Driven up the wall

I am sorry to tell you that the Russian robot you featured last month (October Research Notes) is not the first climbing robot. There have been quite a number of similar climbing mechanisms produced over the last five years, mainly from Japan. However the first articulated-limb, wall-climbing, genuine robot is British. To be a genuine robot the mechanism must be able to modify its own behaviour in the light of the circumstances if finds.

Robug II, shown in the photograph, which was developed by Portech Ltd in conjunction with Portsmouth Polytechnic, is able to do this. It is pneumatically powered, but controlled by a separate 8/16 bit microprocessor for each leg. Instructions are sent as a string of high-level commands from a PC via a serial link, using a structured language. The robot is able to respond to general intentions such as REACH, HEAVE, etc, but the robot, with its on-board sensors, itself decides where to put its foot, searching for a good grip. When climbing buildings, it is able to step over obstacles and negotiate window ledges.

At the recent Robot Olympics another of our robots, Zig-Zag, won the gold medal for wall climbing, going about three times faster than its rival. Unfortunately, due to water in the air supply, Robug II developed an aberration, crossed out of its lane, stamped on the Russian machine and refused to let go till it was ignominiously disqualified for unsportsman-like behaviour and switched off. I hope that this is a lesson to all other robots who are reading this and preparing themselves for the next Olympics in 1992!

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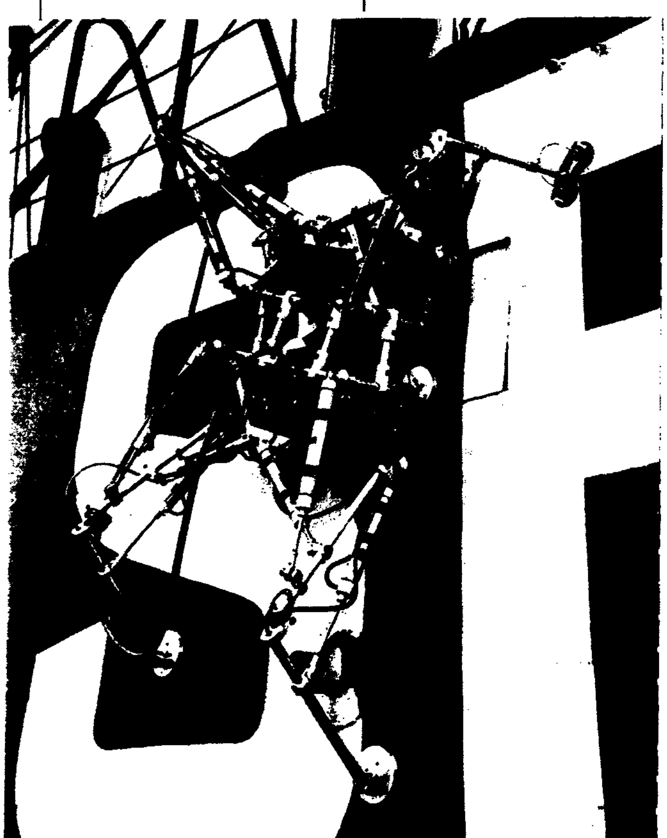

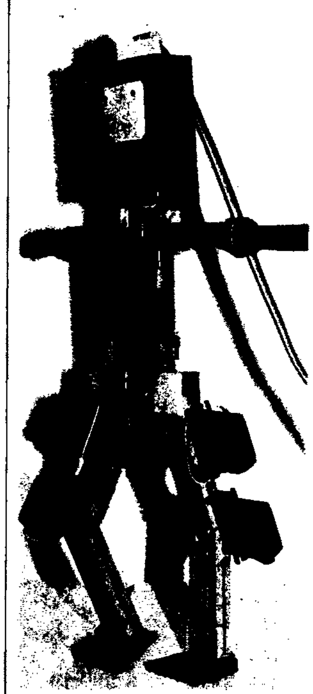

Sporting (and unsporting) robots

I thought you might like to see pictures of some of the robots entered in the recent Robot Olympics held in Glasgow in September. Fifty entries came from 14 countries and entertained 1300 schoolchildren and other spectators by wall-climbing, pole-balancing, walking, staggering, shuffling and avoiding obstacles.

