

What time is it in Jackson Hole?

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Background

In June of this year, the Jackson Hole Wildlife Film Festival sponsored a test shoot intended to expose important characteristics of various film and video formats. The results were to be presented at the Wildlife Film Symposium in Jackson Hole on September 1. The test was billed as "High Noon at Jackson Hole". As a participant in the test, I was concerned about the immensity of the task and the possibility that incorrect conclusions would be reached by those who did not understand the conditions and limitations of the test. The "High Noon" shoot-out billing seemed particularly inappropriate for such a demonstration. I asked to give a paper at the Symposium describing the difficulties in evaluating imaging formats and was accepted. This paper is the result of that request. It was given as an introduction to the display of the results at the Symposium.

The final thoughts were intended for presentation after the tapes were viewed but time constraints prevented me from giving them. The entire paper is being distributed at the request of several members of the audience and the panel. I hope that it will stimulate discussion about the methodology of equipment comparison in this time of confusion over imaging formats. It is, like many of my contributions, more questions than answers.

All opinions in this paper are my own and not necessarily those of my clients or the Symposium sponsors.

The Shoot

The plan involved comparison of the following systems:

- Sony DVW-700WS Digital Beta camcorder, recorded in camera (480i)
- Panasonic AJ-PD 900W DVCPro 50 camcorder, recorded in camera (480p)
- Polaroid/Philips PTC-9000 camera with control unit, recorded on HD D5 (720p)
- Sony HDC-500 1" FIT camera with control unit, recorded on HD D5 (1035i)
- Sony HDW-700 2/3" HDCam with remote control panel, recorded in camera (1035I)
- Arriflex 435ES Super 35 film camera shooting Kodak 7245 stock (EI-50D)
- Arriflex HSR3 Super 16 film camera shooting Kodak 5245 stock (EI-50D)

Each camera shot the same static and dynamic scenes. The scenes were outdoors and were designed to test for sharpness, motion reproduction, slow motion rendition and artifacts.

Macbeth test charts were included to assist in post production color correction.

Each operator set the exposure and color balance of the camera according to his or her standard practice. There was not a person designated to match all the cameras.

The video format results were presented as follows:

- The 480i and 480p tapes were upconverted to 1080i and recorded on HD D5 by Panasonic using the Panasonic upconverter.
- The other formats were edited to reduce confusion but all were maintained in native formats and were edited digitally.

The film formats were transferred using four different telecines and recorded to HD D5 tape.

- The telecines used were (all telecines transferred both Super 16 and 35mm negative)
 - Sony Atsugi custom telecine at Sony High Definition Center (also ran 35mm IP)
 - Rank MKIII Telecine at Universal HD Center
 - 1080i Spirit at The Film Group Division of Crawford Communications
 - 720p Spirit also at The Film Group (newly installed)

Each facility used a different colorist and each one applied what they considered to be appropriate correction.

Laser Pacific digitally edited all the 1035/1080i footage plus the Polaroid/Philips 720p footage, and did color corrections of the interlaced-format film transfers. A sequencing edit of the Crawford S16 transfer to 720p was done digitally in Jackson Hole by the Panasonic folks.

The players:

I was video operator for both 1035i cameras.

Gary Demos and Steve Mahrer were video operators for the 720p camera.

There were no video operators for any other camera.

The camera operators were generally familiar with operation of the cameras and technical support was available for all cameras except the Digital BetaCam and Polaroid 720p camera.

Barry Clark planned and supervised the test.

Lisa Samford coordinated the test.

Chuck Lee of Fujinon chaired the video results panel.

Larry Thorpe represented Sony on the panel.

Michael Brinkman represented Panasonic on the panel.

Gary Demos represented the 720p interests on the panel.

Hector Rodriguez of Kodak represented the film community on the video panel.

I represented myself and other skeptics on the panel.

Most of the participants (or their employers) volunteered their time.

This paper addresses the video portion of the demonstration although many of the points apply to the film portion as well.

My Presentation at the video results panel on September 1, 1998:

Introduction

I told Barry that I would help out on this test only if i could talk about why what we were attempting to do was not possible.

