

## Reports and Surveys

### AUTOMATION APPLICATIONS

#### 1. *Intelligent robot probes*

Intelligent robot probes weighing no more than half an ounce could, it is predicted, be moving around the solar system, getting to places where no satellite could reach. At the Los Alamos national laboratory in New Mexico, scientists plan to give their probes rudimentary brains which will allow them to decide how best to survive in a hostile planetary system which has dangerous radiation belts. It is reported that some 50% of satellite failures occur because of the loss of radio contact. This it is said is due to the effects of radiation on the microprocessors they contain. The developers of the new robots say that:

We are working on satellites that have no microprocessors or fixed algorithmic behaviours. These satellites are domesticated by their sensors and control payloads into performing high reliability tasks.

The scientists say that the control systems are modelled on the 'twiches' of animal neurons, and are almost immune from electrical or mechanical faults. An example of the ingenious design is that if, for example, a robot's leg gets blown off it is capable of working out how to continue its tasks without it. One forecast is that clouds of these tiny robots could drift in the electrical charged wind from the Sun sending out data to a micro satellite and on to the Earth.

#### 2. *Antarctica test for robot components*

Carnegie Mellon University (USA) scientists are travelling to Antarctica to test components for a robot that could allow them to search remotely for meteorites on the frozen continent. It is in the Patriot Hills region of western Antarctica that tests are being carried of a camera that would allow the robot to detect meteorites on the surface, radar designed to find meteorites buried in the ice, and a spectrometer that is designed to distinguish between meteorite and ordinary rocks. If the components work as expected the researchers plan to test a robotic vehicle, which is equipped with the three devices. The last Carnegie Mellon robotic expedition to the Antarctica did not go well, when robot Dante failed during its descent into volcano in 1992. In 1997 the researchers tested a prototype of their robotic vehicle, Nomad, in Chile's Atacama desert and they believe that it has demonstrated its ability to explore unknown territory, and conduct scientific research by remote control.

#### 3. *RoboShopper*

Not a robot, in one sense, but a piece of software that dispenses with the need for such a hardware device, the Roboshopper currently shops the Internet. The World Wide Web is a source of cheap goods such as books, CDs and software. The increasing number of sites offering such products, and at different prices, presents problems to the browser and potential customer. A new company now offers a free piece of software that will allow its user to instruct it to patiently browse through every site for a particular product, such as a book and find the best offer. The RoboShopper will then display a report on its shopping expedition. It can work in the background whilst the user can continue to use the Web for other purposes. It is currently available for Windows 95 and NT and works with Netscape Navigator 3.0 (or later versions) or on Microsoft Internet Explorer 3.0 (or later versions). See: <http://www.roboshopper.com> for a free copy.

#### 4. *Robots hit the toy market*

We are told that robots have arrived in the toy market and that next Christmas will see children sitting at computer screens programming a robot to walk across some Internet pen-pals bedroom floor in some other part of the world. A display in London earlier this year by the world's toy makers showed that computer-controlled toys, intelligent Lego bricks, MindStorms robotic systems, Internet based systems and other technological wonders will now become essential items on a present list for any coming festivities.

#### 5. *Robot vacuum cleaner*

As expected, a domestic robot that can be left indoors to clean carpets thoroughly and without supervision has been launched by one of the world's biggest electronics companies. This miniature robot has an electronic brain, the company say, as well as a sophisticated navigational radar system that allows it to see its way round any room without bumping into furniture and other obstacles. It is expected to be the first of a long line of specialist domestic robots that are being developed worldwide in electronic laboratories. This development, by the Electrolux company ushers in a new robotic age in which dozens of laborious household chores become fully automated.

#### 6. *Robotroll follows RoboMow*

The company Friendly Machines who produced what they claimed to be the first robotic lawnmower to be put on sale, is now developing Robotroll, a robotic golf trolley which

will follow the player around the course. RoboMow which mows the grass in straight lines and avoids garden obstacles, went on sale in February last, priced at around £999. The key to these Israeli developed robot systems is the tracking devices developed by the country's military. They boast electronic 'brains' which are currently powered by batteries. In the case of RoboMow, gardeners can peg in a wire around the edge of the grass and connect it to a small generator, which, at the push of a button will send a signal to a computerised guidance system and start the machine cutting one parallel line after another. Full details of Robotroll which will, of course, have even more sophisticated electronics, have not yet been released but their potential will be clearly enormous.

#### 7. Automation no panacea

That humans, particularly in safety-critical circumstances distrust automation will come as no surprise. Many airline pilots, we are told, feel uncomfortable with the latest automated cockpits. The computer-controlled cockpits of today's jet is far removed from the previous generation of aircraft. The pilots complain that in more advanced airliners there is a lack of sensory stimulation, because they no longer need to keep their hands on their controls. Others complain that technical Manuals are inadequate. The findings are reported in the *New Scientist* and come from a survey of an association of German pilots.

