

## **Summary**

### **Where do we go from here?**

The Autonomous Robotic Greenhouse Workshop was successful in identifying industry based needs and priorities alongside government agencies and academia. The initial support and interest shown by the participants is assisting CRESTech in identifying and developing a new program initiative that will be part of the driving force behind the next generation autonomous robotic greenhouse.

## **Summary of breakout sessions**

The workshop identified several key concepts and areas of research that will need to be addressed. These can be found in the power point presentation included on this CD ROM and are summarized here under the subtitles of the breakout sessions used at the workshop. Each breakout group was asked to address technical issues, technology transfer potential, possible collaborations and potential funding sources they saw as available or eligible.

### **Break out group 1**

#### **Systems**

This group identified several issues, the top three being robotic technology; power and energy; and plant biotechnology. Sector technology transfer potential includes the following:

- greenhouse industry
- agricultural industry
- food industry
- space industry
- manufacturing industry
- waste-handling industries

Several areas for potential collaboration were highlighted and sources of funding identified. Among these are the regular investors such as the space agency, federal and provincial sources and university. Additional sources were identified such as the greenhouse industry, power/energy suppliers, the agricultural industry, regulatory and international aid agencies. All of these represent viable and probable sources of funding that can be used to leverage additional funds under a larger program objective.

### **Break out group 2**

#### **Sensors and Sensor Systems**

This group identified the need for specialized sensors to monitor a breadth of parameters. These would include above and below ground environment, electromechanical sensors and imaging systems, energy control and subsystems (e.g., heating, cooling, ventilation etc). It is evident from the information produced in this breakout session that one of the key challenges in an

autonomous robotic greenhouse will be sensor function and feedback control. This represents a large area that will require intensive R&D and a commitment of long term investment by the partners. Potential funding sources still need to be identified however there is overlap in the basics (e.g., federal/provincial gov't programs (IRAP) that encourage technology development proposals). Industrial partners will be the key to successful sensor development.

### **Breakout group 3**

#### **Communications**

Flowers Canada (ON) identified an urgent need to develop communications systems that will allow for cross boarder (and international) tracking of commodities from source to end user/seller. This area of research, integrated into an autonomous robotic greenhouse is envisioned to include bar coding, traceability back to the commodities origin, information systems that capture grower/producer information and relay this to boarder officials (FDA) to alleviate safety and security concerns, and data management (interpretive systems). This area is feeling pressure from federal regulatory agencies that are blocking markets south of the border due to events post 9/11.

CRESTech is currently working with FCO and The Ontario Greenhouse Alliance (TOGA) to establish a road map specific to priorities identified by this market sector. As well, CRESTech is identifying synergies with TOGA's priorities and those of CRESTech's. Capitalizing on these synergies will enable a larger group of industry and researchers to address these specific needs and to successfully lobby for funding resources being identified by TOGA (e.g., AAFC/CanAdvance, CAIS, ACAAF).

#### **Short Term Goals**

Using the information gathered at the workshop, CRESTech is seed funding a collaborative umbrella program to expand on these issues and develop it over the next 3-5 years. CRESTech has begun this initiative with a call for Expressions of Interest (EOI) to produce a technology road map and propose feasibility studies for a range of technologies relevant to the autonomous robotic greenhouse concept. These studies will be the spring board for future, more intense research in the next fiscal cycle (2005-2006).

The goal of CRESTech is to establish and bring together a core resource of industry and researchers that are intent on long term collaboration goals in areas that meet with CRESTech's strategic plan (see website [www.crestech.ca](http://www.crestech.ca)). Once this base resource is seeded, CRESTech believes it (the program and partners) will be in a position to identify and drive the agenda into its longer term goals.

## EOI's

- ✚ Assessing the Application of Soil Arthropods for the Acceleration of Fibrous Horticultural Waste Composting
- ✚ Low- cost CMOS sensor network for pest monitoring
- ✚ An Autonomous Gantry Robotic Solution for Greenhouse Environment
- ✚ Developing a communications system for the operation of a remotely deployed automated bacterial testing unit
- ✚ Vision Sensor Based Autonomous Robotic Harvesting Vehicle
- ✚ A Review and Preliminary Assessment of Greenhouse Automation Technologies

## **Longer term Goals**

CRESTech and the University of Guelph are planning a follow up workshop in 2005 (TBA) to present the results of the feasibility studies and discuss a way forward in preparation for the next round of CFI funding expected to be announced soon. This CFI proposal (2006-10) for the Autonomous Robotic Greenhouse will provide the third phase of infrastructure developments in controlled environment systems. It follows:

Phase 1: Controlled Environment Systems Research Facility at the University of Guelph;  
Phase 2: The Biotron at the Universities of Western Ontario and Guelph;  
Phase 3: The Autonomous Robotic Greenhouse is the next step in the plan. It will couple the needs of the greenhouse industry with the requirements of space exploration. This will result in two way technology transfer between both industries; enhanced productivity and a reduction in overheads in the greenhouse industry; and ensure a food supply for space exploration.

We propose to integrate the infrastructure objectives of the university/industry collaborative community with the technology and expertise requirements of a broad spectrum of industries. These include the greenhouse sector (eg. TOGA, FCO, OGVG), the aerospace sector (eg. MDA, Neptec, Routes) and the controlled environment technology sector (eg. Angstrom, Jonkman, Priva, Argus, Conviron).

This longer term approach, capitalizing on federal and provincial initiatives, will position Ontario's industry and academic partners to excel in the areas of technology deployment and commercialization with new technologies emerging from the efforts of research related to the autonomous robotic greenhouse initiative.

## **Special Note**

CRESTech would like to thank the Canadian Space Agency for their generous financial support of the workshop. These funds enabled the organizers to invite international participation and to

produce these proceedings. Capitalizing on this collaboration, CRESTech hopes to move this agenda forward onto the national and international platform.

CRESTech would also like to thank the University of Guelph for their support and participation in the organization and administration behind the scenes. Stemming from a long standing relationship, CRESTech has developed access to a strong base of research expertise in many facets of plant agriculture, environmental science, engineering, and space science.

Lastly, CRESTech would like to thank all the participants for their input, time and dedication to this endeavor. We will be soliciting future participation from all interested parties in order to stabilize a critical mass of industry, government and academia which will represent the driving force behind phase three of the infrastructure developments. Watch for an announcement in 2005 for the next cycle of workshops that will position this program to drive the agenda forward. **We look forward to working with you again!**

Thank you.

Sincerely,

Richard Worsfold  
Director, Business Development  
CRESTech