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Bionics of Walking: The Technical Application of Biological Knowledge

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Bionics of walking – this is the name given by the interdisciplinary group of biologists and engineers to their project which is currently one of the best in the field of robotics anywhere in the world. Modeling themselves on nature, machines are learning to walk.

Object of scientific curiosity: the nervous system of the stick insect Carausius morosus. (Photo: Friedrun Reinhold)

Wheels are not always the best option. They do not work well on rough terrain, in rooms containing obstacles or in kinked pipes, where legs are required to make progress. And the need for walking machines is considerable: whether it is for the exploration of distant planets, military operations or repairs in nuclear power stations or refineries. This is why the guild of robot researchers has had a walking technology department for many years – but it is only making slow headway. Walking is far more complicated than it appears, and this does not apply to the centipede alone. When is a leg to be lifted, swung forwards, lowered, then placed on the ground again? And which of the joints is to execute which movements, for which purpose, and with how much force?

With their six-legged walking machine the engineers at Chair B for Mechanics at the University of Munich have thrilled the media, and not just because it appears to be quite alive and is much more nimble than comparable, equally famous fellow creatures from the United States. The special feature of the Munich machine is that its designers have emulated the legs to be found in nature. And they have done so in a strictly scientific way, namely based on knowledge gained by the biologists at the University of Bielefeld from observing stick insects. The basic principle is that the legs are not commanded like soldiers by a general, but decide internally which one will make the next move. And lo and behold: anarchy does not necessarily mean chaos – it can walk.

Using stick insects as examples, knowledge on the timing of neural stimuli is transferred to a robot model. (Photo: Friedrun Reinhold)

It was not even quite finished when the walking researchers already took the next step, namely the construction of a pipe crawler. Our civilization is based not least on innumerable pipeline systems which are often inaccessible for maintenance and repair work – in chemical plants, power stations, and supply lines. Naturally, sending in robots does suggest itself here, and it would be ideal if they had legs. This is the reason why the scientists in Munich and Bielefeld teamed up with experts on climbing machines in Moscow and a bio-researcher from Marseille who is studying how the crawling of lobsters is controlled.

The prize money supports this joint project. The pipe crawler must meet particular requirements: for example, its eight legs must guarantee a firm grip. The movements are to be controlled later by an artificial neuronal network which does not, however, deviate in any way from the principle of decentralization.

"Animats" is the name given by robot researchers to such techno-animals. Their scientific values lies not least in the fact that we can hope for a better understanding of nature if we succeed in reproducing its greatest successes. And walking is truly one of the run-away winners in the history of evolution.

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