# What s Cooking at Eidos?

This month Eidos founder Stephen Streater talks about his company and their exciting development work in the video

The Computer Concepts Eagle Card uses a codec designed by Eidos

For a long time, computers could handle words but not pictures. The ability to process photographs led to the desktop publishing explosion of the last decade. With the steady advances in computer power, it has been inevitable for some time that computers would become fast enough to tackle real-time video. At some point, video editing software for multimedia presentations would become as common as DTP software is today.

I had been working in the field of image processing for many years, and as I was finishing off my PhD in Artificial Intelligence and image recognition, I was looking for an application of the experience I had gained in the commercial environment. I founded Eidos plc in 1990 to use as the vehicle for my work in this area. These technical advances were to be catapulted into a computer market undergoing a revolution as dramatic as that of desktop publishing a decade earlier - the arrival of video on computer.

Most high-tech companies in the UK are under-funded. My financial advisers recommended a stock exchange flotation to overcome this problem. We raised £1,000,000 using the rare device of a Green Field flotation on to the Unlisted Securities Market (USM) of the London Stock Exchange. This is the section of the stock market where Acorn Computer Group plc are listed, and it is designed for small, high risk companies. With just over the necessary 100 shareholders, we signed up on Friday November 30th 1990. Being a quoted company has strengthened our position considerably - for example, we raised additional capital with two small share issues last year.

For independent technical advice, I asked the legendary Roger Wilson to come onto our Board as a non-executive Director to advise on strategic developments. Roger's technical

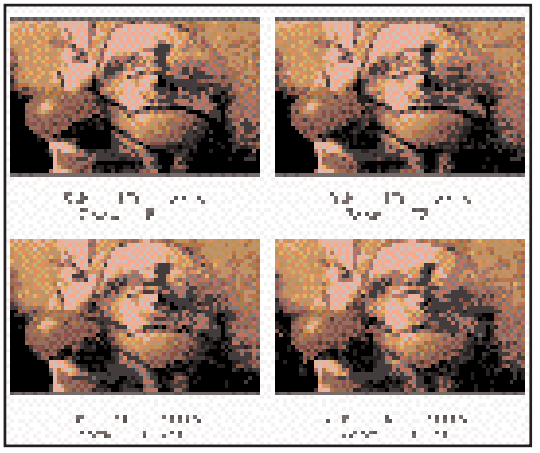

Acorn Replay was written by Roger Wilson, who is now a non-executive director of Eidos

advice has helped to keep Eidos at the leading edge of technology. All our products use Acorn machines, and we are now starting to sell directly into the Acorn market. Martin Coulson, the Atomwide wizard, joined us as a


MPEG is the industry standard video format

Consultant.

Nick Davies, our former Applications Director had been working in the professional video editing market for some time. He had the vision to recognise the benefits of a computer in his market. Videos are made on cheap equipment at poor quality, before the final product is re-mastered at broadcast quality. This is a similar process to that of DTP on screen at 72 dots per inch (dpi) followed by final publication at 2400 dpi.



Fractal image compression provides impressive compression which can be adapted to use in video technology

Although the professional video editing market suffered its worst recession ever as soon as we started, and despite the conservatism of UK consumers and unwillingness to move away from the old tape formats that they had come to know and dislike, Eidos technical progress continued rapidly. By 1993, we were well placed to expand out of the narrow field of professional video editing, and into much wider markets based on our video compression technology. I brought on a new Managing Director, Charles Cornwall, to help cut the deals, followed by two technical gurus, Simon Protheroe and Brian Brunswick. We are now well placed to exploit the advances in technology we have made over recent years.

Eidos is now one of the world s leading software video compression houses - it out-performed every other share on the London Stock Market last year. This article explains the market and the technology in which Eidos operates.

THE PROBLEM

People have been able to play back sound and show still pictures on computers for some time now. However, video has remained a difficult problem to crack. To see why this is, consider the data rates for sound and pictures.

CD quality audio is sampled at 44,100Hz at 16 bits per sample and in stereo. This corresponds

to a data rate of 1,411,200 bits per second (bps). By sampling at a lower rate, sound quality will still be reasonable, and more data will be available for moving images.

In the UK, broadcast quality video has 25 frames per second (fps), each consisting of two fields. Each frame has a resolution of 768 by 576 pixels, with colour about 24 bits per pixel (bpp) RGB. This corresponds to 265,420,800 bps. Film is even higher quality, say 4000 by 1600 pixels at 30 bpp, 24 fps equivalent to 4,608,000,000 bps. So, to store a typical two hour feature film would need 4,000,000 MB of disc space. This would take about 100 years to send down a fast modem.

THE SOLUTION

The solution to the problem caused by these huge numbers is compression. But although radio, TV and tape formats sold in the consumer market use analogue technology, most compression techniques are based on algorithms which can only be implemented on a digital computer. Because bandwidth is limited, there is more and more pressure to use digital signals and digital compression techniques to allow computerised video communication and storage.

