Supplementary Video 1: ***The hexapod AMOS-WD06 walks with different gaits under a simple neural chaos oscillator.***

Additional description:
Examples of five different gaits. Slow wave gait (p = 9), fast wave gait
(p = 8), mixed tetrapod-wave or transition gait (p = 6), tetrapod gait (p = 5), and tripod gait (p = 4).

Supplementary Video 2: ***The hexapod AMOS-WD06 walks through an obstacle course: Different gaits, obstacle avoidance, phototaxis, and resting.***

Additional description:
Autonomous walking behaviors in different environmental conditions. A complex sequence of eight different behaviors is shown that include standard walking in a tetrapod gait, upslope walking in a wave gait, rough-terrain walking in a wave gait, self-untrapping through chaotic motion, down-slope walking in a mixture or transition gait (from wave to tetrapod), active phototaxis by fast walking in a tripod gait, and resting. As soon as obstacles are detected the machine performs obstacle avoidance behavior by turning left/right.

Supplementary Video 3: ***The hexapod AMOS-WD06 escapes from danger from behind, orienting and self-protection.***

Additional description:
Sensor-driven behavioral patterns. In the first scenario, the walking machine tries to escape from the attack of a manually controlled robot by increasing its walking speed by means of changing its gait from a wave gait to a tripod gait. In the second scenario, the walking machine shows orienting responses by avoiding obstacles and performing phototaxis. Note that in this scenario it is set to walk with only one gait type (tripod gait) in order to see the orienting behavior more clearly. Furthermore, here we show that stopping the machine in front of a light source during phototaxis can be achieved by inhibiting only all TC-joints. As a result, it performs “marching” in front of the light source. In the last scenario, the walking machine performs a self-protective reflex by standing upside-down when it is turned into an abnormal walking position and it immediately returns to walk again as soon as it is turned back to its normal walking position.

Supplementary Video 4: ***The hexapod AMOS-WD06 exploits chaos for self-untrapping its foots from holes in a floor.***

Additional description:
Foothold searching experiment with and without chaos. When applying chaos, the walking machine successfully performs self-untrapping if its foot gets stuck in a hole but without chaos it fails.

Supplementary Video 5: ***The hexapod AMOS-WD06 learns to use optimal gaits to save energy.***

Additional description:
Learning to optimize energy consumption during walking on a steep slope. The walking machine learns to search for an energy saving gait (i.e., slow wave gait) while walking on a steep slope.

Supplementary Video 6: ***The hexapod AMOS-WD06 learns to escape the noisy enemy.***

Additional description:
Learning to escape danger from behind. The walking machine learns to search for a fast gait (i.e., tripod gait) in order to escape danger from behind. Here the low frequency sound and the reflex infra-red signal are thought to represent danger signals. They are detected by the auditory-wind detector sensor (AW) and the rear infra-red sensor (IR).