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Laser light increases computer's capacity to think

Alex Szabo, a physicist with the National Research Council (NRC) in Ottawa, has developed and patented techniques which some consider could revolutionize the computer industry and create a business worth literally billions of dollars within the next decade. His discovery, "optical hole-burning", which was an offshoot of his 15-year investigation in an esoteric field known as "the laser spectroscopy of solids", may be used to construct a powerful and sophisticated computer memory.

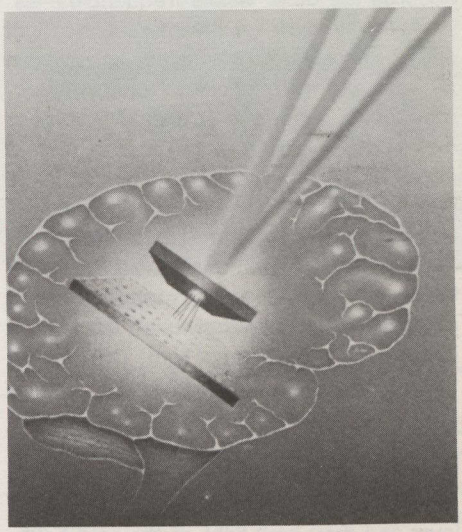
While the earliest computers worked only with numbers, computers today listen to language and shuffle text. At their deepest level, however, even their "non-numeric processing" capability still uses numbers.

"Thinking" computers

The "fifth generation" machines of tomorrow will not seem like mathematical drudges to their users. Such machines will be asked to reason, to learn, and to perform billions of operations at incredibly high speeds. User-friendly abilities will include comprehending and translating spoken languages, and reading maps, photographs and handwriting.

Researchers are agreed that fifth generation computers will amost certainly rely on innovative computer architecture known as "parallel processing." The present dominant design is "von Neumann architecture", named for mathematician John von Neumann who described it near the end of the Second World War. In the von Newmann approach, data and instructions must flow between a computer's central processor and its memory along a single channel. This single channel creates a bottleneck which limits the computer's speed and capacity. In parallel processing, on the other hand, many processors, each with its own memory channel, operate simultaneously on various parts of a problem.

Parallel processing is already found in Canada's *Cray-1* supercomputer, a "fourth generation" computer inaugurated in Montreal in February 1984 as the country's central weather forecasting computer.



John Bianchi

Stylized depiction of how a fifth generation computer might store a million billion bits of information — the number of litres of water in Lake Superior — in a space one centimetre square.

Modelling the earth's atmosphere for weather forecasting is one of the classic computer problems and provides an excellent demonstration of the power of parallel processing. In forecasting models, the earth's atmosphere is divided into a giant three-dimensional grid. Data are collected for each of the points where the grid lines intersect, and then the parallel processors perform similar calculations on each of these data points to march the model forward in time and predict the weather.

The number of calculations is extensive. Even for supercomputers like those in Montreal with lightning-fast speed of 50 million arithmetical operations a second, a ten-day weather prediction takes seven hours of computer time and involves in the order of 10^{20} calculations.

Light to replace circuits

Dr. Szabo is one of many experts who suggest that the complexities of full parallel processing may pose intractable problems for computers based on electronic circuitry and that optical computers, where beams of

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