



The mechanics of multimedia science. Three frames from a *Nanotechnology* article, thought to be the first genuine research paper, from a science journal made available on the World Wide Web, to feature multimedia video of an experiment

The Video Laboratory

Lynton McLain delves into the hypertext jungle of multimedia publishing and encounters video. But the right plug-in is a more difficult animal to track down

"I shall claim here, as I always have done on these occasions, the right of addressing myself to the younger members of the audience – and for this purpose, therefore, unfitted as it may seem for an elderly infirm man to do so, I will return to second childhood and become, as it were, young again among the young." (Michael Faraday, *Lectures on the Various Forces of Matter*, to an audience of children at the Royal Institution, London December 1859.) Michael Faraday, one of the greatest experimental scientists of the 19th century, was perhaps the first to take his experimental message direct to his audience by becoming, in effect, one of the audience.

Faraday was saying he was going to get into the minds of his audience by "becoming" one of them; he was going to present his lecture bearing in mind the knowledge and experience of his (young) audience. By so doing he was able to approach his subject not from his perspective but from the perspective of the audience and, conversely, the audience was able to approach the subject not from their (limited) perspective but from the perspective of the lecturer, for he had become "young again among the young." Audience and lecturer

were putting themselves in each others' mental shoes. The best lecturers still practice the Faraday approach.

Away from the lecture theatre in the world of the electronic scientific paper scientists now have the means to place the readers inside their mental shoes, to have the reader, perhaps a scientist on the other side of the globe, sit alongside them, in some cases as fellow experimentalists, at least as observers watching and sharing results of an experiment unfold on computer screens.

Several variants of this new form of scientific publishing and communication exist, including surgical operations viewed and commented upon at a distance, as at University College Hospital, London under the Interactive Surgical Teaching Between Remote Centres project.

Potentially, the most widely accessible technique is the use of multimedia in scientific papers. Pioneering work in this field of publishing has been carried out successfully by the Institute of Physics Publishing. Since 1996, all 33 scientific journals published by the IoP have been available electronically and in conventional paper form. The text is identical and

those who subscribe to the paper journal get the electronic version at no extra cost. Three IoP journals, starting on a trial basis in 1997, will have online multimedia in electronic versions of the journals. Authors for *Combustion Theory and Modelling*, *Nanotechnology* and *Journal of Micromechanics and Microengineering* are encouraged to submit two types of multimedia material: video clips and supplementary data or figures.

The printed journal will remain the archival version. One important reason for this is that, at present, in the UK at least, the research assessment exercises carried out by the Higher Education Funding Council are based only on printed research papers. Papers published only electronically are quite simply not assessed.

The IoP approach to the new media is that multimedia items should be supplements which enhance and complement a reader's understanding of a paper but which are not essential to that understanding. In other words, the printed journal contents will be prepared conventionally, to stand alone, but with references to any multimedia supplement.

Gaetano Continillo, of the Instituto di

New Video in Sight

Optics Express, an online physics and engineering journal with no print version, has just been launched in July by the Optical Society of America (OSA), offering authors the opportunity to include video clips and animation, and "high-quality colour graphics at no extra cost", writes Toby Chapman.

The fortnightly journal is peer-reviewed as normal, but has no subscription fee to keep it easily accessible to anyone anywhere in the world near to an Internet connection. The journal will be free to authors, too, in 1997 but its publishers will charge authors from 1998 in line with print costs in paper journals.

The OSA hopes the new journal will benefit from being electronic, eliminating copyediting and printing delays to save time and money. It should eventually also allow readers to search for information more easily, with electronic links to references, other journals and a search engine for keywords.

Optics Express covers all fields of optical science and technology (eg medical optics, non-linear optics, detectors). Issue 1 features a demonstration QuickTime movie and animated Java applet.

Its editor, Joseph Eberly, has high hopes: "I'll be quite surprised if there aren't close imitators being developed within a year, at most." See epubs.osa.org/optics-express.

Ricerche sulla Combustione, Naples, Italy the multimedia editor of *Combustion Theory and Modelling* launched in March 1997, says in his first editorial that the decision to make the multimedia material available through the Internet rather than to supply it with the printed journal was taken at the outset. He identified three questions relating to multimedia on the new journal which have relevance for the use of multimedia generally in scientific publishing.

As a combustion scientist and prospective contributor how would he benefit from multimedia in communicating the results of his studies?

How should multimedia contribute to, and ultimately result in, an improvement in the quality of technical information conveyed by the journal to its readers?

What guidelines should he, as multimedia editor, follow in evaluating multimedia additions submitted to the journal?

Continillo makes the point that some scientists place the greatest value on the aesthetic, mathematical aspects of a theory or model. Other combustion scientists, however, believe that an important goal of

a theory, or model, is to offer a representation of 'reality' as perceived by people through their senses. This can be achieved with multimedia. "The translation of results of a theoretical or numerical study into a representation of a physical system is often seen as something useful, if not necessary, in that it can be understood easily by scientists regardless of their background in the specific methodology used," he said.

This form of communication could facilitate exchange of ideas between quite different disciplines despite each having its

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own formal language, and could excite students who do not yet possess the technical skill of senior colleagues but who are fascinated by this way of representing results. "These considerations are sufficient to provide the motivation required to produce multimedia material," Continillo said.

The innovators of multimedia scientific publishing believe their creations must conform to certain guidelines. Multimedia material should be (thought of) as archivable material, in other words it must "communicate a sense of formal completeness, be essentially self-contained, and make reference only to archival material," Continillo suggests. The desire for archival references inevitably comes up against a shortage of such material in these early days of multimedia scientific publishing, but supporters are optimistic that this will change rapidly.