I have been selected by this panel as a less biased witness to give you a flavor of the test and to point out the limitations of the results so I think that I should lay my prejudices out front. For the past decade, I have made a living designing, implementing and operating high performance systems, most of which use an 1125/60 format. I have shot some 480p and have only had my hands on 720p cameras twice outside of trade shows. I obviously have more experience in interlaced HD but I do not own any equipment and I do not get a regular paycheck from a vendor. I have worked for NHK, HD VISION, Sony, NASA and many others. My priorities are good images, satisfying clients and whenever possible, working myself out of a job so that I can do something more interesting the next time.

So what is the problem?

General comments

In general, the more elements that you add to a test, the more variables you create, the more data you get, the harder it is to control for the variables, the harder it is to reduce the data, the less you are certain of the pedigree of the components, and the harder it is to compare the products against one another. and there is always a tendency for these comparisons to grow as we plan a test and see more options that should be compared.

And, of course, as soon as you try to measure something, you affect that which you measure and the more you try to measure, the more the test affects the subject. This is not an obscure phenomenon in atomic physics, it is a real problem in everything we do. That is why scientific studies try to minimize uncontrollable variables and use double blind testing whenever they want uncontaminated results.

So let's get one thing out in the open. No one that I have heard is saying that this evaluation of various imaging systems is a scientific test. It is a valiant attempt to make some sense of a very confusing subject that affects all of us as we move into a new century of technology. It may be a useful demonstration if you take away a few clues about what to look for at the next demonstration that you see. Beware of wise guys bearing pat answers.

The problems with this "Test"

So let's look at the specific issues that affected our demonstration. Comparing images produced by different systems is a complex issue and small changes in any variable can have a gross effect on the outcome of a test.

For example:

There are format capabilities, limitations, strengths and weaknesses.

These are the issues that you thought you were coming here to hear about but this is only part of the story. Variations in many of the other variables can overshadow the differences between the formats, so be careful in making assumptions about what caused an effect that you see

But,

one format may handle motion better than another;
one format may support more resolution;
one format may provide a better product to convert to other formats;
one format may be more widely accepted today;
one format may offer better opportunities for future adaptation;
one format may be politically more palatable for decision makers;
no format may have an advantage in some areas;
and you may see the effects of some of these characteristics in the tapes or hear about them from the panelists.

But there are also equipment capabilities/limitations that are not directly the result of the selected format and these can make big differences in the images.

One camera may be more sensitive and/or the video cleaner;
one camera may be more portable;
one camera may be easier to learn to control;
one camera may be more controllable;
one camera may be more flexible in different situations;
one camera may use less power;
one camera may be quieter;
one device may exploit it's format better than another;
one device (recorder, converter, camera, processor) may be more transparent than another;
and one system may be more mature in design than others.

You may not see the effects of some of these characteristics on the screen but they directly affected some of the pictures and indirectly affected the conduct of the test.

For example, you will not see the HDC-500 video on the motion test because it would have slowed down the test by some time to run another cabled camera on the back of the truck and we decided that the issue of that test was not resolution but motion reproduction so we just shot that one with the HDCam.

There are personnel capabilities and limitations.

One person will not be equally proficient in the use of all formats.

An experienced operator with one system may get more out of it than a novice with a more powerful system.

Of course, I think that you will like my images best in the video comparisons. (Gary feels the same way about his images.) But that has very little to do with the formats: it has everything to do with my experience as a video engineer with this particular equipment, the control that I had over the camera, and my personal preferences; that was not necessarily the case with other formats.

There are subject considerations.

Is there a fast moving subject?

Is there an animal sensitive to noise.

Is there a dark horse and snow.

You might see some effects of subject problems, but they were probably overshadowed by the equipment configuration and operational limitations.

It could be the format, the operator or the equipment that caused a problem that you see.

There are environmental considerations and limitations.

Is it a sunny day on the water?

Is it raining?

Are you trying to shoot in the mud?

