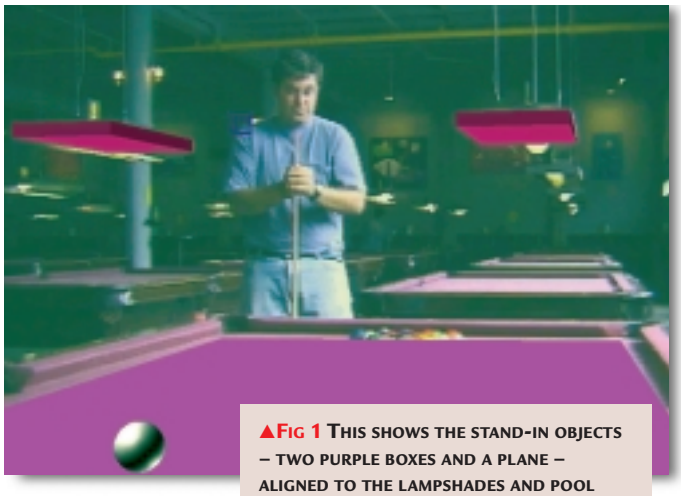
The big match

Benjamin Woolley hustles his way into a rather unusual game of pool using 3D Studio MAX.

One of the most exciting developments and rewarding applications in 3D is combining computer-generated objects with live action video or film. Until recently this has been the preserve of the professional effects house, but now it's spreading into the mainstream. This is partly because, as discussed in recent columns, it is getting easier and cheaper to get video in as well as out of your system (particularly if your equipment has digital connections), and it is also because 3D authoring software is beginning to catch up with this sort of application.

The higher-end packages already provide facilities to do this, so I thought I would try out the ones offered by 3D Studio MAX Release 3, to see how it worked and how easy it would be. I used the tutorial files supplied with the package, which involve creating a rather strange game of pool.



▲Fig 1 This shows the stand-in objects – two purple boxes and a plane – aligned to the lampshades and pool table surface in the background image, to help with camera matching

One of the most important issues to bear in mind before trying to mix together live action and computer graphics is that the live action material has to be shot specifically for this use. What you need is a sequence that fills two criteria: It must use a locked-off camera (ie one that does not move or zoom) and have simple foreground features. Having a locked-off camera is essential, otherwise you will have to animate your virtual camera to match the movements of the real one. This might be possible if the camera moves or zooms in a predictable, smooth fashion, for example if you have a computer-controlled rostrum shot (this is how it is done professionally, with the camera's co-ordinates and lens data being fed directly into the 3D software). It is nearly impossible if you are using the sort of wobbly, handheld, crash-zoom material the rest of us tend to generate with our camcorders.

As for foreground features, you have to bear in mind the need to create mattes or masks, so that any virtual effects you add to the centre-ground do not overlap the foreground. If you have a plant with lots of leaves in the foreground, for example, you are likely to have a heck of a job building an accurate mask.

The first job in combining computer graphics with live action is to create a virtual space that matches the physical space that was filmed as closely as possible. The easiest way of doing this is to establish several – MAX demands at least five – key reference points in a variety of positions in the physical space. You should then measure their positions as accurately as possible and use the data to build a virtual version of the space, with simple stand-in objects marking the positions of the reference points.

This sounds easy, but as I discovered, getting the match to work is not always simple

Now you import the first frame of the video you will be matching to, place it as the background in a perspective viewport, and try to align the virtual space with the image. This sounds easy, but as I discovered with Metacreations' Canoma, which uses the same principle to create 3D scenes out of 2D pictures, getting the match to work is not always simple. There are all sorts of variables that can mess things up. The most likely are distortions introduced by the camera lens or the conversion process, though you would hope that, if you are using digital video, conversion artefacts would be minimal.

Assuming that such problems can be overcome, you now have before you a viewport with a video picture in the background and some stand-in geometry floating over the top. By manipulating the camera's point and field of view, you can hopefully match one perfectly with the other [see Fig 1].

With 3D Studio MAX you align the scene using a special type of 'helper' object called a 'campoint'. In the tutorial example, you have two helper objects (simple boxes) with campoints set on most of the visible corners, as these are to act as the key reference points. These are then aligned to the corners of the overhead lamps in the background image. You then press 'create camera' and, *voilà*, a camera is automatically set up that exactly matches the perspective of the camera used to film the background scene.

Of course, it is not always a matter of '*voilà*'. In the tutorial example provided with MAX, we have a scene conveniently filled with rectangular objects (overhead lamps and pool tables). If the scene comprised more complex shapes, camera matching would be far more difficult. Often the way round this is to ensure you have an obvious ground plane which is as flat as possible, and a couple

of dummy objects with enough visible corners and straight edges to provide that all-important perspective information.

You could then mask out these dummy objects in the final render with foreground action. It is interesting to note that in the excellent BBC series *Walking with Dinosaurs*, which takes the mixing of video and virtual objects to a new level of sophistication, most scenes have a clearly identifiable and very flat ground plane. Obviously this is one of the keys to getting a good camera match in an otherwise complex image.

Another way to get a match is to import a frame of the video into a paint package and artificially highlight the reference points. You can then export that frame as a separate bitmap file (ensuring you keep the same resolution and aspect ratio as the original video) and use it as the background in the 3D software viewport when you are aligning the camera.

In the MAX tutorial example, the pool player in the background is using his cue to control a lump in the surface of the pool table – which blocks his competitor's cue ball [Fig 2]. It works very nicely as an idea, and has inspired at least this 3D artist to explore the area further, as has *Walking with Dinosaurs*.

◀Fig 2 Two frames from the final animation

■ Focus on depth of field

In the October column I looked briefly at the issue of adding focus to a virtual camera, and this prompted a lively correspondence from readers. One issue that came up was whether it was better if depth of field (DoF) effects (ie having things in and out of focus) were generated as part of the rendering process rather than added as a post-production effect. The software I used (Defocus Dei) added DoF effects in post-production.

Andrew Garrard has obviously pondered on this subject long and hard as part of his work for a British 3D graphics company called Advanced Rendering Technology. He came up with some interesting thoughts which he passed on to me in email (written, he was at pains to point out, in a personal, not corporate capacity).

He argued that with post-processing, artefacts (ie unwanted effects) can occur at the points where objects overlap. To illustrate his point, he wrote a little program that processed DoF as part of the rendering process. The result is shown in Fig 3. He thought that, had the scene been produced by post-processing, the sharp edges of the in-focus balls as seen through the blur of the out-of-focus balls in the foreground would be wrongly rendered. This is not so obvious in a still frame but, he argued, it would be in an animation.

▼Fig 3 The depth of field effects in this image were produced as part of the rendering process. Note the sharp edges of the in-focus balls are visible through the blurring of the out-of-focus balls. According to Andrew Garrard, post-processing software would probably not render this as accurately

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