

If DoPs designed cameras...

Geoff Boyle solicits the views of three manufacturers who are approaching digital cameras from a different angle – they're emulating traditional film cameras, rather than TV cameras.

Three companies are challenging the recent wisdom of top-end digital camera design: Kinetta, Dalsa and Arri. They take the view that the major camera manufacturers have a much greater economic interest in the TV market rather than the film market, and this has led to the creation of high definition cameras for cinema that, in essence, are upgraded TV cameras. They believe cinematographers are better served by an approach to digital cameras that take its inspiration from traditional film cameras.

Here, in their own (sometimes controversial) words, Jeff Kreines of Kinetta, John Coghill of Dalsa and Marc Shipman-Mueller of Arri explain their reasoning and their approach.

Jeff Kreines, designer of the Kinetta digital camera: At the recent Geneva Auto Show, Volvo showed a new concept car, designed by women, for women. Most of the press treated this with bemused condescension – the BBC said, "if the Calendar Girls were making cars, this is what they would look like". But shouldn't this approach be dreadfully obvious? Pay attention to the people you are making cars for!

The same, of course, could be said of the manufacturers of HD/digital cinema cameras. Look at the Sony F900 or the Panasonic Varicam and what do you see? An overgrown TV news camera. While the current generation of TV news cameras might be good for... well, shooting TV news, this doesn't necessarily makes them suitable for making films.

There are so many reasons why.

The ergonomics are terrible. Way too many controls, most of them in the

wrong places. If you want to use a matte box or follow focus, you can't reach any of the controls on the front of the HDCam, as they're obscured by the rods. If your sound recordist needs to see the audio level meters on the camera, they can't, because your head is in the way.

There are way too many switches and connectors. Every inch of these cameras seems to be covered in dreck. Use all the connectors at once and you end up with a Medusa. I pity the poor techs that devote their lives to building custom snakes for these messy rigs.

And before you can shoot, you have to tweak all sorts of menus, setting colour matrix, gamma, sharpness, and more – because if you don't, you may not have enough latitude in post to colour correct. That's because the recorded image is not only heavily compressed, it's filtered down to 1440x1080 – and with 3:1:1 colour sampling in the case of the F900.

This leads to the disaster of trying to

set up a de-facto colour-correction station in the field, with accurate monitoring – because it's important to capture an image that is as close to final as possible.

Philips (or is it Thomson, or GVG, or – they change their name so often) had the right idea with the Viper – output a raw 4:4:4 image with great dynamic range, and treat it as a 'digital negative'. Colour correct in post. Like film. Capture it uncompressed to a hard-disk recorder.

Great idea. But they are depending on third parties to make field recorders, which, if the Director's Fiend is any example, make for an unwieldy field setup. Not just physically... these hard-disk recorders are computer-based – meaning that you have to boot them up and deal with operating systems. Just what I want to do – entrust my film (er, data) to Microsoft. Blue screen of death roulette, here we come!

The CineRam does offer a solution

Jeff Kreines shows off the Kinetta digital camera at NAB. Photo: Mark Forman.



to some of these problems, but it's not designed for long takes in the field without frequent downloading to a computer. And the S.two field recorder is a big improvement over the clumsier DVS and Director's Friend devices (see *Choosing a Camera for DI*, page 75).

Of course, the Viper looks like a video camera, and uses the dreaded B4 lens mount. It's not the mount that's dreaded; it's the block of glass behind it. Sony pioneered the B4 mount, and in doing so spec'd a special glass for the prism that focuses the red image a few microns behind the blue and green images – meaning that all lenses designed for this mount must also throw the red image out by 10 microns.

Big deal, you say. Let the lens manufacturers deal with this. They have. Zeiss makes the marvellous DigiPrimes. Wonderful lenses. But a set of them costs about US\$115,000. That's a lot more than a set of S16 Zeiss Superspeeds, which also have pretty decent optics.

Even with great lenses, prism cameras tend to have problems with chromatic aberrations – ever notice the blue stripe on the right side of any contrasty image captured with an HDCam? It's subtle, but once you've seen it, you'll never be able to ignore it.

Of course, you won't see it in the mediocre viewfinders that these HD cameras come with. They're low-res, flickery monochrome CRTs. Of course, there are better aftermarket finders, from Sony and Accuscene, but they're not cheap – prices start at \$10,000.

The housings of these cameras all feel cheap – lots of plastic and lots of pressed tin. Not solid, like a film camera. Some rental companies, such as Clairmont Camera, have had to ruggedise these cameras so they can stand the rigours of rental use.

I could go on. But I won't. I've been shooting film since the late 60s, and I like the way film cameras look and feel and, most importantly, work. Some of my favourite film cameras have only two switches – on/off and frames-per-second – and one connector, for power. You have to think a bit when you use these cameras, but you don't have to fight the camera's personality in order to use it. Kind of like shooting

with a Leica rangefinder camera. Have you ever struggled to shoot a simple snapshot with your little pocket digital still camera? In the attempt to design them to be idiot-proof, manufacturers designed them to be unfriendly to serious users.

