Jim Slater visited Dolby's Wootton Bassett facility and was not only allowed to see an impressive demo of the Dolby 3D system, but was able to have a poke around the 'in-nards' of an NEC digital projector to see just what is involved in converting a standard digital projector to the Dolby 3D system.

The Dolby solution to Digital 3D

The Dolby 3D digital cinema system has been demonstrated at several of the big cinema exhibitions over the past year or so, and we have carried a good deal of information about it in Cinema Technology, but this was the first time I had been able to get up close, and I watched a series of clips and trailers in Dolby's Wootton Bassett screening room. Nightmare before Christmas, Beowulf, Star Wars Episode 2, Chicken Little and Bugs 3D all allowed me to experience the effects of a wide range of different cinematic production values, and the selection provided everything from magnificent scenic images with huge depth of field to carefully controlled reverse zooms moving out from big close-ups to encompass impressive landscapes.

There were the occasional 'poke you in the eye' 3D gimmicks that you would expect, but by and large I get the impression that directors of 3D movies have moved on from such things, and are learning to use 3D as just another tool to provide the best images to get the message of their movies across to the audiences.

The clip from the U2 3D 'pop' concert was, however, quite a different experience - for some reason the 3D added a whole new dimension (yes, I know that is the whole idea!) and produced images of a pop concert that were very different from anything that I had seen before, and really did give a very different and exciting feel to the whole production.

Moving on from all this 'arty' stuff to what CT readers expect, let's remind ourselves about how the Dolby 3D system works, and that it uses passive glasses with any ordinary cinema screen, with no requirement for the installation of a special 'silver screen', since the system doesn't depend on the use of polarised light, but instead uses a technique based on the wavelength of light.

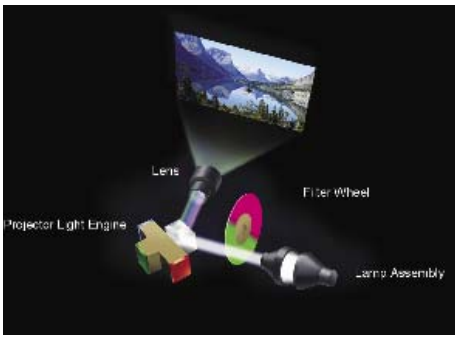
Dolby long ago realised that for digital 3D to be adopted widely, it will need to fit seamlessly into daily cinema operations, with operators wanting to open a 3D movie on the big screen, then move it around, just like they do with 2D releases. This means that it will be important that the system will work on screens of different sizes, and is practical and cost effective enough to support in several screens in a multiplex. It's also important that screens can easily be switched from 2D to 3D playback to preserve scheduling flexibility, and that the quality of regular 2D presentation is not compromised in a 3D-equipped screen, so it was a 'sine qua non' that the system must work using exhibitors' existing white screens. Dolby also considered it essential that the glasses be 'passive', to avoid any need to recharge units or to deal with customers complaining of glasses that don't work.

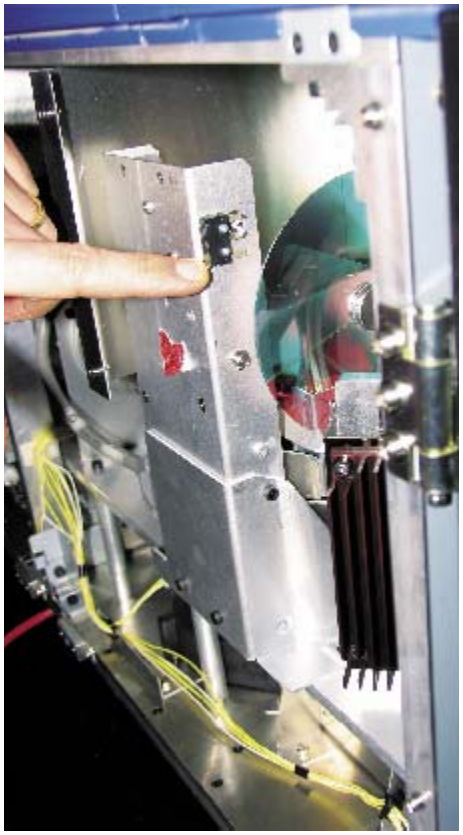
Dolby 3D uses a "wavelength triplet" technique originally developed by the German company Infitec, specialists in 3D visualisation for computer-aided design. In this technique, the red, green and blue primary colours used to construct the image in the digital cinema projector are each split into two slightly different shades. One set of primaries is then used to construct the left eye image, and one for the right.

