Not only computing – also art

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I see your face before me

Progress is continually being made in the computer graphical representation and rendering of objects of all sorts. This work entails dealing with both the form and the surface appearance of the objects. Not surprisingly, the biggest strides have been made in delineating man-made objects – like machined parts for instance – in smooth, glossy materials such as plastic, metal and glass. The forms of these objects can often be described by rotating a cross section around an axis or by 'extruding' a 2 D shape along a line: processes which are collectively known as 'sweeping' (Figure 1). Alternatively, many complex forms can be made up by adding together simpler primitive forms such as cubes, spheres, cylinders and so on using a technique which has come to be known as *constructive solid geometry* (CSG). In both these cases, the computer representation to some extent echoes the way in which objects are made in the real world.

The smoothness of such objects can be shown by shading them in fine gradations of tone or colour and their glossiness depicted by the inclusion of bright highlights calculated with formulae derived from fairly well understood physics. Recently, also, great progress has been made in depicting convincing images of natural objects such as trees, rocks, mountains, coastlines and so on. Generally this has been done by use of fractals – Benoit Mandelbrot's mathematical invention which I've mentioned several times in these pages. Indeed, we can almost conclude from press articles on the subject that more computer time and programming ingenuity has been spent on rendering photographically realistic pictures in the last few years than on devising systems to deal with life-critical subjects like medical imaging or air traffic control.

However, despite the enormous progress that has been in some areas of representation and rendering, depicting the human body and its parts still has to be seen as the major challenge in computer graphics. Making convincing computer pictures of the human face is especially difficult. As long ago as June 1976 in Not Only Computing (actually when the column was called 'Not Quite Computing – Almost Art') I touched on the computer graphics work on faces by Frederic Parkes then at Case Western Reserve University, Ohio. Since then some striking developments have been made in a number of quarters. fatigable Canadian husband and wife team, Nadia Magnenat-Thalmann and Daniel Thalmann of Montreal, who have contributed so much to computer graphics. Their short prize winning film, *Rendez-vous a Montreal* made a year or two ago shows an animation of a beautifully delineated, but synthetic, Marilyn Monroe meeting an equally synthetic Humphrey Bogart and having a properly lip-synched conversation with him. Try and see this film if you can. It is an ingenious and witty way of illustrating research results. Englishman, Brian Wyvill and his colleagues at the University of Calgary have also developed a facial model which shows considerable promise. The works of both Canadian sets of researchers as well as that of the highly productive French team, Monique Hahas and Herve Huitric – based on manipulating B-spline control points – are covered in March 1988 issue of *The Visual Computer* and make fascinating reading.

Over here, Keith Waters of Middlesex Polytechnic is looking at facial modelling too although his research takes a rather different line to that of most North American workers. There are essentially two methods of animating facial expressions. One, as in Parkes' original approach and that of conventional 2 D animators, is the earlier method of devising key frames of the 'peaks' of movement then interpolating between them. The other is the more recent and more computerly idea of parameterisation, where a geometrical model is devised and its

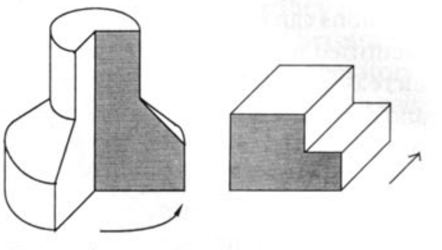

Figure 1

parameters dynamically varied to suit specific needs of the expression to be imitated. The latter approach is used in Parkes' later work and forms the basis of most of the current efforts. Keith has also chosen the parameterisation approach but he models not just the surface form of the face but also its underlying muscle structure. His parameters control the movement of groups of modelled muscles which pull or squeeze parts of the face in ways which conform as closely as possible to anatomical realities. The advantage of this approach is that a more general model can be devised to deal with the often subtle but universal changes that occur in facial expression when we show happiness, fear, disgust and so on. This basic model can then be applied to the form of the actual face being depicted. Figure 2 shows the results of applying the structural model to show a representation of one of the six types of emotion that have been studied in some detail.

Keith outlined his work to date at the regular yearly joint meeting between the Displays Group and the Computer Arts Society in December and showed some striking examples of his work. Anyone who followed the BBC TV series 'Welcome to my World', hosted by Robert Powell will

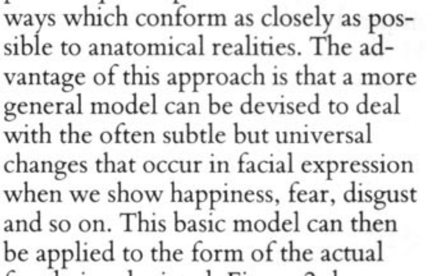

Figure 2

have seen Keith's fully rendered, animated and lip-synched facial modelling of the narrator. Figure 3 gives a flavour of this. For more details, see *ACM SIGGRAPH Computer Graphics* (21) 4, July 1987 pp 17-24 and *Realism and Visualisation*, BCS Displays Group Conference Documentation, December 1987.