So, what can you do about this miserable state of affairs? Well, you can look to the past for inspiration.

In 1914, Carl Akeley couldn't find a suitable camera for shooting his African expeditions, so he built his own – and the Pancake Akeley remained popular for over 30 years. In the mid-60s, Jean-Pierre Beauviala wanted to make a film about architecture – a film that required several cameras in different locations running in absolute sync. He asked Éclair, and they said it was impossible, because at the time there were no commercially available crystal-controlled motors. Not to be deterred, Jean-Pierre designed and built one. And took it to Éclair, who hired him. Although his film never was made, camera history was. After Éclair died a sad death at the hands of Harry Saltzman, Beauviala founded Aaton, and has made many wonderful cameras – because he paid great attention to the needs of users.

Inspired by Akeley, Beauviala, and others, we chose to make a digital cinema camera that completely ignored the past 30 years of TV-news-camera design. We instead looked to 100 years of film camera design for inspiration. I'm lucky to be working with Martin Snashall, a pioneer in digital video design (he designed the Abekas A64 disk recorder and the A84 vision mixer) – it's amazing what he can do with a few Xilinx FPGAs – and Glenn Smith, who collaborates with us on mechanical design.

One great thing about film cameras is that they get a free upgrade whenever Kodak or Fuji introduces a new emulsion. We designed the Kinetta HD camera to be sensor-agnostic – the camera's architecture will support future CCD and CMOS sensors with resolutions up to 16 megapixels (over 4K). Just replace the sensor and its daughterboard – very simple. No planned obsolescence.

Film cameras are completely

variable speed – they can even be hand-cranked. There's a hand-crank option for the Kinetta camera as well – and you can change just framerate or framerate and exposure, like a film camera. Of course, you can also do conventional speed ramps and time lapse.

We record RAW data – 4:4:4, 10-bit log, uncompressed – to a magazine that contains 12x40Gb hard drives – the same drives that are used in iPods. Tiny and rugged. Each magazine, recording in a parity-protected RAID-3 format, will store 110 minutes of 1920x1080 material at 24p. The magazine can be used on the camera, for shoulder-mounted use, or it can be separated from the camera head by a thin 3mm fibre-optic cable by over a kilometre. Combined, the camera, magazine and battery weigh about 6.5Kg. You can attach a magazine to a non-linear editing system via single or dual HD-SDI links and digitise, or you can export data directly as DXF files if youd prefer.

Since we record RAW data – everything the sensor puts out, we record, unaltered – all you have to do is make sure you don't overexpose any pixels you want detail in – and you can tweak the rest in post. The camera has multiple user-defined zebras – you can do the zone system if you'd like – and a histogram. All are available in the finder when desired.

We use a standard PL lens mount and a single sensor – so all of your favourite film lenses can be used. No prisms. Our high-resolution colour viewfinder is OLED-based – it's compact and consumes very little power. It can be positioned anywhere on the camera (or a few feet away), and includes controls for finder zoom and various display options.

Note that Akeley and Éclair and Aaton (and even Arriflex) are tiny companies when compared to, say, Sony. Sony is interested in HD not because they really care about selling cameras to this tiny market, but because it might help in their eventual desire to sell lots of HDCAMs to TV stations for news shooting. Ah, now we see why these cameras really do look and feel like TV news cameras!"

John Coghill of Dalsa, designers of the Origin digital camera:

In 2001, when we embarked on the Origin digital camera programme, we had two fundamental questions facing us as a development team:

- 1 How are we going to translate the requirements of what is essentially an artistic community into engineering terms we can effectively implement, and,
- 2 How are we going to overcome the potential handicap of not having a history of video engineering experience that the large consumer electronics companies were bringing to bear on this market?

The answer to the first question was fairly obvious. When you don't know what you don't know, go ask someone who at least knows what questions to ask. So very early in the paper design stage we involved people with experience in the development of film cameras and working with filmmakers and asked them to educate us as to the core needs of the professional filmmaker. This process began by taking the core engineering team to a local (Toronto) camera rental shop and spending the day pouring over the various camera configurations and gaining better insights into the importance of the myriad accessories, their use and how they interact with the set and crew. We studied books such as *Every Frame a Rembrandt* by Laszlo Kovacs, the *American Cinematographer Manual* and the *Student Filmmakers Handbook* by Kodak, and asked lots of questions of the people who would eventually be using the camera as their primary tool: the cinematographers. The list of 'credits' is too long to reproduce here, but suffice it to say there were many people who contributed to the shaping of our final thoughts on the design approach.

We learned very quickly that filmmakers are not only creative in their mind's eye, but also with the physical media in terms of modifications to accessories, cameras, rigs, lighting and the final processing of the film. It became apparent that there are only



three constants that are important to the filmmaker and everything else needs to be flexible. The three key elements around which a professional digital motion picture camera would have to be designed are: existing high quality 35mm lenses, a high performance image capture media, and a through-the-lens viewing system with a safe framing area. We also learned about two other key tools required on the set: Velcro and duct tape!