There are three constraints which limit the performance of a compression algorithm: compression time, data rate and picture quality. The best compromise depends on the application.

In a CD-ROM system, compression is performed only once, but playback may be performed millions of times. It makes sense to relax the limits on compression time, and use non-real-time compression, but aim at the highest possible picture quality. The Moving Lines compression algorithm designed by Roger Wilson at Acorn for Acorn Replay is aimed at this market.

In a telecommunications environment, like a video phone, the compression must be real-time and the data rate must match the network (ISDN 2 at 128kbps or PSTN at 14.4kbps) which means that the quality takes all the slack.

HARDWARE VS SOFTWARE

Compression can be carried out either in hardware or software. The main advantage of the former solution is that it can achieve very high picture quality. The biggest problems with hardware are that it is expensive and time consuming to make. To design a chip can take many years, and so hardware manufacturers insist on standards. Unlike a software solution, where the computers can be easily reprogrammed, a hardware solution relies on an inflexible algorithm. This means that incompatible hardware solutions cannot be used together, whereas decompression software can always be included with the compressed video.

The Eidos approach is quite different. We use an accepted standard - the computer. The decompression code can be ported easily and moulded to the particular application. RISC processors are ideal for video processing, because their efficient and flexible instruction sets are well suited to a software approach. Computer upgrades continue relentlessly. Even cheap computers will be able to play back VHS quality video in software. The ARM 610, costing only $20, is currently the best chip for fulfilling this promise. A $100 MPEG hardware playback solution, with no decompression facilities, will soon be obsolete.

HOW COMPRESSION WORKS

When compressing a text file, all the information contained within it must be preserved, so it needs a loss-free compression algorithm. With video, the decompressed image usually only has to look similar to the original. Also, in practice, limitations on storage mean that there is no option but to reduce the quality.

Typical videos are representations of the real world, so compression can be designed so that these videos compress well. Many things which happen can be predicted. Only information which cannot be otherwise reconstructed during playback need be stored. The better the computer is at understanding what is going on, the more compressed the video can be.

Images contain smooth areas, which can be compressed independently of any other frames in the video. This is called intra-frame compression. Also, if there are repeated references to the same object, they need only be stored once.

Video frames represent scenes which are very close together in time. This means that very little happens between consecutive frames. If something is moving at 10 pixels per frame, its new position can be predicted with a high degree of accuracy. This inter-frame compression reduces the data rate by many times as only differences between frames, or delta frames are stored. To facilitate starting playback in the middle of the video, complete key frames occur every now and then.

Developers have to be aware of how the eye and brain perceive video to make the information thrown away as imperceptible as possible. One example of this is that, although the eye is very sensitive to what colour something is, it is not very sensitive to where this colour is, particularly on fast moving objects. A typical video compression algorithm will have reduced colour resolution.

## COMPRESSION STANDARDS

Most standards do not define how to compress a video so much as what the compressed bitstream must look like. Thus a decoder can read any standard format file. Each video supplier can decide on the quality and resolution of the video. For any given data rate, different implementations vary widely in image quality.

Experiments show that people find it more important for images to look realistic, than for them actually to be accurate. Although this sounds surprising, my experience confirms it. Furthermore, people tend to believe that the appearance of analogue VHS means high quality. The Joint Photographic Experts Group (JPEG) compression method was designed to achieve this.

The Movie Photographic Experts Group (MPEG) format is like JPEG but is adapted for moving pictures. It includes motion estimation and can make use of the relationships between frames. Compression usually takes a long time, but dedicated systems have come down in price from £500,000 to £20,000. Playback boards are much cheaper - between £250 and £1,000 depending on the volumes.

H261 is the poor man s MPEG. It is designed for real-time compression as well as decompression, and for low bit rates. It is being used in ISDN videophones at 128kbps.

Fractal compression is based on the assertion that parts of a scene are self-similar. Finding the relationships is time consuming, but replay can be real-time. The principles behind it are interesting, particularly to someone who has a deep interest in fractals.

Video is now so important that computers have standard architectures which allow video encoders and decoders (codecs) to be added. The Eidos codec currently runs under Acorn Replay and Video for Windows.

## ACORN PRODUCTS

So what is possible today in software on an Acorn computer?

With real-time compression we achieve:

- about ¼ resolution VHS colour (160 by 128, 15bpp, 12.5 fps) at ¼ to ½ CD-ROM rates of playback
- ¼ VGA resolution grey scale (256 by 256, 5bpp, 3-12fps) at 64kbps

With compression rate limited we achieve:

- PSTN modem (14.4kbps)
  - up to 10fps, 256 by 256 eg. videophone working on normal telephone lines
  - up to 4fps, 512 by 480 eg. security system
- ISDN 2 (128kbps)
  - up to 18fps, 320 by 240, colour + sound eg. videophone and video conferencing
- CD ROM (1.5Mbps)
  - VHS quality

With fixed quality we achieve:

- Quarter VHS resolution (160 by 128, 32,768 colours)