Robotics Evolution to Nanotechnology Revolution: Machine Control to Thinking Small

Calling All Mentors
ASABE Conferences and International Meetings

To receive more information about ASABE conferences and meetings, contact the Meetings Department at 800-371-2723 or hq@asabe.org. For the complete list, see www.asabe.org/resource/asabevents.html.

2006

April 8-12  International Symposium on Hydrology and Management of Forested Wetlands. New Bern, North Carolina, USA.

July 9-12  ASABE Annual International Meeting. Portland, Oregon, USA.

2007

June 17-20  ASABE Annual International Meeting. Minneapolis, Minnesota, USA.

ASABE Section and Community Events

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2006

ASABE Endorsed Events

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2005

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2005


September 12-16  Frutic 05. Information and Technologies for Sustainable Fruit and Vegetable Production. Montpellier, France. Contact www.frutic05.org.

2006

TBD  5th International Conference of the Asian Federation for Information Technology in Agriculture. Bangalore, India. Sponsored by the Asian Federation for Information Technology in Agriculture.

To have an event listed here, send information to Suzanne Howard, 2950 Niles Road, St. Joseph, MI 49085, USA; fax 269-429-3852, howard@asabe.org. Information must reach us at least two months before the event.

Call for Papers

WORKSHOP ON AGRICULTURAL AIR QUALITY: STATE OF THE SCIENCE

Bolger Conference Center
Potomac, MD
June 5 - 8, 2006
www.esa.org/AirWorkshop

The sponsors and organizers of the “Workshop on Agricultural Air Quality: State of the Science” invite you to submit abstracts for oral presentations and posters. The workshop will bring together a diverse array of scientists, policy makers, and nitrogen producers and users to assess the state of science regarding agricultural air quality, and to recommend changes and improvements in assessment tools and best management and production practices to mitigate air pollutant emissions from agricultural sources. The workshop will provide a unique opportunity for multidisciplinary exchange of ideas and development of new partnerships. The organizers are interested in oral and poster presentations that update current and emerging knowledge about agricultural air quality science and policy, as well as innovative ideas, processes, and programs by which to optimize agricultural management in crop and animal food production, and environmental protection.

Submit your abstract at www.esa.org/AirWorkshop by October 14, 2005. Limited travel support for junior scientists and students is available. Questions can be addressed to airworkshop@esamail.org, or Air Quality Workshop Manager, The Ecological Society of America, Phone: 202-833-8773, Fax: 202 833-8775.

More on Automation to Come!

On our striking, juice-packed cover, a robotic hand reaches for the harvest — and the future as well. The photo is provided by OARDC photographer Kenneth D. Chamberlain, who skillfully chronicled the greenhouse setting and work of Peter Ling and colleagues at CropKing, Inc. in Seville, Ohio (p.13-14). Automation technology is on the advance, as feature writers of this issue prove: varied instrumentation that allows for sorting of kernels from insects; intelligent pesticide spraying; robotic cucumber picking in a greenhouse; and electrostatic sampling to trap nasty viruses and spores. These are no longer merely concepts but are on our doorstep.

GPS, sonic, laser, and optical systems combined with advanced electronics allow for more machine control than ever before, even if humans are still needed to guide automated efforts into tomorrow. And nanotechnology — a current marketing buzzword, is our tomorrow, says Wolfgang Porod (p. 15-16). Beyond the hype, there are countless possibilities for serious applications and business opportunities.

Because the response to our call for automation tech features was considerable, watch for a continuation on the current issue’s focus: more off-highway equipment on the technology curve toward automation, and more science based on the nanometer, roughly equal to 1/100,000th of the diameter of a human hair.

We can’t split hairs. We just have to bring you more! Stay tuned — to the future and to the next issue of Resource.
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### ON THE COVER

Any one for a BLT? A robotic hand integrated with a commercial robotic manipulator snatches lunch for The Ohio State University (OSU) Agricultural Research and Development team. Delving into the possibilities of a fresh produce harvest for space mission crews, the OSU crew integrated a custom-designed machine vision system, end-effector, platform, and more. Fast machine algorithms were developed to select only the best: red, ripe tomatoes. Their next project? Lunch, of course. *(Photo by Kenneth D. Chamberlain, Ohio Agricultural Research and Development Center; chamberlain.1@osu.edu)*

### Calling All Mentors

17 Mentors are needed for the ASABE Online E-Mentoring Program. Learn how you can make a difference as a mentor, what is involved in mentoring a student or young professional, and how mentors and mentees are matched. This program is in the final phase of development and requires your help for completion. Sign up today!
POSITIONS OPEN

The deadline for copy to be received at ASABE is the first day of the month preceding the month of publication (October 1 for the November issue). Each issue mails on the first day of the month.

