Vision machine

In an upper window at the Artificial Intelligence Laboratory at the Massachusetts Institute of Technology, a peculiar camera looks out on the main street connecting the two universities in the City of Cambridge. Representations of the camera's visual field are regenerated at intervals of about a second — a technical limitation, caused by the decision to use simply a linear array of gallium arsenide photodetectors as a means of generating a two-dimensional picture but also by the capacity of the computer. The owners of the camera, however, claim that it is the first true electromechanical vision system.

But what is wrong with an ordinary television camera, which can produce an image of the scene in front of it with much greater speed? The answer is that a television camera (with accompanying video display) is not a replica of a visual system, but an analogue thereof. There is no means, as in the visual system of the primate, by which information subsidiary to the construction of a two-dimensional image can be extracted. Vision in depth is not possible. And there is no way in which some kind of homunculus can be enabled to monitor what is happening.

In the machine the video picture is regenerated from the top, and each sweep across the frame shows that the cars waiting in line to cross the Charles River have moved on a yard or so. The only intermediate use of the explicit representation of visual perception that the system is so far equipped to exploit is to degrade the quality of the image, lumping together the signals from groups of sixteen or so picture elements to form a blurry picture. The resulting images are blurred. But shapes are surprisingly recognizable.

The plan is that there should soon be a second camera, so that it should then be possible to try out the algorithm for binocular vision. It may then be possible also more stringently to test the underlying theory of vision embodied in the computer program — that what matters, in the perception of the outside world, is the definition of the lines (outlines) that mark the one-dimensional contours in a scene where contrasts between light and shade are greatest. The constructors of the camera confess, however, to one conceptual failure. The project is financed partly by the military services in the United States, which have an obvious interest in machines that might be able to see as people do. So could the system be used for spotting tanks on a battlefield, or missiles in their silos? Well, of course. Certainly such a system, if the theory is correct, could recognize such objects. But could it give them a name? Not yet — maybe that requires "higher", cognitive functions.

principal and more or less symmetric axis to which the details of the image may be related. At the level of the algorithm, the suggestion makes sense. It is, however, unpersuasive. It may serve well enough in the identification of a knitting needle or even a human face, but what about a landscape? Or a familiar face in profile? Somehow, the algorithmically derived theory does not ring true.

Implicit recognition of this failure seems to have driven the devotees of Marr's programme to controlled despair[50]. In the past few years, the artificial intelligence community has slipped into the habit of asserting that the only proof that perception and cognition have been understood is that they (or somebody) can construct a machine that will replicate the process. The strategy is sensible enough: if a machine that will replicate the process of human vision could be built, a demonstration of its power would persuade all kinds of people that the problem of vision had been tackled seriously. Sceptics will, however, complain that simulation is not the same as understanding. □

A few loose ends

The general impressions created by the neurosciences and their practitioners on the rest of the professional community is that it can be only a matter of time, a few months or at the most a few years, before big questions are finally decided, before the pot of gold is finally disinterred from beneath the rainbow's end. Naturally, the practitioners are unabashed when it turns out that the prudent direction of the hunt has changed. For it will be only a few months, or at most a few years. . . .

This impressionistic survey of what is happening in the neurosciences should give the lie to that always false expectation. Perhaps the most striking of the impressions gathered is that quite old-fashioned approaches to the working of the nervous system appear still to have a great deal of promise left in them.

Is there, perhaps, a case for asking that those about to embark on the isolation and cloning of this or that neuronal gene should first be asked to carry out a simple experiment with the giant axon of the squid, if only to acquire a sense of what neuronal transmission is about? And an understanding of what makes it so interesting as a phenomenon? As things are, there is a danger that the neurosciences will be imprisoned by the fashions from time to time inflicted on them.

It also emerges that several long-standing problems in biology (not much discussed above) and apparently central to the function of a self-respecting nervous system have been skipped over in the headlong rush of the past few years. Here is a brief list:

Circadian rhythm

Although the phenomenon of diurnal metabolic activity is not well attested in human beings, it does appear that insects such as the locust can keep time with the Sun (and often have no choice). Several suggestions have been put forward as to how this might be arranged. Groups of cells linked synaptically together might just do the trick, especially with the entraining help of a diurnal stimulus. But which are those groups of cells, in some insect or other species? And how precisely do they function?

Schizophrenia

For several years, the text-books have rightly drawn attention to the connection between the most serious (if not necessarily the most common) of psychiatric disabilities and abnormalities of the behaviour of dopamine (a neurotransmitter) in the human central nervous system, especially in the limbic system and in the structure known as the substantia nigra. Once (ten years ago) the case seemed simple. Drugs known to bind to dopamine receptors, the phenothiazines in particular, were found to help alleviate the symptoms of the disease. So what more natural than to suppose that the underlying biochemical defect in schizophrenia is an excess of dopamine by dopaminergic neurones, an increased frequency of dopamine receptors in postsynaptic cells or an increased sensitivity on the part of a normal neurone population?

Unfortunately it has not been possible to make theories of this kind accord with what is known of the disease and its drug treatment without postulating an uncomfortable variety of dopamine receptors, at least one of which is a kind of receptor not known elsewhere — an auto-receptor on the presynaptic neurone which is sensitive to the neurone's own product. Given the social importance of the disease, would not an investigation of the nature of the dopamine receptor (what, physiologically, does its activation do to a cell?) be worthwhile?

Manic-depressive illness

This is a simple question. Why is lithium effective in the treatment of manic depressive illness, a disease in its own way as important as schizophrenia? Presumably lithium has something to do with ion channels. Nobody seems to know what the answer is.

Colour vision

Thomas Young in the seventeenth century

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