Keeping on course

I am frequently surprised how often in these columns I come back again and again to the same set of names of artists and researchers. Mandelbrot, Keith Waters, Frederic Parkes, Brian Wyvill, the Thalmanns, and so on have all been mentioned at various times before. This repetitiveness, of course, expresses my own particular preoccupations and interests. It also follows from the way in which people persevere with and develop their work over fairly long periods of time. The work of one particular painter has appeared and reappeared in these pages like a recurrent theme over the years. He is Manfred Mohr: undoubtedly the best and most prolific computer artist working today and one whose paintings are in the same class as those of the finest conventional abstract artists.

Manfred, who now lives and works in New York, keeps me informed of his progress by sending me catalogues of the regular exhibitions he has in Europe and North America. One of the most recent of these, under the title, *Fractured Symmetry*, was held in December at the prestigious Wilhelm-Hack-Museum at Ludwigshafen am Rhein, Germany and has been illustrated with a lavish 120 page booklet which should be in the hands of anyone interested in modern art.

Since 1969, Manfred has been systematically exploring the potential of what he calls Algorithmic Art – that is, art which is generated from some step-by-step, programmable process. For some time now this exploration has been concentrated on the simple but imaginative idea of manipulating various views of the cube. However, as pointed out in an excellent introductory critique of Mohr's work in the catalogue by Richard W Gassen,

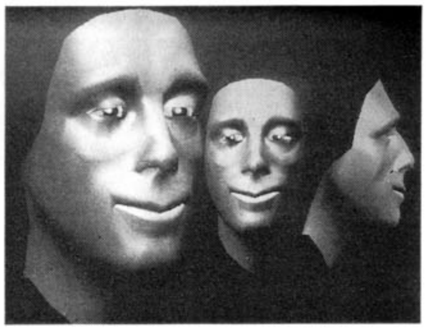

Figure 3

this interest has not been in the realistic form of the cube but in its '. . . system of line relations'. By starting, say, with a wire frame view of a cube, we can cut it into parts and rearrange these to give us a picture which has all the elements of the original but which adds a new meaning to the lines making up the form (Figure 4). We still see something of the original cube: the way three lines meet at corners and the angles that these make with one another, for instance, but the cuts and displacements make us look at what we see in a new and unexpected light. As with most good ideas in art, this one seems trivial after one knows about it. However, it has enormous visual potential and what Manfred has done is to recognise this before any of the rest of us. The sparseness of the imagery is also significant. The lines dominate the spaces and, despite their incompleteness, they firmly enclose the blank areas – a phenomenon which arises from the Gestalt way in which we see images (Figures 5, 6, 7).

Manfred Mohr is an important artist and his work should be better known in Britain. It is a shame that, except for showings in Computer Arts Society exhibitions, no gallery in the UK has followed the example of Germany, France, Belgium, Canada and the US and had an exhibition of his work. Recognition here is long overdue.

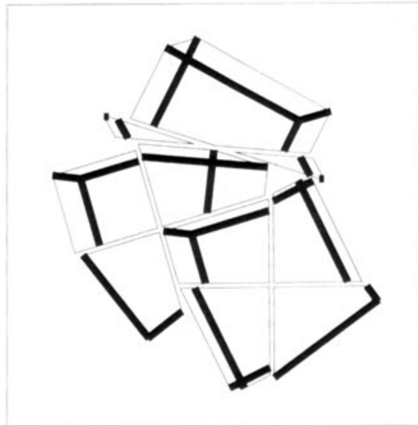

Figure 5

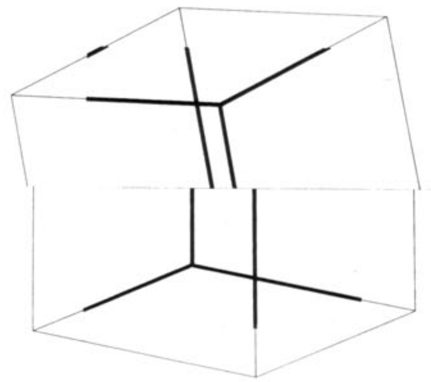

Figure 6

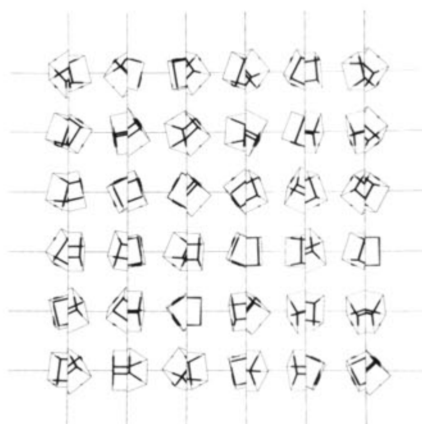

Figure 7

Figure 4