Advertisements are $110 per column (3.5-inch wide) inch, which includes free placement on ASABE’s new Career Center Web page at http://careers.asabe.org. Ads are posted on the Web site within three business days of final approval and remain there for 60 days. If the insertion order is for two months, the cost is $99 per column inch per insertion and includes a 90-day free Web listing.

For more details on this service, contact Pam Bakken, ASABE Personnel Service, 2950 Niles Road, St. Joseph, MI 49085-9659, USA; 269-428-6337, fax 269-429-3852, bakken@asabe.org, www.asabe.org/resource/persads.html.

FACULTY POSITION ANNOUNCEMENT

North Carolina State University, Biological and Agricultural Engineering
Assistant Professor—Drainage Water Quality Engineering
Tenure Track, 100% Research
http://www.bae.ncsu.edu/

Responsibilities: This faculty member will work with other faculty and students to further develop and enhance a well-recognized research program in agricultural water management and drainage water quality. Initial areas of interest will include development and testing of a new generation of models for predicting effects of water management and cultural practices on loss of nitrogen and phosphorus from drained lands to surface waters. The successful candidate will be expected to take an active role in field and watershed scale studies on drainage hydrology and water quality, and to develop collaborative relationships with other faculty in the department and with other disciplines on campus and around the world, including national and international agencies involved with drainage and drainage water quality.

Qualifications: Candidates must have a PhD in Biological and Agricultural Engineering or a related field, and a strong background in Soil and Water Engineering. Preference will be given to candidates with experience in drainage and in experimental and modeling approaches to drainage hydrology and water quality. Candidates must possess the ability and desire to direct graduate student research, publish articles in professional journals, and attract external funding. Excellent verbal and writing skills are required. Registration as a Professional Engineer or eligibility for P.E. licensure in North Carolina is required.

Salary: Competitive and commensurate with background and experience.

Equal Opportunity Employer: NC State University is an equal opportunity and affirmative action employer. All qualified applicants will receive consideration for employment without regard to race, color, national origin, religion, sex, age, veteran status, disability, or sexual orientation. In its commitment to diversity and equity, NC State University seeks applications from women, minorities, and persons with disabilities. ADA Accommodations: Betsy Maness, Email: betsy_maness@ncsu.edu; Phone 919-515-6701; Fax: 919-515-6719.

Application Procedure: Applicants are requested to send a letter of intent describing qualifications and interests along with a statement of career goals in research and teaching, curriculum vitae, copies of academic transcripts, and the names and contact information of three references to:
Dr. J.H. Young
Campus Box 7625, North Carolina State University
Raleigh, NC 27695-7625

Application Deadline: Applications received by October 1, 2005 will receive first priority but applications will be accepted until the position is filled.

(continued on page 26)
Automated Instrumentation Sorts Grain Kernels and Insects

ASABE member Floyd E. Dowell, floyd.dowell@gmprc.ksu.edu, USDA-ARS Grain Marketing and Production Research Center, Manhattan, KS, USA

Agricultural and electrical engineers at the USDA-ARS Grain Marketing and Production Research Center, Engineering Research Unit in cooperation with entomologists and cereal chemists have developed an automated single-kernel trait-selection system. The system feeds single kernels to a viewing area where a near-infrared spectrum is collected. The system was originally developed to measure wheat quality characteristics, such as protein, hardness, vitreousness, fungal damage, toxin levels, and sprout damage from the NIR spectrum. Kernels are then sorted at a speed of about one kernel per second based on user calibrations. Applications of this technology include selecting specific grain traits, such as high protein content, from early generation breeder samples to aid in development of cultivars with specific attributes. The system is also being used to select specific traits from samples, such as kernels with specific hardness characteristics, to study environment and genetic affects on quality traits. Other applications include selecting specific quality traits, such as sprout damage or toxin levels, to potentially aid inspectors in determining grade criteria, including those relating to food safety. The system is also finding applications in other grains, such as sorting millet by starch levels and sorting sorghum by hardness. An additional application of this technology includes sorting tsetse fly pupae, which are about the same size as grain kernels, by sex. In fact, the first commercial application of this technology was to automatically sort tsetse fly pupae by sex so that males could be sterilized and females returned to rearing colonies as part of the Foreign Agriculture Organization, International Atomic Energy Agency, Sterile Insect Technique fly eradication programs in Africa. The system was developed through the Cooperative Research and Development Agreement with Perten Instruments, Springfield, Ill., and is currently being commercially produced by Perten Instruments, Stockholm, Sweden.