#### CONTROL OF ELECTRONIC TRANSMISSIONS

How long will it be before some enterprising government will see the Internet as a lucrative source of revenue? For the moment international agencies are opposed to setting such tariffs, but there are obviously going to be some difficulties in providing the technology to either improve tariffs or, indeed, in preventing them being imposed on a worldwide basis. The European Union has already announced that they would recommend that the Internet should stay customs-free, in a report to the *World Trade Organisation (WTO)*. Similar proposals from the U.S have specified that all levies on electronic transmissions should formally be legislated against. A recent press report suggests that if the WTO were to agree to legislature it would head off moves by the *International Telecommunications Union (ITU)* to police the Internet and impose restrictions on electronic sales and the delivery of goods and services. It was the ITU that estimated that the annual expenditure on the Internet is now some \$8 billion worldwide and that it may well rise to \$300 billion within five years.

One of the main problems appears to be that some governments believe they could police the net more effectively by levying tariffs on audio and video products delivered over the Web along with such services as advertising, consulting and accounting. As the Web replaces so many of the traditional ways of communicating and consequently affects the way in which taxes are gathered, it is inevitable that tariffs will be imposed in some way on Internet services or facilities. Already many countries are seeking to control Internet usage by placing regulations on the server companies.

The European Union decision does, however, seem to support the US current position. Meetings are planned and a ministerial conference is scheduled later this year. Other problems will also be discussed including the complex issue of domain name registration.

#### DESIGN OF AUTOMOTIVE GLASS PRODUCTS

Software used in the Film Industry has been used to produce better vehicle windscreens and other glass products. Many of the latest Hollywood films particularly those with animated sequences rely on a purpose-built computer software to achieve their spectacular formats. One British company has adapted film software to give car drivers better visibility, and consequently the chance to win new contracts worldwide. In this unique and innovative development the automotive glass producer Pilkington of Lancashire, UK., has used the revolutionary 3-D effects developed for a Walt Disney film and adapted them to produce new glass shapes.

The bright and clear cut images of the Disney film have helped Pilkingtons' designers to forecast rapidly by computer simulation how successful a new glass shape will be. It provides 'virtual reality' views of the optical effects of complex new curves and shapes in car glass that also ensures that the car occupant's comfort and safety has been designed into the product from the start.

This new technique, it is claimed, has reduced this process to one of days as opposed to the weeks it used to take. It also gives an immediate insight into whether the new glass shapes are physically possible to produce, and if so, how they should be handled and formed during manufacture. Pilkington's manager of the Shaping Technology Group, Dr. Alan Woodward says that:

"We believe this form of simulation will become the world standard technology within two years. Up to now the best way of predicting imperfections in glass has been to use a pattern of stripes, known as a 'zebra board', with wiggles in the stripes showing the position and extent of the curvature and flow lines in glass which would cause distortion. Computer technology can now generate these stripes and forecast distortions theoretically but images such as those produced by the film software will reveal what the car occupant will actually see. The proposed design or manufacture can then be modified to eliminate them." We believe that the car-maker will want to see what the car buyer is going to see and this technique will allow him to do just that.

A recent report has highlighted the difficulties of producing glass with a perfect optical quality now that car manufacturers have sought to use window shapes as part of the overall design. They now require glass in the form of double curvatures, creases and wrap-around shapes. Each new car design producing more problems for the glass designer and manufacturer. One result of this innovative approach has been that the simulation team can usually suggest modifications to ensure optical correctness and production feasibility whilst also keeping within the car designers remit. Even

external reflections, Pilkingtons say, can be predicted by simulation, and designs can be modified.

Virtual reality simulation, it would appear, has arrived at the right moment for the industry. Simulation in the design and manufacture of car glass has been coming to fruition over the past six years. And now it has been recognised as a major industrial process in the motor vehicle design and production. The *European Mechanical Society*, it is reported, has now called an international conference of these innovative techniques.

### LEONARDO'S ROBOT

A report from Italy describes how a robot designed 500 years ago is being rebuilt in Florence. The clockwork robot is of a knight in armour and it was designed by Leonardo de Vinci in around 1495. This we were told, was before the artist, scientist and inventor began his work on *The Last Supper*.

The announcement of the project was made at the Florence MediArTech, multimedia and cultural heritage show by experts from the city's Institute and Museum of the History of Science. The working model of Leonardo's robot is being built, under much secrecy in the city.

The model is said to have a clockwork mechanism and the project is expected to cost around £500,000. The target date for completion is prior to the Millennium celebrations when it is expected to form part of a travelling exhibition.