It may be easy to shoot beautiful pictures in great lighting, magic hour for instance, with an automatic or fixed setup camera. One strength of full camera remote control is the improvement of images in marginal conditions. You may see some of that in the tapes made on this overcast day.

There are aesthetic considerations imposed by the director of photography, director, camera operator, video operator, colorist, editor and color timer. Even if each one is completely competent, they will not interpret the same scene the same way and one person's effect may be another person's artifact.

There may processing impacts that have little to do with the originating format and these may or may not be typical of processes that you would use to complete your project.

We think that processing between the shoot and the display was minimum in most formats in the video tests with the notable exceptions of the 480i and 480 up conversions to 1080I.

In the film portion this afternoon, I suspect that processing in the chemical and electronic domains had a bigger effect and correspond to the differences in the field for video.

Remember that when you shoot video, you have part of your colorist in the field with you because you can only change so much in post.

One valid conclusion you might draw is that if you see something that you like, it must at least be possible under some conditions to get acceptable images with that format but, there is the huge issue of the viewing environment

I tried to help make this part a little less variable and the folks from Panasonic and Sony went a long way toward making the comparisons useful but the display can often be the weakest link in the chain and can make or break an otherwise valid comparison. The display is a part of the processing that I talked about and can introduce artifacts that may be significant. If your displays are not appropriate to the format or the content being viewed, you may not see differences that are significant or you may see some that are irrelevant in your situation like enhancement artifacts that make a sharp wide shot look ugly but don't affect a source with less resolution. Tom McMahon of Microsoft noted in some recent testing that some CRT displays have small beam spot sizes optimized for high resolution signals and emphasize the scan lines in lower scan rates.

And the conditions around your display device may disguise or emphasize other problems. We have tried to give you one large image, smaller bright images and the same displays for the two display formats so that you can compare apples and oranges but we are not sure that there are no biases built into the displays. The mere fact that these displays can handle multiple formats does not necessarily mean that they display all equally well.

All of these considerations affect each project that you take on but rarely do you have to control for all of them with a half dozen different systems.

So what should you take away from this exercise?

We attempted to minimize the difficulty of the shoot by limiting the locations to those accessible by the big cameras with power limitations so portability is talked about but did not significantly affect the quality of the images - that is not a realistic condition for most of you.

We attempted to compare a multitude of formats so there are probably not enough different scenes to successfully tax all of the formats.

We tried to get the best people but some were not available so some of the new formats did not have the benefit of experienced operators, others did - that makes it hard to isolate the differences in performance to format, equipment maturity, or operator expertise.

Even if we got the best folks, some operators had more control than others and exercised that control in different ways.

The processing tools are limited for converting between formats so any conversions that you witness should be noted and considered suspect.

And finally, the displays are limited to the available ones and may not do justice to all formats.

So let's look at some results and we will all have a few words as we go along. We'll try to answer your questions as we go but don't be surprised by "I don't know", and we'll each have some summary conclusions after we finish watching the tapes.

(The edited results videotape playbacks occurred here.)

(This is the portion that didn't make it because of time.)

Image Analysis

I was not surprised by the general results of the test and I will offer a few words concerning the quality of my own video results because those are the only results about which I know enough to comment.

Looking back at my video, I would not have done things much differently. On a typical natural-light shoot, I expect the Director of Photography or Director to give me guidance concerning what portions of the scene should be optimized. Cameras (video or film) often cannot reproduce all of the information in a scene. Film has more latitude in handling extremes but video cameras can often be adjusted to significantly improve performance in a specific area.

When I don't get that guidance, I use an approach similar to that described by Vince Forcier of Roland House at the 1997 Festival. I attempt to hold as much highlight without clipping and as much low light without crushing. I expect the rest to be handled in post production color correction. This approach has its limitations in high definition because the color correction tools have been somewhat limited and because too much stretch in the blacks can create obvious noise on large screen displays. Contouring can also appear if the recording or processing depth is only 8 (or even 10) bits. If possible, I also push or pull the gamma in the analog domain before digital processing to optimize the contrast for recording (based on what I think that the Director of Photography is trying to achieve in the final product.)