The multimedia objects conceived so far have been created for the World Wide Web. This requires the objects to be 'light' in digital terms - small in storage requirements. This is necessary for the practical reason that the Internet access can often be painfully slow for people downloading multimedia and other programme items. The appearance of multimedia items also requires careful consideration of hypertext links, and the way that material can be presented which makes the best use of the multimedia format, in ways that reflect the difficulty of reading and understanding long passages of text *continued on page 111*

from page 109 on a computer screen.

The knowledge of how material is best assimilated from a screen, as distinct from a printed journal, is based more on pragmatism than on a rigorous intellectual understanding of what is the most successful approach to screen-based communication. And as with journal design there are unlikely ever to be such hard and fast guidelines that innovation is squashed.

Already, scientific publishing has some stunning examples of multimedia enhancements to printed scientific papers. Selected parts of the September 1997 issue of *Nanotechnology* from the Institute of Physics is already – in June 1997 – available electronically, months ahead of its paper version. The screen version is available at www.iop.org/Journals/na and is quite readily accessible once the multi-layered nature of the Web has been mastered.

Nevertheless, there is concern among some users that many forms of multimedia and World Wide Web technology still require a “non-negligible” technical awareness, as Continillo puts it, and a substantial amount of preparatory work. I can confirm that a “non-negligible” amount of technical awareness is required to access some of the innovative multimedia work presented as supplementary material with some scientific journals. In a search for the *Nanotechnology* multimedia work already online from the September journal everything went swimmingly well, up to a point.

I sped through the home page and its hypertext links, coasted up to the “Now Available – Multimedia Enhancements ★New” section. This revealed that “*Nanotechnology* now offers exciting multimedia features. Papers published in the next issue of the electronic journal incorporate MPEG videos of molecular simulations – one of these papers is freely available from the Featured Articles section below.”

What came next – via the red M for multimedia button – was the promise of a stunning scientific paper on Molecular dynamics simulations of carbon nanotube-based gears, by Han, Globus, Jaffe and Deardorff from the NASA Ames Research Centre, Moffett Field, California, USA. The subject matter was dramatic and the prospect of viewing it online in *video* form was surely a treat in store.

“We use a molecular dynamics simulation to investigate the properties and design space of molecular gears fashioned from carbon nanotubes with teeth added via a benzene reaction known to occur with C₆₀. A number of gear and

gear/shaft configurations are simulated on parallel computers. One gear is powered by forcing the atoms near the end of the nanotube to rotate, and a second gear is allowed to rotate by keeping the atoms near the end of its nanotube constrained to a cylinder. The meshing aromatic gear teeth transfer angular momentum from the powered gear to the driven gear,” the authors say in their abstract.

The multi-layered access routine was straightforward through to the point when I clicked on the red M – for multimedia – button to view the video of the molecular gear simulation. The crunch came when I was told to select a “Plug-in Finder”. I was informed that I had arrived there because I loaded a page that contained information that can be viewed only with the aid of a Netscape plug-in (software). This did not seem to be too difficult, but it proved to be impossible in the time I had available. The computer I was using was a 486, linked to the UK academic network. I put the slowness down to the computer. My many attempts to connect to an appropriate plug-in video viewer were fraught with obstacles, such as when I thought I had loaded correctly the VMPEG17.exe file, the computer told me: “This application has violated system integrity due to an invalid fault and will be terminated.”

Video will knock down the walls of the laboratory

Information on how to configure the web browser to play MPEG video was available at the MPEG.ORG site. The full address is www.mpeg.org/MPEG/MPEG-video-player.html.

Andrew Wray, who developed the electronic journals for the Institute of Physics, was immensely helpful and sent the video files of the molecular gear simulations via e-mail. He agreed that technical support was a difficult issue, because of the numbers of different computers used, the range of plug-in video viewers available and their compatibility with the individual computer.

Despite the teething troubles, not with the molecular gear video itself, more with the receiving equipment and the familiarity of the user with the technology, the electronic journals home page and its multimedia features have been accessed “many hundreds of times a month.” Not surprising, since the *Nanotechnology* article is the first of its kind.

Other journals are making use of Web technology. *Earth Interactions* is a new, Web-based journal that is intended to exploit electronic media to take formal scientific discourse beyond the printed page. The electronic journal is published by the American Geophysical Union, the American Meteorological Society and the Association of American Geographers. It features videos and animated data and interactive mathematics. The reader can zoom images, download data, or enter and analyse other data. Peer review is done electronically.

Continillo believes that existing WWW technology and its development will eventually enable scientists to simply export multimedia material they are already using in their own experimental work, using selection and editing processes which differ little from those used for traditional manuscripts for printed journals. Video will knock down the walls of the laboratory, making the science once behind those walls visible to all who want to share in the work.

Video clips for the three IOP journals with multimedia versions, *Combustion Theory and Modelling*, *Nanotechnology* and *Journal of Micromechanics and Microengineering*, should be submitted as MPEG or QuickTime files, animated GIFs, or VHS video. The IOP recommends a maximum length of one minute to keep files to a reasonable size. Video clips will be published in the electronic version of the journals in MPEG and QuickTime formats.

Files or extra figures can be submitted in any of the usual formats (such as TeX, EPS, GIF, TIFF) together with a printed copy of the material. In addition, the IOP will consider output files from specialised data processing software and computer program source codes; authors should also send a printed copy and a read-me file with brief instructions on how to use the file. Supplementary data submitted as figures or TeX will appear in the electronic journal in PDF or PostScript formats; specialised files will be offered in their original form.

Multimedia supplements in either of these two forms should be submitted at the same time as the printed copies of the article, but the electronic media permit later submission if this is necessary. The material should be sent on 3.5 inch disk, VHS cassette or CD-Rom by post or by e-mail to the journal mailbox:

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