Latest Agricultural Robots and Traceability Information Based on Robotic Agriculture

ASABE member Naoshi Kondo, kondo-n@si-seiko.co.jp, SI Seiko Co., Ltd., Japan

Food traceability systems are helpful for solving various problems that can surface in the quality of food supply systems: food poisoning, illegal unregistered chemicals, camouflage products, BSE, bio-terrorism, etc. Bioproduction robots can be substituted for human labor and have contributed to raising product market values and ensuring product uniformity. Robots can also be useful and necessary for adding precise information to field operations data and, thus, can be invaluable contributors to precision agriculture. Several robots and sensing systems have been developed and commercialized thus far.

A real-time soil sensor, announced to the media in November 2004 by Japanese companies, gives information on organic matter, moisture content, nitrogen, pH, EC, and compactness of field, and provides an information map of a field immediately after sensing.

Seedling production and crop management robots include transplanting, grafting, and spraying robots. Cutting/sticking robots are also being readied for market. These robots provide information for farm operation records, e.g., when, where, how much, and what kind of chemicals or fertilizers were sprayed.

Much research has been done on fruit-harvesting robots, but a commercialization stage has yet to be reached, although a Japanese company along with a national research institute are attempting to market a strawberry-harvesting robot with government support. If they succeed, the robot will give information not only on harvested location, time, and date of individual fruits but will provide plant monitoring data during the actual growing season. The robot will also help locate disease or insect-injury at an early stage.

A fruit-grading robot system with two manipulators for peaches, apples, and pears was commercialized in July 2002. Many automated fruit grading systems with six

Automated single-kernel trait-selection system that measures grain characteristics using near-infrared spectroscopy.

Real-time soil sensor, Shibuya Machinery Co., Ltd., SI Seiko Co., Ltd.

Fruit-grading robot, SI Seiko Co., Ltd.
color-TV cameras, X-ray imaging equipment, and an NIR internal quality inspection system on each line have been sold. These systems can store data on fruit size, color, shape, disease, bruises, sugar and acid contents, and internal defects in their own PCs.

Because information gleaned by robots and automation systems is much more precise and lengthier than that compiled by human workers, it can be accumulated in a traceability database handled by a management group for effective use.

Automated Online Poultry Safety Inspection Tested

ASABE members Bosoon Park, bpark@saa.ars.usda.gov, and Kurt C. Lawrence, William R. Windham, and Douglas P. Smith, USDA-ARS, Richard B. Russell Research Center, Athens, GA, USA

Although the United States has one of the safest food supplies in the world, significant food safety problems can cause either human illness or economic losses. Reduction in the potential health risks to consumers from human pathogens in food is an important food safety issue and public concern.

The Centers for Disease Control and Prevention (CDC) estimates that 76 million persons contract foodborne illnesses in the United States annually, resulting in 325,000 hospitalizations and 5,000 deaths. As the government agency responsible for overseeing the safety and wholesomeness of the meat and poultry industry, the USDA’s Food Safety & Inspection Service (FSIS) has developed a series of rules and regulations designed to prevent the occurrence of these bacterial pathogens in the U.S. meat and poultry food supply.

Citing a potential correlation between fecal contaminants and bacterial pathogens, FSIS established a standard that requires the surfaces of meat and poultry carcasses during slaughter to be free of fecal contaminants. Preventing poultry carcasses with visible fecal contamination from entering the chlorinated ice-water tank (chiller) has been deemed critical for preventing cross-contamination with other carcasses. Currently, FSIS ensures compliance with their zero fecal tolerance in poultry and meat processing establishments by visual inspection.

Agricultural Research Service (ARS) scientists in the Poultry Processing Research Unit at the Richard B. Russell Agricultural Research Center, Athens, Ga., have patented a method and system to detect contaminants on the surface of foods. ARS is developing a real-time multispectral imaging system for use in a poultry processing plant. For an automated online fecal detection system, the development of a reliable high-speed imaging system, which can process birds at a rate of 140 birds per minute, is needed.

The core component of the real-time multispectral imaging system is a common-aperture charge-coupled device (CCD) camera. This camera utilizes a single aperture and dichroic prisms, which act as cutoff filters, to direct broad spectral regions onto each of the three CCD detectors. Just prior to reaching the CCD, a trim filter allows only a specific narrow wavelength band to reach the detector. Thus, each detector captures an image at user-defined, specific wavelengths that are spatially aligned with the other detectors.

In conjunction with object-oriented image processing software the system performed well for online detection of fecal and ingesta contaminants. The real-time imaging system can be employed to reprocess contaminated birds, resulting in fewer processing line slowdowns and a safer food product for the U.S. consumer.

