first flying spot scanner installed in the midwest. In

September 1980, he was hired as a colorist at Modern VideoFilm (MVF), becoming the 13th employee. Thirteen years later, MVF had over 200 employees and Levinson left to join MCA/MEI Telecine Research Center as a colorist, working in what was the third HD telecine room on the planet. In 1998, he joined Post Logic Studios, where he is currently a senior colorist. A longtime ASC associate member, Levinson has been on the ASC Technology Committee since its inception.



JOSHUA PINES is vice president of imaging research and development at Technicolor Digital Intermediates, where he is currently in charge of imaging and color science, providing the motion picture industry with digital color correction processes for theatrically released films.

Pines joined Technicolor after more than ten years at Industrial Light & Magic (ILM), where he supervised their 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 a degree in electrical engineering. He began working in visual effects at MAGI in 1982 during its work on *Tron*, 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.



GARY DEMOS has spent his career working with the physics of light in motion pictures, together with corresponding mathematical and computational analysis. Demos was integrally involved with the first generation of digitally simulated scenes, CGI, for motion pictures. 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, he has been working independently on wavelet-based and optimal-filter-based moving image compression.

Demos has authored many technical papers and is the inventor of numerous patents in digital signal processing, image processing, and moving image compression. In 1985, 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," and shared another for his work in digital film scanning in 1995. Demos also shared a Technical Achievement award for work in digital compositing systems in 1998. In 2006, he received the Academy Gordon E. Sawyer Oscar for lifetime technical achievement.



JIM HOUSTON is Sr. vice president, Imaging, for Postworks L.A. and is chair of the Academy/ASC Common LUT format committee. He is also chair of the Academy of Motion Pictures Arts and Sciences' Image Interchange Framework Committee, a project of the Academy's Science and Technology Council.



ALAN 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 currently serves as executive vice president, engineering, responsible for all technical resources.

A member of SMPTE since 1975, Hart served as Chair of the Hollywood Section, two years on the Board of Managers and 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 (ATAS) Technical Emmy committee for approximately 14 years.



GLENN 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.



GROVER CRISP is currently the senior vice president of asset management, film restoration, and digital mastering for Sony Pictures Entertainment (SPE). In this capacity, his department oversees all facets of the restoration, preservation, and mastering program for the Columbia Pictures and TriStar Pictures feature film and television libraries for SPE. He has worked in the motion picture and television industry for over 25 years, and since 1984 for the Columbia/Sony Pictures Entertainment studios. Crisp is an associate member of the ASC, a member of SMPTE and the Academy of Motion Picture Arts and Sciences (AMPAS), and has served on the Board of directors for non-profits, including the Association of Moving Image Archivist (AMIA) and National Television and Video Preservation Foundation (NTPVF).



STEPHANIE ARGY is a filmmaker and journalist. Her films as a writer/director (in collaboration with her partner Alec Boehm) include the independent feature *The Red Machine* and several award-winning shorts; among them *Gandhi at the Bat*, which received an honorable mention from BAFTA, and *Scene*, in which the lead actor won a Scottish BAFTA for his performance in the film. Argy has written extensively on the art, craft, and technology of filmmaking for many periodicals and websites, including *American Cinematographer*, *Variety*, *Hollywood Reporter*, and many more. For three years, she edited the *Editors Guild Magazine*, published by the union that represents film editors, sound editors and re-recording mixers. She holds a B.A. in history from UCLA and an M.S. from the Graduate School of Journalism at Columbia University.



PETER ANDERSON has served as the Disney Studio's staff director of photography and was head of visual effects facilities for both Walt Disney Studios and Universal Studios. An expert in 3-D, special venue, large format, theme park, and digital production, Anderson has worked on more than 40 feature films and numerous hours of prime time television. Among his many entertainment industry affiliations, Anderson is a founding member of the ASC's Technology Council and a career-long member of SMPTE where he served on the DC28.40 3-D standards committee.



LENNY LIPTON, CTO of Real D, founded the StereoGraphics Corp., where he invented the most widely used method for projecting theatrical 3-D movies, the ZScreen. He is the author of the books *Foundations of the Stereoscopic Cinema* and *Independent Filmmaking*. Lipton has been granted 31 patents and has 40 pending. In 1996, he received an award from the Smithsonian for his invention of CrystalEyes, for 20 years the dominant electronic stereoscopic product. In July of 2007 he was the featured physicist in *Physics World* magazine.

Lipton produced and directed 25 films. One of his films, *Let a Thousand Parks Bloom* was included in the exhibition "Summer of Love" at the Whitney Museum of American Art (2007).



DAVID MORIN After receiving a B.Sc.A. in computer science in 1982 from Laval University in Quebec City, Canada, Morin first worked as an artist in traditional media. In 1991, he joined Softimage, where he participated in the early development of 3-D software technologies and supported product sales and marketing in various functions worldwide. He opened an office in Santa Monica, CA, where he headed the Special Projects Group as director when Softimage was acquired by Microsoft, and then served as vice president when the division was sold to Avid Technology. In 2001, he retired from the industry, and in 2007 he returned as an independent consultant.



RON FRANKEL is president and founder of Proof, Inc., a market-leading previsualization company based in Los Angeles, CA. After receiving a masters degree in architecture from MIT in 1996, Frankel began his professional career as creative director/previs supervisor at Pixel Liberation Front. There he introduced such directors as David Fincher, Steven Spielberg, and Darren Aronofsky to the use of previsualization in feature film production.

Intrigued by the promise of previsualization as a singular tool for integrating the technical and design processes that underpin filmmaking, Frankel founded Proof, Inc., in 2003. He has been a driving force behind the development of Previs, beyond its roots in technical planning for visual effects to serve directors, cinematographers, and production designers.