

Major Success for HDTV Course



Jim Slater reports on yet another worthwhile technical event at the Digital Test Bed

Training courses on all sorts of hi-tech subjects are 'ten a penny' these days and it is comparatively rare to find one that really does 'what it says on the box' and that achieves something really worthwhile for its participants. It was therefore great to see that a brand new course organised by BKSTS Member Peter Wilson of *High Definition Digital Cinema Limited (hddc)*, in conjunction with BKSTS and the Digital Test Bed at the NFT, attracted over thirty top class delegates and provided them with a two day course packed with information about HDTV and with hands-on opportunities to play with some of the latest equipment. Delegates from organisations including broadcasters, film-makers, post-production houses, hire-companies, archiving companies and researchers came together at the Digital Test Bed, where BKSTS Member Richard Boyd and his technical team provided all the facilities necessary to mount a really worthwhile set of technical presentations.

Any course is only as good as its presenters, and Peter Wilson had done a first class job in assembling a group of top class speakers, each of whom really 'knew his stuff' and was able to not only make a worthwhile presentation, but could also answer all manner of questions, not only about the subjects directly under consideration, but about many peripheral topics as well. You really do need people with long experience of the broadcasting industry to be able to tackle such a wide range of topics with confidence, and it was good to see how well the various speakers were able to respond to some pertinent and difficult questions over the course of the two day period.

The course had been advertised as being designed for TV industry professionals facing the challenge of a migration to HDTV, covering both theoretical and practical issues, as well as being 'highly practical', and it actually delivered on all these promises.



Day one began with Peter Wilson welcoming the delegates to the comfortable surroundings of the National Film Theatre's NFT 3, introducing the speakers, and giving a brief but comprehensive history of the development of HDTV. He traced this from its origins with Japan's NHK in the 1970s, through the pioneering work of CBS, RAI and NHK during the 1980s, and the European 'Eureka' attempts to rival the Japanese systems. The developments from the United States ATSC that eventually led to a multi-standard set of standards for US broadcasters were described in sometimes cynical terms, not forgetting the inputs from the computer industry that provided some surprisingly good 'HD' pictures with only 480 lines. Sky's plans for HD in 2006 and the BBC's recently announced HD tests brought the audience up to date with what is happening in this fast-moving field.

Peter went on to list the various milestones and relevant technologies that were eventually to lead to HDTV, describing the years 1990-1998 as the 'golden years' for quality in TV, with one-inch CCD cameras and uncompressed full-bandwidth digital tape recorders, but his mention of tape costs of £1000 per hour for such systems put things into perspective and returned the audience to the reality that modern HDTV systems are going to have to consider costs as well as quality issues. Thanks to Ed Mauger's sterling efforts in the NFT3 projection room we were then treated to an HD showreel from Collosal

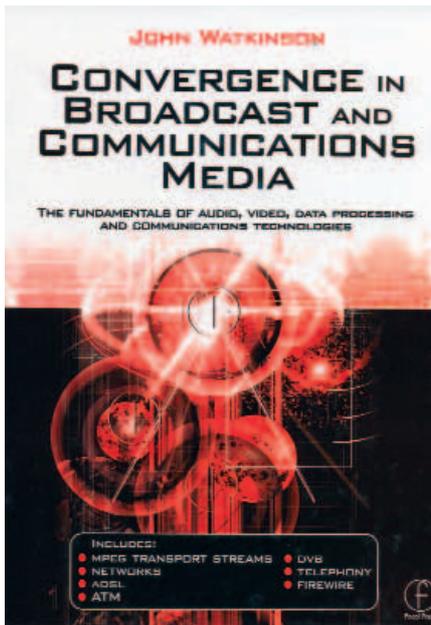
Vision, which contained a good many interesting HD clips, mainly from the 1980s, and it wasn't surprising that some of the pictures were good, some were very soft, and most of them lost their high-def qualities when the camera moved! This was contrasted by a recent showreel from BBC Post-Production, effectively showing HD work twenty years on which provided some magnificent images. Even so, on the NFT's big screen it was sometimes possible to see how detail disappeared from some areas of the picture when images were scanned.

The course work then began in earnest, as well-known author, lecturer and consultant John Watkinson, who has made a career out of making digital television understandable to the world's engineers started on a series of lectures which lasted for the rest of the first day and the first part of day two.