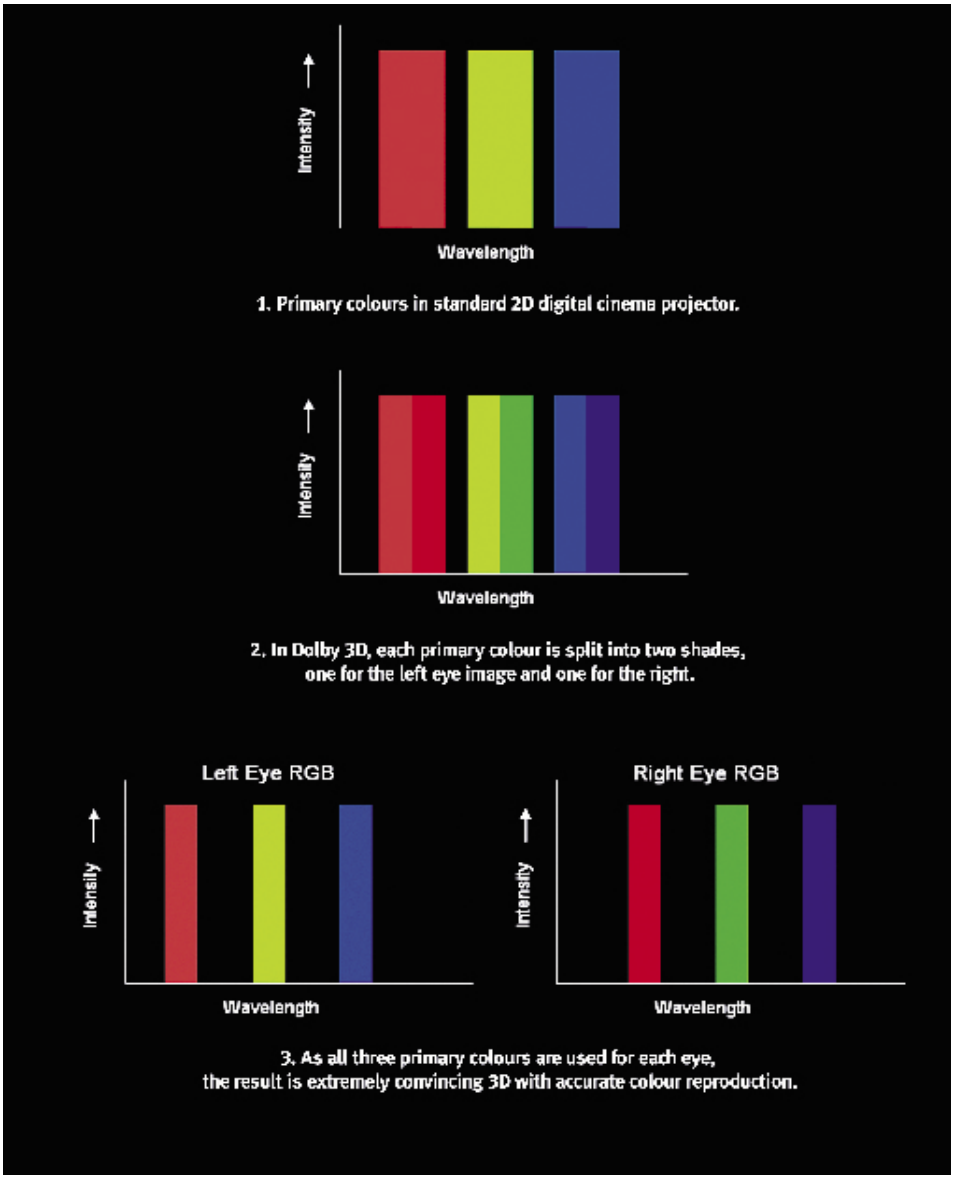
Very advanced wavelength filters are used in the glasses to ensure that each eye only sees the appropriate image. As each eye sees a full set of red, green and blue primary colours, the 3D image is recreated authentically with full and accurate colours using a regular white cinema screen. I can confirm that the technique yields very realistic and comfortable 3D reproduction. The lightweight glasses were of wrap-around construction, and although I twisted and turned my head and moved the glasses about, I wasn't able to find any of the problems with 'edge effects' that earlier versions of the specs had been reported as being prone to. In fact I understand that the only remaining problem with these glasses is their price - in an ideal world passive glasses should be cheap enough to be disposable, but the complex plastic optical filters used in the Dolby specs are expensive to make, with current prices around 40 dollars. The glasses utilise very precise wavelength filters that ensure that each eye sees only the appropriate image, and are constructed using 50 carefully-applied layers of coating to fine tune the exact response required. The current lenses are made of glass, but I would guess that if this system were to really take off, the benefits of mass production might one day lead to them becoming really low cost. I wasn't able to find anyone at Dolby who agreed with that view, though! It was interesting to discover that the company has given a lot of careful consideration to the benefits of re-usable glasses, and there was an interesting suggestion that regular cinemagoers in a 3D world might choose to buy their own 3D specs and carry them with them for all cinema visits, rather like we have our own tennis rackets or swimming goggles. Aside from the cost benefits of reusing glasses, an increasingly important consideration might prove to be the environmental impact of disposables – I was told that showing just four 3D movies on 500 screens could result in 690 tonnes of disposable glasses heading ultimately for landfill. There is lots to think about here.