Paisley College's entry was a two-legged walking robot, built for less than £200, excluding the PS/2. Robots of this type were in two classes as far as motive power was concerned: pneumatics and radio-control servos, the latter being well suited to the latest generation of microcontrollers with PWM control on-chip. Our robot took second place behind a human-sized pair of legs that looked at times as though they might annihilate their competitors by simply falling over on top of them.

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Spaceships or trains?

Einstein's problem, discussed in "Relativity" (translated in 1920), is restated in effect by John Ferguson in his letter in your November 1990 issue; in his book for "popular exposition", Einstein sought to show the difficulty of agreeing the simultaneity of spatially separated events when viewed from different frames of reference. He took for his example a train travelling along an embankment, suffering simultaneous lightning strikes at widely-spaced points along the railway-track, but analysis of his argument discloses a similar cause of confusion to that in the spaceship example. It is essential in both cases to determine the propagating medium that transports the light-signals; is it fixed to the train, or the ground, or indeed, to the electrically broken-down atmosphere; is it fixed to the earth, the travelling spaceships, or possibly is it flowing across the void?

Mr Ferguson suggests that we are all (including heretics) expected to imagine that radiated electromagnetic energy finds its own way across the void unregulated by any action of an "ethereal" medium; perhaps he was a little forgetful in not mentioning that, by Einstein's Second Postulate (given in his celebrated paper of 1905), it is implied that every receiver is hit by radiations at the universally constant rate c, so that we have to consider each receiver as embedded in its individual ether which it carries with it. Einstein himself had to admit that he had not created a consistent theory of electrodynamics which dispensed with the concept of medium, which had been the declared objective of his 1905 paper.

If we are to join with Mr Ferguson in commending Mr Harrowell's May 1990 call for a learned panel to further debate the creative speculations of Einstein, should we not be prepared, for the sake of an appearance of consistency and sanity, to abandon the methodology of scientific investigation? Should we not

ban all practical research which might produce rational explanations for Bradley's aberration, the Doppler effect, the Sagnac effect, and all else? Shall we then agree that the physical domain includes a "thing", the element time, which has properties which enable it to "combine" with space, to "dilate" itself, to act on material entities, moderating the regulation of the natural systems used as clocks?
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Cracking-up Cracker

The reviewer of Cracker 4 (November 1990) set forth only its good points; however, there are drawbacks. It is a quirky little program that shows its origins on a toy computer in several irritating ways and gives the impression that the features have been cobbled on to make it qualify as a "real" program. It will gobble up your data in several ways the moment you take your eyes off the screen and, as you contemplate its leisurely ways, it is easy to convince yourself that the damn thing is networking on the side for four other people. It takes fifty seconds to step across twenty five columns without entering any data, with messages saying "wait" or "rewriting the screen". If you miss these and type on, your data gets mangled and the program starts to interpret it as commands. The same happens when the program does its autosave. The cursor can be in text or number or neutral mode and if you move a text cursor over existing numbers, they disappear, and vice versa with the numbers cursor.

The drop down menus are clumsy to use – many needing ten or more strokes on four different keys to select an item. Two selections, the **Reference checking** and **Autocalc** can be on or off, but the menu does not say which state you are in. If you select one, the menu disappears instantly and you are in the opposite state – but you still don't know which it is.

There are three quick ways to get to line 255 but there is nothing there when you arrive. The **error** function displays as 0 and calculates as 0, which is not good. There is no x to power y, and no absolute cell-addressing. Fifty two columns are all you get. The first twenty six are labelled A to Z (upper-case) (shades of the toy computer) but the next twenty six are lower-case – there would be fewer keystrokes the other way round.

The sideways printing of wide spreadsheets is a nice idea but the printing on an Epson is NNLQ, ie nowhere near letter quality. There is no **table fill**, but you can set up a program with the **if then else** or **do while** features – see the example in the book.

I filled a spreadsheet A1 to Z27 with numbers and then used them to produce the result in A28 to Z55 but the program won't let me delete the first half or save just the second half, because as it says, B29 uses B2. I saved it all as a **txt** file, but it took two and a half minutes to save the 66kb to hard disk.