I must have have been to John's presentations on different topics over a period of at least a quarter of a century, and a good many of his books grace my shelves, so it was good to see that the 'course notes' with which delegates were presented included his 750 page Focal Press tome entitled 'Convergence in Broadcast and Communications Media'. Absolutely no chance for delegates to

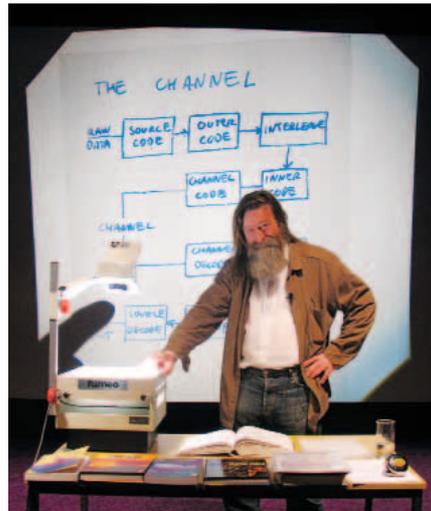




complain of not having enough reference material from the course to take home, and John was on several occasions able to say quite truthfully to questioners seeking more information, that 'it's all in the book'! Delegates were also given a very useful CD Rom containing the papers and slide presentations from the other speakers on the course, which will again provide a valuable reference source in the future.

John began as he was to continue, in a somewhat cynical vein, claiming not to believe in a hi-tech approach to presentation, rejecting computers and Powerpoint as 'for presenters who don't know how to present', and claiming, justifiably as it turned out, that the only power-point he needed was the mains socket into which he plugged his overhead projector! For the rest of the day and well into the next morning John used a well-organised heap of hand-written transparencies to provide a veritable 'tour de force' covering everything from the basics of digital television, the characteristics and foibles of the human visual system, colorimetry, compression, and digital recording. I took pages of notes, but there was far too much in this course for me to even attempt to do more than touch on the 'headline' topics in the space we have available here, so I will have to take the cowardly way out and say that those who are interested should book themselves on the next hddc course.

John started with the basics of what HDTV actually means, pointing out that there are no existing definitions that are really meaningful, and that he would define HDTV as 'a system for delivering moving images and sound that is significantly better than anything that we have seen before.' If the system doesn't do



at least that, then the consumer will just yawn! He pointed out the need to reduce flicker, improve colour accuracy and motion portrayal, as well as to reduce all artefacts - without these improvements any increase in definition will merely make the artefacts easier to see.

John then took us through sessions on the human visual system, the portrayal of

You will recognise true HD when it is like looking through a window...

moving images, colorimetry, compression, and digital recording, in each case providing a superb detailed overview, starting from the basics and bringing the audience up to date with the latest ideas and techniques. The comparisons between progressive and interlaced images at different parts of the broadcast chain were particularly interesting, and although we were to hear somewhat different opinions from other speakers later in the course, John left us in no doubt of his well-argued conclusion that 'Interlace has no place in HDTV'.

Interlace has no place in HDTV...

There is no doubt that John's lectures needed a good deal of concentration and hard work to gain the full benefit from, but I found, along with the other delegates, that the concentration paid off, we were never bored or sleepy (the chilly temperatures in NFT made sure of that, but that is another story!), and John's laid-back style, interspersed with humorous and cynical quotes and anecdotes kept us all interested and eager to keep on learning throughout the sessions. My only

possible complaint was that in view of the many hours of lecturing time that we encountered it might have been better to 'hone down' some of the more general technical content in order to focus on what was 'different' in each technical area for HDTV purposes. For example, we were given a good grounding in digital TV fundamentals and in topics such as compression and colorimetry, as well as in the characteristics of the human visual system. Most experienced senior engineers will already have known most of this information, and what they needed to get from this specifically HD course was which bits of their experience and knowledge need to be revised as they come to deal with HDTV systems in their daily work.

One of the excellent features of the course with its thirty-odd delegates (split into three groups for the practical sessions) was the opportunity to discuss the course with each other at every refreshment break. Although several of the delegates told me that they found these 'refresher' sessions on existing technology useful, and that they had filled in gaps in their knowledge, there were also comments that a more 'this is how it will affect you when you switch to HDTV' approach would have enabled more time to be given to strictly HD topics. The organisers will no doubt look with interest at the 'feedback' forms that they receive from delegates, to see if a slight difference in the SD/HD balance would be beneficial on future courses.

