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The PLANTOID project is making a robot that imitates movements and behaviours of plant roots. ©PLANTOID Project 2012-

Plants can 'hear' running water

A plant root will grow towards the sound of running water, researchers have discovered, and it is inspiring the development of space robots that can hunt for water and even seek out life.

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'Between 100 and 400 hertz (cycles per second) plant roots were able to detect sounds and also to grow towards the source of the sound,' said Professor Stefano Mancuso, a researcher at the PLEASED project, which is working out ways to exploit the sensing abilities of plants.

For over 100 years, researchers have known that plants produce electrical signals when exposed to a change in environmental conditions, such as increased heat from forest fires. These electrical signals are to some extent similar to human electromyography or EMG signals that record electrical activity of the skeletal muscles.

The PLEASED researchers have been recording the electrical signals produced by plants and analysing how they react to different stimuli, such as sulphuric acid that is related to acid rain. They do it by placing electrodes on the leaves of for example a sunflower plant, and then applying a stimulus, such as a flame, close to the leaves and monitoring the changes in the signal.

The project, funded under the EU's Future and Emerging Technologies (FET) initiative, which supports research that challenges current thinking, has found that plants also react to the sound of water. They played the sound of running water to plants and found that the roots started to grow towards the source of the sound, suggesting that roots react to the acoustics of their environment.

They hope to use this information to turn the plants into sensors inside the soil, 'listening' out for underground water and checking acidity by attaching small, simple and cheap devices to the roots that can collect and store information on changing environmental conditions. Plant biosensors will open the door to a sustainable method for environmental monitoring.

Plantoid

However, the sensing ability of plants is also helping researchers to develop a soil-exploration robot for earth. The robot, being developed as part of the FET-funded PLANTOID project, coordinated by Dr Barbara Mazzolai from Istituto Italiano di Tecnologia, mimics the behaviour of roots to monitor environmental conditions underneath the ground. The technology could one day be used for missions on planets in outer space to search for underground water.

'Root systems do not grow randomly and knowledge of why roots move is crucial for a successful subterranean robot,' said Prof. Mancuso, who is also a researcher on the PLANTOID project.

The project hopes to produce a prototype soil-exploration robot by next year, and the technology could be used to make a space robot explore under the soil of a planet for evidence of water or life, or to detect pollutants in earth soils.

As well as sensing, the project is looking to plants for inspiration on how to move underground. Plant root systems can move through the soil very efficiently by growing from their tips - they slowly increase the

pressure on the soil to move through it by changing direction, adding cells to lengthen the side of their root tips in an opposite direction to that in which they are travelling.

PLANTOID researchers have observed that a corn root can grow up to five centimetres per day. In order to mimic this efficient growth, PLANTOID is developing an artificial root that uses a combination of robotics technologies and smart materials to simulate biological movement through soil.

Plant-versation

In addition, the way by which individual roots communicate with one another has shown some surprising results. Using very sensitive measurement techniques normally used to study insect hearing, Prof. Mancuso and researchers at Bristol University recorded roots emitting a continuous clicking sound as part of a separate study. This has led to the hypothesis that these clicks act as localisation cues for roots, allowing them to liaise with each other as they move through the earth.

‘We were able to demonstrate that roots use a kind of swarming behaviour in a way not so different from the way a swarm of ants is able to do it,’ said Prof. Mancuso. The roots explore the soil efficiently without growing too far apart or close together to find nutrients, this coordination is similar to insect-swarm behaviour.

Interview with Barbara Mazzolai, coordinator of the PLANTOID project.

More info

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