The controls that get the most use on my camera are knee point and slope, gamma and black gamma. These contrast controls can help to reduce the information lost in recording. You must be very careful when using heavy knee and/or gamma correction to not distort the natural reproduction of skin tones and when using a combination of gamma, black gamma and gain to not generate additional video noise. I also try to minimize the use of detail and to use the secondary detail controls to minimize noise enhancement under conditions requiring severe correction.

Of course, the camera must be tracking for these controls to be effective in the field. That means that the individual color gamma controls, the flare controls and the overall gain controls must be properly adjusted to maintain a consistent ratio when overall changes are made. Modern cameras are much more stable in these areas than traditional video cameras but some require periodic auto setup procedures to maintain stability.

Final thoughts

I would like you to consider your typical project.

Think about all the variables in the process that can cause your product to be a source of pride or to be disappointing.

Consider which ones you have control over.

Consider which ones you can back up and re do: editing, printing, transfer.

Consider the ones that you cannot re do: scene lighting, filtration, field capture, field recording.

Now consider those variables multiplied over 7 different shooting formats, none of which you have control over; all of which no single person had control over; now consider if you would use the results of such a comparison on which to base your future.

Well, if this type of comparison is so flawed, how do you decide what equipment is right for you?

Perhaps you should ask yourself the following questions.

What are you trying to do?

What do you really need out the end of the process?

What can you sell to your clients?

What are your operational limitations?

What is the target format?

What equipment can you make the most of and what will just be in the way?

What is your budget?

The answers will not be the same for all of us and they may even be different for each job that you do so do your own tests and teach yourself what works and what doesn't in your applications.

Limit your tests to the specific formats and issues that are significant to your project. Tailor the test scenes to the questions that you need to answer. Remember the confusion that we generated trying to test all the formats at one time.

View the results through the same path that the final product will take and on the biggest screen that you want to look good. This business of making decisions on 20 inch screens is dangerous unless you don't care about big pictures.

You need to optimize the available equipment for the task at hand. There will be holes in any new system but if you think about how you will work, you can eliminate many of the problems in the field. Most of the issues that you face will not be format specific. They will be the same ones that plague every shoot. Some may be enhanced by a bigger camera or a separate recorder with a cable or different environmental sensitivity, but those are rapidly converging for the most likely format choices.

Then follow through.

Remember that a big variable is in the head of your viewer so it is your job to tailor the images for your primary product and the most demanding viewer that you expect to satisfy.

Integrate the images carefully. Think about what shots work best on what format and try not to create stark changes in scenes by cutting between inappropriate formats unless you are trying to achieve that type of effect.

Make use of offline editing. Don't waste time in an expensive edit suite making decisions that you should have thought of beforehand.

Think about format conversions before you spend money having them done. Simulate cropping on a cheaper format or in a computer to see how the framing will work.

Think ahead! And remember the seven P's: proper prior planning prevents piss poor performance (please pardon my impertinence.)

Maximize your chance for success by covering your bases. Have a contingency plan.

...and, by all means, use the right tool for *your* job and go tell an interesting story.

Which brings me to the title of this paper: What time is it in Jackson Hole?

Is it the dawn of a new day ? It may be, if you are ready for the challenge.

Is it 11:59 PM and time to get on with it ? It is for those of us who have been at it all day.

Is it High Noon?

...probably not...

But the answer may be another question - When is your project due?

If it is due soon, you had better shoot what you shoot well. If you have a little more time, then a new format could be right for you. Test and shoot. If your customers are pushing you to shoot in high definition, then you had better get busy.

I leave you with a thought from Mark Schubin, video historian and PBS technical producer, about making the big format decision.

Mark offers an obvious but sometimes difficult approach - simply look at lots of pictures, lots of ways.

Look at SD pictures.

Look at HD pictures.

Look at compressed pictures.

Look at converted pictures.

Look at compressed converted pictures.

Look at converted compressed pictures.

Don't make a decision based on one test that shows what you want to see.

...and call me at midnight.

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