Pulling faces

**Ben Woolley gets to grips with NURBS, which are about to hit mainstream 3D graphics.**

NURBS. It sounds like an expletive. It is, in fact, an acronym for Non-Uniform Rational (or Recursive) B-Splines, which is not much prettier and even less descriptive. Nevertheless, NURBS are now everywhere. Once, they only appeared in top-end 3D products such as Softimage. Newtek's Lightwave has them, but they did not reach Kinetix's 3D Studio MAX as a standard component until version 2. However, they are now beginning to migrate downmarket and the latest release of Caligari's trueSpace version 4 features a basic but effective implementation of them. NURBS, in other words, are about to join the 3D graphics mainstream.

So what are they? Technically speaking, they are mathematical entities used to describe the geometry of a curve or surface. 'Rational', for example, refers to a property of the equations used to generate them. 'B-splines' (basis-splines, in full) are a method of constructing curves: Bézier curves, familiar to anyone who has manipulated the shape of a curve using the two handles either side of a vertex, are a sort of B-spline. In simpler terms, NURBS are shapes or surfaces that can be sculpted like pieces of elastic using control points scattered across their surface. This makes them ideal for creating curvaceous objects. They are frequently used in product design, for example to design the bodywork of a concept car, but can be used for more organic shapes.

The example shown in Fig 1 is a face created by using NURBS. It is a version of a model supplied with the excellent but expensive Inside 3D Studio MAX 2. The shape itself can be generated in a number of ways, in this case possibly by using a primitive (a sphere) and then converting it into a NURBS surface.

Once converted, you no longer have a collection of faces and vertices but a lattice of 'control vertices', or CVs (in 3D Studio MAX-speak). These hover like a sort of exoskeleton above the surface, shown as yellow in Fig 1, and the CVs

are at the intersections of each line. By selecting a single CV, or a group of them, you can manipulate the shape. CVs do not necessarily sit on the surface of the object they control but often hover above it. As you tug them out, they pull away from the surface like magnets being
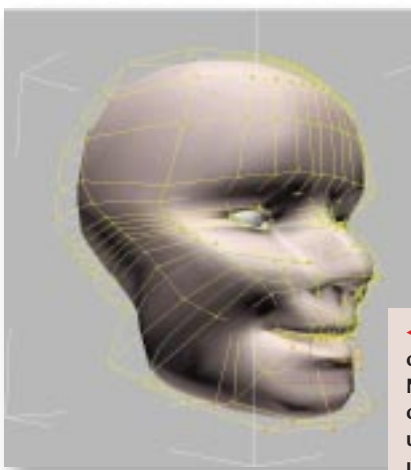
◄ **Fig 1** **A 3D** head created using **NURBS. The lattice of yellow lines is used to manipulate its shape**

pulled away from the surface of a pool of mercury. CVs can also be given different 'weights' which influence the pull they have on the surface they control. A higher weight produces a stronger pull.

NURBS modelling is a bit like clay modelling. Using the CVs, you press in and pull out bits of the object, gradually refining it into the shape you want.

Following the example in the 3D Studio MAX 2 tutorial, I tried to open and close the mouth of our Fig 1 model face. Compared with conventional techniques for editing meshes, using NURBS made this relatively easy. The biggest challenge was choosing the right CVs. I selected the ones clustered around the lower lips and jaw. Then, by moving the selected CVs down and rotating them slightly, I produced the results shown in Fig 2.

I also tried a little plastic surgery on other parts of the head — reducing the size of the nose, the prominence of the chin, and so on. These attempts highlighted one of the difficulties of editing using the CVs. Any transformation (movement, rotation, scaling) applied to a selection of CVs obviously applies equally to all of them. Unfortunately, with an entity as elastic as a NURBS object, what you really want is some form of soft-edged selection which applies transformations to CVs with less force on the edge of the selection than in the centre. Using 3D Studio MAX, you can achieve something like this by lowering the weight of the CVs on the edge of the selection set. However, this is a complicated process which does not always produce the anticipated results.

FIG 2 Sequence (*left to right*) showing the animation of the head's jaw dropping

I spent some time using NURBS both with 3D Studio MAX 2 and trueSpace 4, and the experience was an instructive one. 3D Studio MAX's implementation of the technology is complex and poorly covered in the documentation. The attempt to give the user as much flexibility as possible has resulted in a very unintuitive set of tools which I was unable to master even after a week or so spent struggling with them.

In contrast, trueSpace made the whole process simple: create a rough outline of an object, turn it into a NURBS surface with the click of an icon and start fiddling with the geometry using the simple point-editing tools.

Both packages crashed spectacularly while I was using the NURBS tools and 3D Studio MAX managed to bring the whole system down. This may have been because these are new facilities in the software and the code has not yet been fully debugged. I suspect it may also have something to do with the extremely complicated mathematics underlying the technology. Whatever the cause, you obviously have to proceed into the world of NURBS with some caution and a lot of determination.

Out and about

The conference season began last November with two graphics shows: one in the UK, the other spread across the globe. The former was Digital Media World (Britain's attempt at a SIGGRAPH) held at the Wembley Conference Centre. This year's line-up included an interesting range of

NURBS: useful books

- *Inside 3D Studio MAX 2* by George Maestri *et al*. Published by New Riders. The chapter on NURBS is in Volume III, which costs £34.59.
- *The Nurbs Book* by Les Piegl and Wayne Tiller. (Springer, £56).

- *Interactive Curves and Surfaces: A Multimedia Tutorial on Computer Aided Graphics Design* by Alyn Rockwood and Peter Chambers. Published by Morgan Kaufman, £35.66.
Prices quoted are from amazon.co.uk

speakers, including the artist Gerald Scarfe. However, the exhibition itself featured no major announcements, reinforcing the feeling that if you want to go where the action is, you have to go to SIGGRAPH in Los Angeles — a more inviting venue than Wembley, anyway.

A more interesting and innovative event was Avatars98, a truly virtual conference; the primary venue being a

generated using ActiveWorlds technology (covered in the February 1997 column, and also see www.activeworlds.com for details). Showing a slight but probably sensible lack of imagination, the organisers created a space that looked like a cartoon imitation of a conventional exhibition hall [Fig 3]. The main difference was that delegates could be found floating around in the air, or

◄ **FIG 3** THE AVATARS98 VIRTUAL EXHIBITION HALL

◄ **FIG 4** 'SUMMER' BY VICTORIA D'ONOFRIO AND RODY GALEANO, WINNER OF THE AVVY AVATAR OF THE YEAR AWARD

wandering along the aisles. The highlight of the show was the Avvy Award, announced online at one of the virtual stands, for the best design of avatar. The winner was 'Summer', by Victoria D'Onofrio and Rody Galeano of My2Keys and Netropolis [Fig 4].

At the time of writing, there was a report on Avatars98 at www.ccon.org/conf98/index.html.

shared 3D space created on the internet. There were ancillary physical venues, too, located in a number of different countries. As the name indicates, the focus of Avatars98 was avatars, the 3D figures which act as your virtual presence when you enter a shared space. The show also dealt with other aspects of creating and maintaining virtual worlds.

The venue for Avatars98 was

PCW CONTACTS

Ben Woolley can be contacted via the PCW editorial office (address, p10) or email 3dgraphics@pcw.co.uk