The deputy director of the Institute, Mara Miniatti said that:

... as far as we are aware his ideas mostly only ever went on paper. So this wonderful project is, above all, a homage to him. The computer reconstruction, to our surprise, proved that the robot designs in fact worked. Now the problem is less mechanical but rather that of finding the money.

The report says that much like the armoured horseman of his day, Leonardo's robot does not walk, but can bend its legs, enabling it to sit down and to stand up. It can also move its arms, hands and head, and open its mouth. Thanks to an automatic drum roll within his mechanism, the robot can even 'talk'. The historical background to Leonardo's robot is that it was designed for theatrical use at the Visconti-Sforza court in Milan, and wears the armour which is described as 'Italo-German' in style.

It is said that the robot's proportions represent an advance on some of Leonardo's earlier anatomical drawings. The inner workings of the robot resemble those of an elaborate antique clock mechanism. For the model the mechanism is set behind the knight's translucent armour so that its quirky and elaborate driving actions can be seen.

Recently, there have been a number of projects designed to reproduce the earlier technological devices, such as the Babbage machines, and more recently the pioneering computing machines such as the Manchester 'Baby', whose 50th anniversary was celebrated in 1998. Few scientists realised, however, that the 500th anniversary project to rebuild a robot was also taking place.

### NETWORKING

Surprisingly, a recent survey has suggested that some 90% of Internet users have little idea how their networking computers work and even less knowledge about the way in which the software they use is designed and produced! We could, of course, ask the question whether the users of any of the latest technological devices need to know how they work. The trouble, however, with computer users is that the majority soon call themselves experts and perpetuate the myth, whereas a television user is hardly likely to call him/herself a TV expert. Computer pioneers blame themselves for producing computer interfaces that are so easy to use that children in the kindergarten can access sophisticated software systems. This is, of course, highly desirable but can lead to the present day ignorance about computer science and technology.

One of the problems with using the Internet has been that users need to be able to understand the elementary interface of a PC, and to use the computer itself on occasions for file handling, etc. . . Now even the easiest of PC interfaces need not be mastered to gain network access and usage. There are many more options as net PCs, network computers and other devices have emerged. All of those provide new ways of networking and present entirely new IT strategies to users and to organisations. Companies are now beginning to question their end-user policies.

In an article in the British Computer Society's *Computer Bulletin* 26–9, March 1998 the whole problem is discussed under the title 'PC or net PC? That is the question.' It tells us that the majority of IT specialists are wondering about the future with network computers. The end-user computing world, the writers say, has exploded with options, and is of great significance; they say that:

The lack of understanding about network computers, net PC's and other devices is highlighted by a survey of nearly 250 senior IT specialists in the UK and Ireland by AST Computer. This shows 'a staggering 51% of IT Directors actually admitting to not knowing the difference between a network computer and a net PC'. Another 10% answered 'not sure'.

Readers may wish to know that the various devices and their implications are described by *Ovum* in a new report\*, published after nine months research. In summary it says that the following four new desktop hardware products have been identified:

- Network computers – are designed to support local processing of *Java* applications, loaded from a computer. Suppliers include Sun Microsystems, and IBM, with the Network Station 1000. This has 8 Mbytes of memory and 1Mbyte of video memory, runs a Web browser, supports *Java*, plus Microsoft windows applications via NT, and X-Windows, and has IBM 3270 and 5250 terminal emulation. It has a 16-bit audio through a built-in speaker, but no disc drive.
- Net PC – promoted by compaq, Intel and Microsoft, in particular. It is based on the PC but is smaller, with a floppy

\* Network Computers: Risks and Rewards for Business; this is the *Ovum* report and details can be obtained: Tel: +44(0)1713127218 and on e-mail: info@ovum.com, and also on www.ovum.com.

disc or CD-Rom drive available as options. It too works across a network with central administration. Compaq's Deskpro 4000 N net PC has a 166 MHz or 233 MHz Pentium processor, 16 Mbytes to 32 Mbytes of memory and a 1.6 Gbyte hard disc drive.

- Intranet terminal – widely thought to be a network computer but is not because it cannot process *Java* applications locally. It provides access to a range of applications, via a browser. Only the browser and a local operating system are on the hardware. Options include terminal emulation, again via the browser. Wyse Tektronix, Neoware and IBM, with the Network Station 100, are in this market. IBM describes its products' a replacement for terminals or PCs that are used primarily for accessing applications on various servers, as well as casual browser use'. It has 8 Mbytes to 64 Mbytes of memory, eight-bits audio, support for Windows via NT and for X-Windows, and 3270 and 5250 terminal emulation.

- Windows terminal – it too, has no local storage or processing, but simply displays Windows applications, held and managed on Microsoft Windows NT computers. It can work through the Winframe software from Citrix, based on its independent Computing Architecture, which is a winning endorsement from a growing number of big suppliers and which also provides links through other systems. Users are also waiting for Microsoft's own Hydra product, which attracted huge interest at the massive Comdex Fall 97 exhibition and conference.