Putting it all into practice

On day two, titled 'Practice Day', the three groups rotated through three different sessions. John Watkinson gave a detailed rundown of video recording techniques, digital editing, and the advantages and problems of recording compressed signals. He looked in detail at MPEG2, and explained about the video applications of MPEG4, comparing the characteristics of the systems, and highlighting the techniques that would be needed for recording HDTV, where sheer amount of data means that HD recorders will always need to use compression. John warned the audience to be careful of low-cost 'HD' camcorders, explaining why they may provide the right number of lines to be called 'HD', but that cheap lenses and small sensors may still provide poor, soft pictures. Once again expressing his preference for 720 lines, he explained that for recording purposes this system starts with fewer bits and therefore gives the recorder an easier life - for any given bit rate 720p is likely to give better results than other HD options.

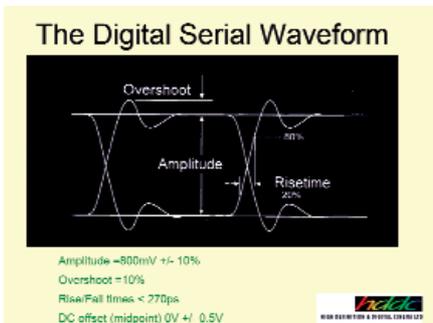
Group two assembled in 'Training Room 1', which bore a remarkable resemblance to the 'racks' area of the Digital Test Bed, where Stuart Somerville from Numedia Technology made good use of his many years of experience with Snell & Wilcox to give an excellent presentation using a large flat-screen monitor, examining



practical considerations affecting those wanting to use HD in and around the studio environment. Stuart began by presenting a big list of HD 'standards', just in case anyone might have thought that there was just one, and then used a first-class set of technical 'Powerpoint' slides that really showed the care that had been taken in the preparation of this course. The slides began with a comprehensive primer



on HDTV, and since they were also made available on a CD Rom, they will prove a really good reference source for those who attended the course.



Stuart then addressed the practicalities of interface standards, design issues, connectors and cables for HD, and explained about the use of test signals, testing techniques and the various type of testing equipment. The picture shows Stuart demonstrating the use of an optical



time-domain reflectometer to determine the return-loss of a hank of co-axial cable. He gave a good explanation of how digital audio is transferred along with the picture information, and showed how compressing multi-channel audio into one AES/EBU pair is becoming a very popular technique.

Stuart then went on to describe the techniques and potential pitfalls involved in the numerous types of video and film conversion. He explained how the different format conversions have different critical parameters, and it was interesting to hear about the particular problems that can arise when upgrading Standard definition displays to hi-def.

The high-bandwidths and low losses associated with optical fibre transmission mean that optical fibres are becoming more and more part of the video engineers armoury, and Stuart introduced Spencer Barr, an expert in fibre-optic techniques, who gave a wide-ranging talk on the use of fibre, saying that when digital signals needed to be sent for distances of over about 100 metres it often makes sense to use fibre. We were introduced to the idea of multiplexing 8 or 16 different wavelengths down the same single mode 1mm optical fibre, and shown a small drum which contained an incredibly 4km of fibre. The 1080i/25 signal from an HDCAM was then passed through the fibre drum, and the excellent results demonstrated, with waveform measurements being shown on the Tektronix WFM 700 HD.

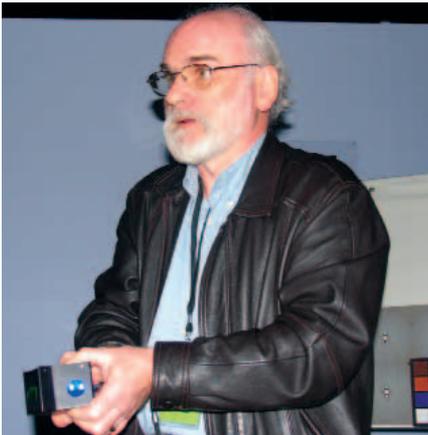
These practical demos resulted in a great deal of interest from delegates (several of whom had to be dragged unwillingly to lunch as the session went on much longer than planned), and many questions were answered on the use of fibre. Spencer gave lots of detail on data rates (a single HD signals at 1.485 Gbit/s presents absolute no problems over a distance of a few kilometres), testing, and the reliability of optical systems, explaining how fibres can be joined simply and



reliably using a fusion splicer. It surprised many to learn that although doing a fusion splice is well within the capabilities of a typical video engineer, the cheapest fusion splicers still cost over £10,000, which is half of the price being charged only a few years ago.