At some point along this process it became apparent that our second concern was not the handicap we had imagined. In fact, the requirement to have an ultimately flexible platform that provided a wide range of features and functions (some yet to be dreamt up on a set somewhere) required the development of what is essentially a high performance electro-optical image capture module with an image processing computer hanging off the back. What was a perceived weakness actually turned out to be a strength, because the design team was not constrained in their thinking by past video camera design approaches.

The enabling technology in the camera platform is the large area, high-speed CCD sensor, and it satisfied one of the three key requirements, namely the high performance image capture media. From this starting point there

were three options to consider in terms of the front-end optical configuration: single, dual and three chip optical assemblies. The three-chip approach was dismissed immediately based on its incompatibility with existing 35mm lenses, not to mention the optical aberrations inherent in prism-based optical assemblies. The single and dual chip approaches each have their advantages and disadvantages, so both were carried forward along the design path, as both are optically compatible with existing 35mm lenses. The final decision to pursue the single chip architecture was based on many factors, but the underlying consideration was that it is the only option that allowed for the rotating mirror shutter and reflex viewing system to be implemented exactly as in professional 35mm motion picture film cameras. Based on the number of single-chip camera designs announced since we went public with our design in October 2002, it would appear other manufacturers have come to the same conclusions we have.

From this base, the design proceeded with two guiding principles. Keep the design modular and flexible and, when faced with a choice, always go with the option that preserves image quality or enhances feature performance in some way. The result

The Dalsa Origin camera, a single-chip model designed to emulate the way film cameras work.



Arri's D-20 prototype digital camera, first shown at IBC 2003.

of this design philosophy brought us to another decision point that required us to seek out the opinions and input of cinematographers once again. The volume of electronics in the camera and the requirement to locate certain circuits in a particular physical relationship to others to maintain performance dictated one of two possible physical profiles: a long low profile (nicknamed 'the bazooka') or a taller profile. The opinions and reasons for preferring one over the other were split almost 50:50 among the people we spoke with, and we clearly went with the taller profile that you now see in the Origin camera. This was not simply a toss of the coin, however. We had 15 different industrial design artists' conception drawings made and it was agreed that all technical arguments aside, there was an appeal to a form that was reminiscent of a 35mm film camera with a magazine mounted on top. Based on the reactions so far, the opinions are still split 50:50.

Going forward from here, the current implementation of the Origin camera will exist for a long time as the full featured 'studio-cam' model, but we continually get input from across the industry that is being folded into our product roadmap. As we introduce new models in the future I hope people will recognise the influence they have had on the various designs. However, regardless of the shape and features of new models down the road, the fundamentals will remain the same – use the highest quality optical

input to a system that enhances the creative control and options available to the cinematographer.

Marc Shipman-Mueller of Arri, designers of the prototype D-20 digital camera: I am currently in New York conducting D-20 focus groups, as part of a larger international tour to gather more information on how the D-20 can better serve the production community.

The film industry is a unique market, with tremendous demands on the equipment. Not only must it be robust enough to work in the Arctic and the Amazon alike, but it must also be so easy to use that a completely exhausted assistant after a 16 hour day in the pouring rain can still operate it without making mistakes. To make matters worse, cameras are complex assemblies of precision mechanics, optics and software, and to design and manufacture them for the above requirements is no trivial task. Since in the grand scheme of things the film industry is a relatively small niche market, few companies find it worth their while building products specifically for this market.

Some companies have specialised in providing cameras to this market though, including Aaton, Panavision and ARRI, and those companies maintain close ties with the cinematographers and assistants using their cameras in the field, and have leveraged these connections in new product design.

The D-20 concept is a good example of this. It was shaped by

countless conversations with cinematographers, producers, directors and their crews. In these conversations we were told that the current HD cameras are still designed like electronic news gathering (ENG) cameras, and that those are not the best tools for productions that traditionally have been shot on film. Film cameras, on the other hand, have been designed and refined for almost a century specifically for single camera narrative productions. As a result of the input from the filmmaking community, the D-20 is a digital camera specifically developed to fit seamlessly into the process used by film productions. A crew that is used to working with 16 or 35mm film should be able to use the same methods with the D-20.

Cinematographers who have honed their skills over decades should be able to apply them similarly to the D-20, thus leveraging their experience, while gaining the immediacy of outputting a high definition digital signal.

The D-20 concept came from informal conversations with film professionals. Then the functional demonstrator (a fancy name for a lab model) was shown at the IBC 2003 show, sparking an avalanche of feedback and many lively discussions on and offline. As part of the process to further refine the D-20 specifications, we are now showing the D-20 functional demonstrator in various focus groups internationally, leading to the creation of prototypes which will then be used in pilot productions. The feedback from those productions will lead to the creation of the product. Developing a product for us is a reiterative process with continuous involvement by working professionals; a continuous process of presenting ideas, concepts, models and prototypes to customers and continually refining the specifications based on this input, until we have a product that works in the production process just like our other film cameras.

Geoff Boyle: I'm really looking forward to working with all three of these cameras; finally, digital imaging has been freed from the tyranny of TV.