Two Case Studies are also published in the *Computer Bulletin* article: the first on Net PCs, and the second, on Intranet terminals.

The former study on Net PCs features the Internet service Demon Internet which is installing net PCs in the shape of the Compaq Deskpro 4000N, rather than network computers. This, the report says, is because of its use of Windows. The company say:

Our internal systems are based on Windows NT and we couldn't consider rewriting them. Our call centre staff need the flexibility of Windows. Changing to network computers would have meant throwing out our entire PC infrastructure. In addition we plan to integrate voice and data in the call centre network, and for this we need functionality that network computers simply cannot provide. However, the net PC promises lower costs of ownership especially maintenance, and will enable us to have standard applications and hardware across the network without user intervention.

The second case study gives an insight into the use of Intranet terminals. It says that the insurance group General Accident is staking its future IT on network computers and *Java* with an order for 4,000 IBM Network Stations. IT is now installing 2,200, mainly to replace dumb terminals to an IBM mainframe, and will then replace office PC networks, moving Windows NT. Meanwhile most of its key business systems will be redeveloped in *Java* by IBM under a facilities management contract. General Accident expects, the report says, significant hardware cost savings, both through initial purchase costs and maintenance.

Finally, the report puts the current dilemma of many users and organisations into perspective. It says that *Ovum* believes sales of the four new devices described here will grow to 22% of all end-user hardware sales in the next five years. Total sales of all end-user devices in the USA, Western Europe and Japan will grow from 120m units to 140m. The new devices will replace dumb terminals in particular, cutting the number installed from 30m to 20m. It also predicts that the number of PCs will stay roughly constant at around 90m, although it suggests that portable units will increase to account for half of these.

Readers will wish to know that not only is the choice of hardware changing but also the terms used to describe the new devices. The term 'thin client', 'network computer' and 'net PC' are used interchangeably to refer to new types of desktop hardware which all runs across networks and depend on a server but vary greatly in functionality. The four types of new desk-top hardware identified by *Ovum* are regarded as the so-called 'thin clients'.

## OPTICAL COMMUNICATIONS

A research report in the UK's *Engineering and Physical Sciences Research Council (EPSRC)* information technology update *Impact No. 17.1997* described pioneering work at *Aston University (UK)* in optical communications. The work has demonstrated the immense potential of solitons, an important innovation in optical telecommunications and processing.

Solitons are short, particle-like pulses which can be used to exploit the non-linearity inherent in fibre-optic transmission. They create a distinctive waveform which is more stable and less subject to fibre degrading effects, such as dispersion, than traditional optical techniques.

Professor Nick Doran of the *Aston Photonics Group (APG)* is quoted as saying that:

These characteristics make solitons the natural digital solution. This holds the key to the next major increase in practical fibre optic speeds over long distances, such as on transcontinental networks. We also expect the ability to use solitons to merge transmission with aspects of processing will have a profound effect on broader areas of network design and all-optical communications systems

The research report says that solitons have been known about since the 1980s. Their take up, however, has been inhibited by practical problems, such as the 'jitter' caused by instabilities in pulse transmission.

The research at Aston University is led by Professor Doran and Ian Bennion and has focused on overcoming such problems in order to optimise the capacity in distance of amplified soliton communications, particularly using existing fibre technology. Innovations in the dispersion management control of solitons have been among the APG's main contributions to achieving this.

For example, its 'uniform finite dispersion' approach produced a very small overall dispersion by transmitting solitons along transmission paths with alternating positive and negative dispersion. This can almost completely eliminate jitter, including that encountered in systems trans-

mitting multiple data stream at different wavelength simultaneously.

The research group has also been at the forefront of developing 'fibre grating' reflecting filters for dispersion compensation, including 'chirped' fibre grating that can change the pitch of soliton waves.

The Aston team has already demonstrated the success of this work by setting a world record for soliton transmission on standard optical fibres. Using their amplified recirculating loop, this showed that speeds of 10 Gbps could be reached with installed fibre for distances of up to 10,000 kilometres.

The proof of the importance of the group's contributions to this field is demonstrated by the adoption by industry of their initial identification of the principles of soliton system

design which is based on pulse duration and amplifier spacing.

APG is also active at the leading edge of many other photonics disciplines, such as the formulation and application of modelling theory and network developments. The major telecommunications companies, such as British Telecom (BT), BNR Europe, GPT, STC, and GMMT have strong working links with the Aston Group.

Details of their work is also available on the Web Link: [benedick.aston.ac.uk/photonics/](http://benedick.aston.ac.uk/photonics/) (Aston Photonics Group U.K)

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