The hands-on practical theme continued as **Group three** were presented with a plethora of camera equipment to 'play' with. TV Consultant Alan Roberts, recently retired from BBC R&D, gave an in-depth explanation of the various types of HD camera that are currently available, identifying six categories including 'Cinema', 'Broadcast Studio/OB', 'Broadcast PSC', 'Prosumer', 'Consumer', and 'Specialist', and he explained the technologies behind each, the importance of different sensor sizes, sensor types and the requirements for the different usages.





He demonstrated how a dichroic beam-splitter works, and explained the use of colour test charts.

Alan looked at the requirements for studio and OB cameras, noting that any HD camera needs to plug into the existing studio fittings, and he ranked various cameras by their resolution and performance, explaining the different compression formats and the effects that these had when shooting a programme and when editing. The importance of using suitable lenses for HD was stressed, and Alan provided a quick optical primer, including 'gems' such as the proof that depth of field depends not depend on the 'f' number as is often stated, but, more correctly, on the overall image magnification.

HD includes the whole system from camera to viewer...

Alan took the group carefully through the various stages in setting up a camera, and I was interested and surprised to discover how much better the output pictures from the camera were after Alan had tweaked various parameters away from the 'out of box' settings provided by the manufacturer. His carefully designed software used the laptop computer to show the considerable differences in picture quality and the much wider range of lighting conditions under which the camera would produce

satisfactory pictures. There is obviously a great deal that can go wrong as you set up a camera, and Alan proved conclusively that his skills can enable you to get the best from the camera equipment that is available.

The group then readily took up the invitation to 'play' with the considerable amount of camera equipment that he had brought along, and many took the opportunity to talk with Alan about the changes in operational techniques that a move to HD would require. This opportunity was much enjoyed by numerous of those attending, some of whom felt that it was one of the highlights of the course.



Making the Panel work

If the panel of speakers had thought that their scheduled 'wrap up session' would be a brief formality, they were soon to learn otherwise. I have rarely attended such a session where so many people wanted to ask detailed questions as well as to make their own points. Questions and answers covered a wide range, from the theory behind the occurrence of Moiré patterning and what could be done to remove it, to discussions of HDCAM and the HDCAM SR recording system. There was general agreement that tape will still have a long term place for archiving, merely because it has massive capacity and is cheap, but other data recording systems will rapidly take over for most broadcast applications. HD monitors were another major topic of discussion, and it was pointed out that all the HD standards assumed that CRT monitors would be used, but that these are now disappearing from the market. The panel gave excellent explanations of the problems that the cheap scalars in modern flat-screens can cause. There are four types of chip set that go into most of today's monitors, and they were described as 'all broken!' To make pixel adaption work you need incredible processing



power, which isn't available in today's low-cost monitor designs. The frustrations of having unnecessary built-in overscan on pixel based panels were well aired, and it was only half-jokingly that one panel member said that it might be a good idea to start up a CRT factory! The different colorimetry from HD cameras, the effects of projection displays, and even Sony's GLV laser projector with its wider range of primaries (which we have covered several times in our journals) provided further subjects for discussion, and the 'HD with interlace' arguments were never going to end.

Cheap 'HD' cameras might give the required number of lines, but small sensors and poor lenses will ensure that the resulting pictures are just not HD...

All in all, then, a fascinating and very worthwhile 'intro to HD' course, which saw the delegates playing a full part and really participating in all the talks and the 'hands-on' sessions. Several delegates wanted these practical sessions to be longer, so perhaps this could be accommodated in future courses, the extra time being found by giving a little more HD focus to the theory lecture sessions. Peter ended by thanking all those who had taken part, stressing that the course organisers really would value 'feedback' from the delegates, and he 'trailed' the idea of a similar type of course focused on Digital Cinema technologies, to take place in spring 2006.

Jim Slater

Setting a camera

Lens Shutter	Shutters	Amplitude	Gain, LTR	AGC	Matrix	RGB to YCbCr	Display	Data format	Gamma Equation	Black stretch	Knee, Clip	Colour	LUT	Colour Balance	12-axis adjust	Output Register
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- There's a lot to get wrong
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