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BIONICS

Chaos control robot legs

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Should move forward in a running robot, his legs must be controlled at regular intervals: for example, during the so-called swing-speed insect-like robot tripod three legs forward, while leaving the respective opposite on the ground. But seeing each other gaits for different situations - and rhythms - are better suited, scientists at the Bernstein Center for Computational Neuroscience in Göttingen developed a robot that can use its sensors to flexibly switch between different movement patterns.

The special thing he does not find suitable pace, for example, because his foot stuck, is changing the previously regular rhythm in a chaotic oscillation, are tried in the movement for so long, until the sensors detect no more problems.

During robot builders typically each rhythm has its own *"central pattern generator"*, Then assign rhythm generators, the researchers of the team to Poramate Manoonpong and Marc Timme on a simple control: Only a single interconnection brings forth all the gaits. It consists of two simulated nervenzellähnlichen elements and forms the core of the control module, the confluence of all the sensors data.

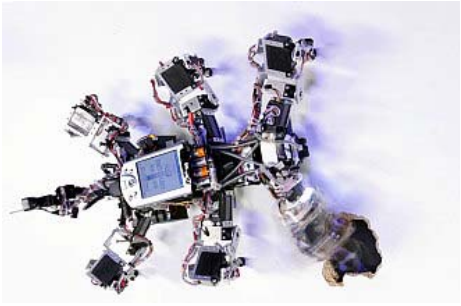
Both artificial neurons inhibit or excite each other and constantly advised by the wings. This oscillatory activity is eventually passed on to the motors of the robot legs and allows the robot to its - still quite leisurely - forward movement.

The aim of the researchers was to investigate the dynamics of two neurons set exactly the way that the system is chaotic swings. This may be highly sensitive to two control neurons, forcing the oscillations of the network into several regular rhythms. AMOS-WD06, such as the Göttingen dubbed the robot adapts so quickly and flexibly to new situations.

Moreover, this principle of the robot the opportunity to add to escape from unforeseen difficulties by trying to be flexible: The influence of the control neurons is turned down, and the chaotic oscillation again comes to light - the engine "fidget" freely.

Since the "synapses" to inhibit on the neurons of the system or excite each other, are variable, the robot can learn to optimize its movements, and adapt behavior to new situations. Thus, the researchers report an experiment in which their robot as long as its pace varied, until he had minimized the energy consumption of an increase in coping.

All in all, dominated AMOS-WD06 eleven different behavioral patterns, including the escape from a loud noise, obstacle avoidance and forward motion on uneven terrain. A total of 18 motors and sensors need to be controlled by the controller. For the design of the robot, the researchers were inspired by the cockroach. Central rhythm generators for the coordination of limbs and other muscle groups are widespread throughout the animal kingdom, however: Even in humans, they control certain movements. (jd)



Chaos frees the robot from a trap
An electric circuit consists of two simulated neurons generates the rhythm, after which the robot moves its six legs. Special feature: The neurons oscillate chaotically.
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Steingrube, S. et al. Self-organized adaptation of a simple neural circuit Enables complex robot behavior. In: Nature Physics 10.1038/nphys1508, 2010.