

PROJECT NANO

Bionics is the science of imitating nature. Be it a lotus flower or the wings of a dragonfly, the feet of a gecko or the skin of a shark, nature is full of fascinating innovations. Researchers study them, try to understand them and imitate them so that, in the future, they can be used in advanced technology.

Locomotion

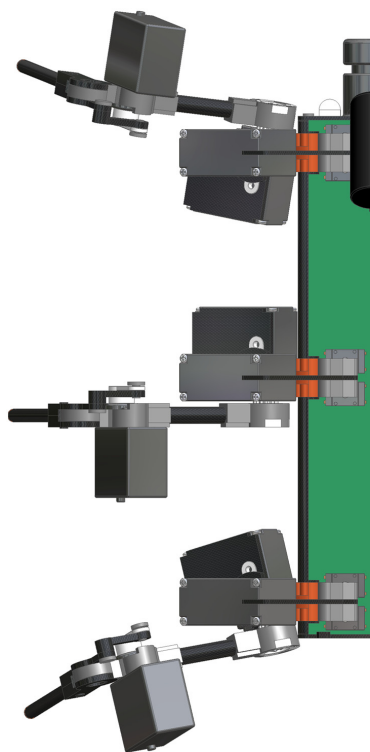
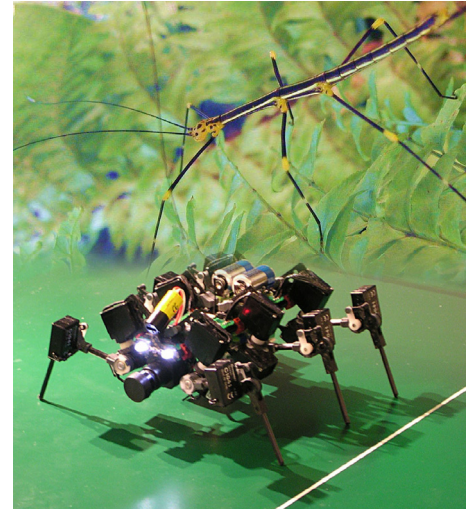
One of the most interesting mechanisms that have resulted from evolution is walking. While the methods mankind has developed for moving are almost always based on wheels, nature has been relying on feet for billions of years. It is a concept that has proved efficient for many different species, which should be reason enough for studying it and for exploring the possibilities of incorporating it into man-made technology.

The robot

Project Nano aims at developing a walking robot that imitates a natural being; the model for the construction of Nano is the Indian Stick Insect *Carausius morosus*. Its anatomy and behaviour have been studied thoroughly and are considered a well-researched field of biology today.

As an interdisciplinary project, one of the major tasks it is faced with is the combination of information from the individual fields of research. On the basis of the biological information needed, mechanical and electrical engineering and computing science complement each other in order to achieve the transition from insect to robot.

Nano's mechanics are made up of a fine framework of light and extremely strong carbon fibres, reducing its weight and size to a minimum. This is an important factor, considering that the power to weight ratio of any being gets less ideal the bigger it is. The



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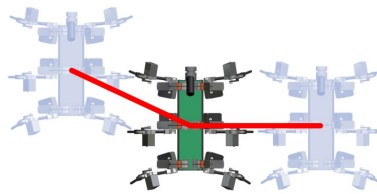
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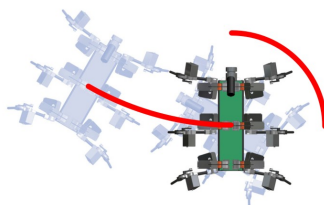


entire robot is only 12cm long and weighs no more than 270g, which is to say it could almost compete with larger insects.

With this mechanical framework and the sensors Nano is provided with, it is an excellent instrument for researching six-legged walking. The sensory network supplies the robot with data about the relations of the forces in the legs (from which information about contact to the ground or to an obstacle can be deduced) and about the inclination angle of the body. For scanning the surface of its surroundings, Nano is provided with a camera and a laser line scanner. The communication with the robot is achieved via Bluetooth, and its spotlights allow operations in the dark.



shifting the body



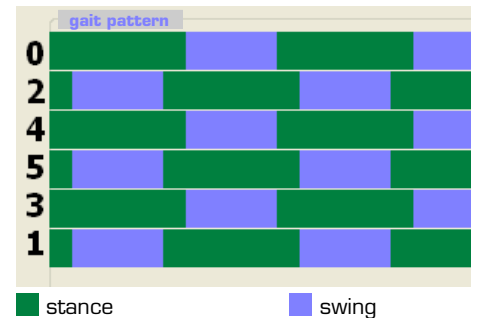
turning around

Nano is controlled by an algorithm based on reacting to the circumstances in an efficient way; it coordinates the robot's 18 degrees of freedom in such a way to make it possible to produce different walking patterns, covering everything from simply walking forward to turning around or shifting the body into the desired direction. Nano's movements are precise and quick: the calculation of a completely new walking pattern needs less than 50ms.

Outlook

The second prototype of Nano will be equipped with new electronic features. Within a minimum of space, there will be additional sensors and two digital signal processors with 750 MHz frequency each. Thus, computation for real-time image processing with stereo cameras, for planning movement strategies and for intelligent obstacle-climbing will take place on the robot itself.

A substitution of artificial muscles from electroactive polymers for the motors of Nano's mechanical framework is planned for as soon as sufficiently tested samples will be available.



Leg phases of a possible gait pattern:
tripoid gate for walking straight