The graphs Mr Williams enthused about are quite good, but he forgot to mention there are no screen prompts to help – just use the book as a template. Where several lines are plotted, x values are required for each y value, which usually means duplicating the x list for each line – no time saving here. The size of the standard graph is decided by the program, but the Cracker Plotting Language can (to quote) "be used to draw your own graphs". The scales log or lin can be any size and are easy to use, but the curves are made up of straight vectors with an x and y value each end, in millimetres from the edge of the paper! Five columns of calculations will change your data to suitable dimensions, but how to enter them all into the command **vector** (enter) x1,y1,x2,y2 (enter) is a mystery. There are no prompts on the screen, or in the book; you are on your own.

Yes there are lots of features, but for my hundred pounds I would have liked two more — speed and convenience
W. Robinson
Redcar

Crystal balls

The astronomers who recently subjected the images of Saturn's rings taken by Voyager 1 to mathematical analysis and used Fourier's transforms to reveal ". . . that the brightenings consisted of a complex of five periodic waves" (Research Notes, October), were anticipated by young Maxwell in 1857, without the aid of close-up images.

His very long paper "On the stability of the motion of Saturn's Rings" secured the 1857 Adams Prize for solving the problem put by the examiners ". . . respecting the physical constitution of the rings. It may be supposed (1) that they are rigid: (2) that they are fluid or part aeroform: (3) that they consist of masses of matter not mutually coherent". Only three rings had been observed.

Maxwell used Fourier's transforms to predict that a ring of disconnected masses of matter would be affected by displacements propagated round each ring in the form of four free waves. Other forced waves would be gravitationally induced in each ring by the free waves of adjacent rings. He predicted ". . . that the only system of rings that can exist is one composed of an indefinite number of unconnected particles, revolving round the planet with different velocities according to their respective distances. These particles may be arranged in a series of narrow rings. . ." He also designed an ingenious mechanical model of a ring of waving satellites "made by Ramage of Aberdeen" to illustrate the predictions.

His paper is a typical example of Maxwell's virtuosity in many branches of exact science; an example of how the exact science of applied mathematics applied to the exact science of Newtonian laws of physics — unified in 1847 by Helmholtz's Law of the Conservation of Energy, followed in 1864 by Maxwell's major contribution to exact science with his Newtonian laws of the electromagnetic ether — were used in the last century to solve the problems of Nature, rather than the 20th-century-reliance on superlatives and the inexact mathematical laws of gaming or "uncertainty" to solve the problem created by human fallibility.

This abandonment of exact science is the inevitable consequence of the infiltration of exact science by a school of mystics at the turn of this century, activety encouraged by committees instructed to award Nobel Prizes in Physics "for *discoveries* conferring the greatest benefit on mankind", who unfortunately agreed that the verb "to find" was synonymous with the verb "to guess". Theorists' guesses have proved to be of no benefit or practical use whatever either to engineers who carry on working with the exact science of Newtonian laws of physics, or to our understanding of "electricity" – the Newtonian inverse square-law effect of mutual attraction or repulsion of matter at a distance, discovered by experiment several thousand years ago.

Fortunately, we can compare N. Heathcote's authentic history of 20th century physics (Nobel Prize Winners in Physics 1901-1950. Schuman. 1953.) with the totally demoralised engineer's equivalent, which certainly satisfies Alfred Noble's criterion, namely Dr Atherton's "Pioneer" series, dedicated primarily to discoverers. Discoveries are made by experiment and always precede theories. There were no theories of electricity before electricity was discovered. A close study of Heathcote's Establishment-approved book shows that we are living in a century of miracles, where theories precede discoveries claimed to be experimental proof of theories by a process of reasoning from self-evident principles, e.g. the rectified wave packet.

The quark theory, still awaiting experimental discovery, a mere detail, requires the existence of a third weightless particle, the gluon, to explain why the electron does not explode under the stress of the mutual electrostatic repulsion of its parts. It would seem the many optimistic schools of profound 20th century thought share the old school song "Another little particle won't do us any harm". In more ways than one!
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