Sensor systems

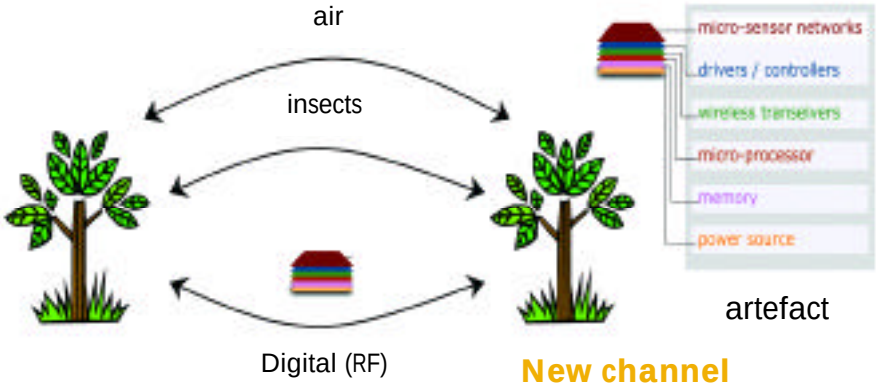
Early stress signals

Plant wilting, leaf scorch, leaf discolouration and pest and disease damage are the result of extreme plant stress. Early plant stress signals commonly remain undetected prior to elicitation of these macro symptoms. The PLANTS project will integrate a number of sensors around plants enabling early signal detection. The amelioration of plant stress by the activation of effectors (or artefacts) will enable optimization of plant productivity and the more efficient use of natural resources.

The Ambient Systems group at NMRC develops sensor technology platforms for use in distributed sensor systems. This technology is aimed at miniaturising the electronics associated with sensors forming autonomous units for power, computing and communication. PLANTS will harvest this technology and integrate some components off the shelf (COTS) as well as some in-house devices to these modules.

Packaging technologies being developed in NMRC will customise the design and fabrication of these devices.

Current channel



New channel

Sensor networks

The **PLANTS** project is investigating methods for creating sensor networks in or around objects and plants, to enable them to form mixed, interacting communities. Plant signals are detected using an array of sensors and converted into digital impulses through the GAS-OS middleware, allowing the plant to communicate directly with artefacts.

Temperature signals

Temperature rise within a leaf is indicative of water stress. Leaf stomatal pores allow the exchange of gases and water vapour (transpiration). Transpiration is stopped by stomatal closure if water levels reach a critical level. Thermography can be carried out to detect water stress using two different techniques: remote sensing by infra-red or by thermisters placed on the leaf.

Chlorophyll fluorescence

The light absorbed by a chlorophyll molecule raises electrons within it to an excited state. On returning to the ground state, a small amount of the excitation energy is emitted as red fluorescence. Chlorophyll fluorescence measurements provide information on photosynthetic efficiency and stress such as photo-oxidative stress, drought and salinity stress. This method is dependent on the proximal sensing of fluorescence emissions following modulated light pulses.

Leaf gaseous signals

Plants emit a range of volatile chemicals with cocktails of these gases relating to the stress response. Commercially available gaseous sensors will be adapted and modified to detect plant stress response. The composition of the volatile gases released from the leaves will identify the type of stress experienced by the plant.

Environmental signals

Environmental sensors will be used as a feedback system to enable proper characterisation of the plant specific sensors and will include light meters, soil moisture sensors and environmental temperature sensors.

Proximal imaging of plant stress. The leaves on the left are showing heat stress. (Courtesy of Prof H G Jones, Dundee University, UK)

This project is funded by the European Community under the "Information Society Technologies" Programme (IST -2001 -38900).