In the Dolby 3D system, the primary colours are split by a relatively

The Dolby Screening Room at Wootton Bassett, with a close-up of the central console that allows the projection equipment in the adjacent room to be remotely controlled







simple filter wheel accessory (pic above) fitted inside the digital cinema projector.

This is inserted into the light path between the lamp and the DLP imaging chips, before the actual image is created. This will provide better quality images than the alternative approach of mounting a filter in the image path somewhere after the lens of the projector.

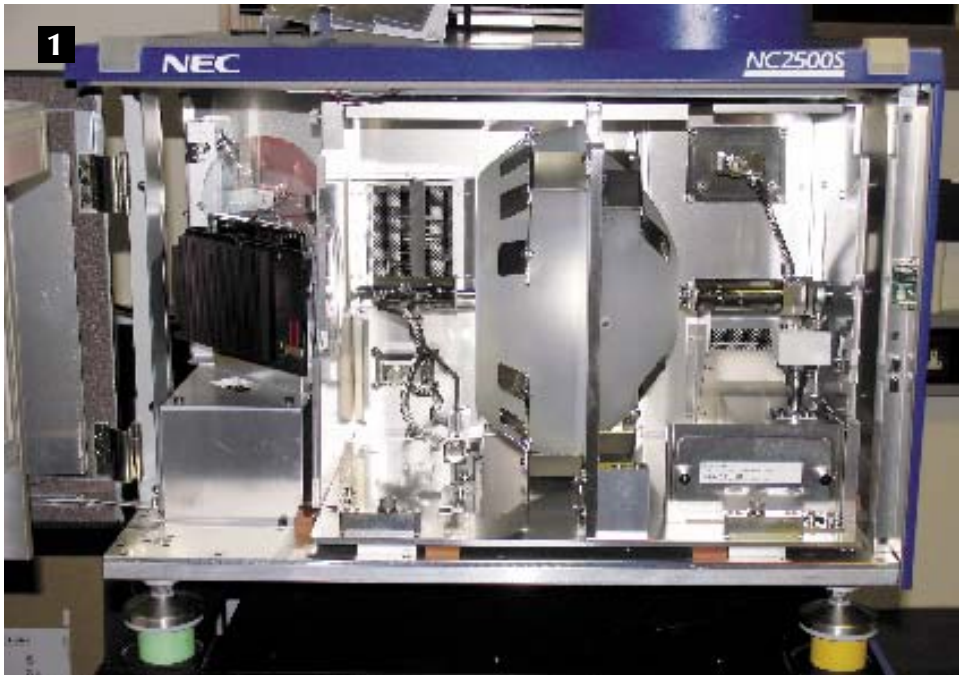
The filter wheel can also be moved in and out of place electronically, enabling automated switching between 3D and 2D playback. Passing the light through the filter wheel will obviously have some effect on the original colours, no matter how small this might be, and I wondered if this might mean that slightly different digital cinema masters might be needed for 3D and 2D versions, as with some of the existing polarisation-based 3D systems. However, the Dolby 3D system has been designed so that a standard 'unprocessed' 3D movie file can be used, with any additional processing required for the 3D version being applied in real time in the Dolby Digital Cinema server during playback. Effectively, a process of compensation for any effects of the filtering on left and right eye images is performed in the server, and an additional 1U high control rack is used to synchronise the operation of the filter with the projector and server.

As I saw, the resulting 3D images are sharp and stable, as the single projector is used to display the left and right eye images in sequence at a very high frame rate – typically 144 frames per second (72 for each eye). The images I saw came from the NEC 2500, which we have examined in previous issues of Cinema Technology.

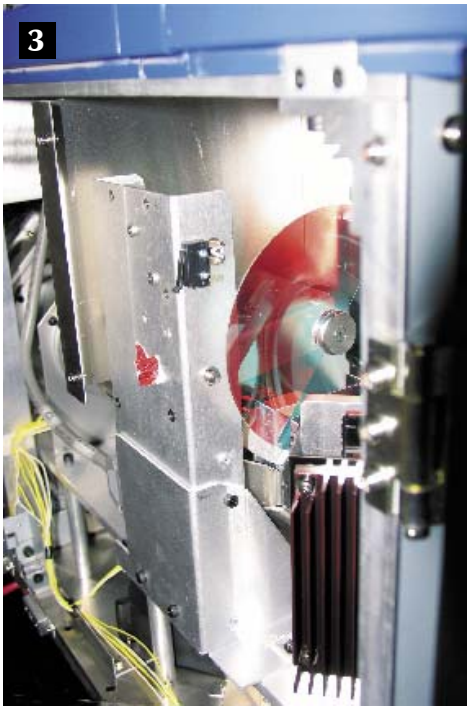
This was all well and good, and I had taken on board the idea and the advantages of 'simply' installing an extra colour wheel in a digital projector, which provides different colour correction for each eye, but somehow the engineer in me couldn't help wondering whether the conversion of a digital projector was quite so simple as had been made out. I asked how you go about modifying a projector for the Dolby 3D system, and was soon taken to the projection room where the side panels were taken off the NEC and I was able to take photographs of the mechanism and to see how it worked in practice.

The rotating colour wheel and its drive mechanism takes the form of a beautifully engineered electromechanical assembly, controlled from the projector's in-built Dolby Digital Cinema server, with synchronisation taking place via the 1U interface mentioned before, which can be seen here tidily fitted into the NEC's base unit - only a couple of wires are involved. It struck me as extremely fortunate that the NEC actually has room inside to take this extra colour wheel assembly, but, as can be seen from the photographs, everything fits in well.

I was told that it takes an engineer about a couple of hours to install the 3D assembly and its control electronics, and it was stressed that the colour wheel assembly and its control box are completely stand-alone, so don't affect the normal workings or warranty of the projector, and can be used on different makes of projector. After the mechanical assembly has been fitted, the colour wheel is synchronised with the projector by running a test program from a file, which allows the correct signals to be fed for each eye, and allows for cross-talk



Photographs:
1. Side view of the NEC projector - the extra 3D colour wheel can be seen top left 2. Side view of the NEC 2500 digital projector and its stand, showing the 3D Control unit 3. The Dolby Digital 3D colour wheel assembly fits snugly into the NEC 2500
4. Closer view of the NEC projector - the 3D colour wheel can be seen top left



to be minimised. I asked how they ensure that all the necessary DCI colour parameters are complied with, knowing how stringently DCI applies its specifications, although there isn't yet a compliance testing procedure in place, and was told that there are agreed reference 'look up' tables which are used to ensure compliance.

Having seen the way in which the 3D equipment was fitted to the NEC projector (it is obviously only so straightforward and simple because a great deal of thought has been given to the engineering of the assembly and to how it will be fitted) I asked about how it might be fitted to other makes of digital projector. I gather that work is ongoing in partnership with other digital cinema projector manufacturers to finalise the design of filter assemblies for use with their particular projectors - many Barco and Christie models already have kits available for converting them to Dolby 3D. Dolby envisage a modestly priced adaptor kit eventually being made available for each make of projector.

The results on the screen are excellent, the idea of being able to watch 3D with passive glasses on standard white cinema screens will appeal to many cinema managements, and the overall solution looks to have been well thought out. It will be interesting to see how the Dolby Digital Cinema 3D system competes in the ever-growing 3D cinema marketplace.

Jim Slater

Thanks to Jason Power and others at Dolby for their help in preparing this article, originally published in *Cinema Technology March 2008*.