The system is currently being tested in pilot-scale poultry processing facilities to test the efficacy of an industrial-scale imaging system. ARS is also working with a poultry processing equipment manufacturing company under a Cooperative Research and Development Agreement to commercialize the system for fecal contaminant detection to implement in poultry processing plants.
Intelligent Pesticide Spraying Aims for Tree Target

ASABE member Jiaqiang Zheng, jqzheng@njfu.edu.cn, Nanjing Forestry University, China

Traditionally, pesticide spraying for forest/tree protection was applied uniformly, no matter whether there were tree targets or target variations within the spraying area while the sprayer passes through. This practice has resulted in non-target deposition, a significant portion of the variable costs of forest production, and a significant impact on the environment, as there are often some spaces between sprayed target trees and crown differences among different trees.

Researchers at the College of Mechanical and Electronic Engineering in Nanjing Forestry University began conducting research on an intelligent pesticide spraying technique in 1999, endeavoring to develop a tree image processing system, a tree crown recognition system, and a smart spraying execution system.

The tree image processing system includes a CCD camera, an image grabber, and computer. The software was developed to realize the functions as follows: capturing the real-time tree video stream, extracting and processing the key frame of the tree image from the video stream, segmenting the green target from its background by a classifier called relative color indices, and measuring the segmented image by a statistic method to obtain morphological and location features of the tree target, which provides for intelligent understanding and pattern recognition.

The tree crown recognition system, based on BP artificial neural networks was developed as the toward-target spraying is largely dependent on the tree crown type. The tree crown features could be extracted after image segmentation. These features were put into the designed ANN, and six unknown typical tree crowns (cone, oval, spherical, cylindrical, umbellate, and truncate) could be recognized precisely and effectively.

The smart spraying system was composed of a spraying table, nozzles, and solenoid valves and relays, which convert the spraying decision-making results into instructions for controlling the spraying execution system. If the value of a presented target tree area is larger than a threshold value in a control zone, the spraying decision is made to turn on the valve of the corresponding nozzle.

Potential applications of intelligent pesticide spraying includes street trees and urban forest, shelter forest belts, sightseeing landscapes, orchards, protected agriculture, and aviation areas. Such pesticide spraying would have social and economical benefits and promote pesticide application automation and the sustainable development of agricultural and forestry productions.

Robot Picks Cucumbers in a Greenhouse

E.J. van Henten, eldert.vanhenten@wur.nl, Wageningen University and Research Centre, The Netherlands

Labor costs are a major issue in European horticultural crop production, amounting to 30 percent of total production costs and showing a rising trend. Additionally, growers face an increasing shortage of skilled labor. Therefore, improving the efficiency of human labor or replacing human labor by robots are ways to tackle these challenges.

Wageningen University and Research Centre has anticipated these trends by developing robots for greenhouse crop production. A robot was developed that removes leaves in a cucumber crop and harvests the fruits, thereby performing two tasks.

To facilitate automation in cucumber production, a new growing system was adopted, a so-called high-wire cultivation system, which is commonly used for growing tomatoes. In a high-wire system it is...
easier to detect, locate, and approach the fruit than in a traditional bush-like growing system.

The robot consists of an autonomous vehicle, which uses the heating pipes mounted on the ground as rails for guidance and support. The vehicle carries electronic hardware for data-acquisition and control, a camera vision system, a seven-degrees-of-freedom manipulator, and special tools for harvesting fruits and cutting leaves. To switch from one task to the other only requires a change of tools and activation of different software modules of the vision system.

A camera vision system combining information in the visible light region with information in the near-infrared (NIR) is used to detect the fruits, leaves, and stems of the cucumber. Ripeness assessment of the fruits is based on an estimation of the volume of the cucumber fruits. The localization of fruit, stems, and leaves in the three-dimensional world is achieved by using stereovision techniques.

To harvest the fruit, the end-effector grips and cuts the fruit stem. During a field test, the cucumber robot harvested 74 percent of the cucumbers present.

For cutting the leaves, a different approach is used. The end-effector consists of a ring mounted around the main stem of the plant, which moves in upwards direction. Leaf stems are electronically detected and then cut.

Wageningen University and Research Centre will now take this solution to industry to commercialize the cucumber robot. In the meantime, several spin-off projects have begun, including a leaf-picking robot for tomatoes, a harvesting robot for roses, and various mechanization projects for cut flowers like Gerbera and Chrysanthemum.

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**Unloading Automation Implemented in Grain Industry**

ASABE fellow Digvir S. Jayas, digvir_jayas@umanitoba.ca, and ASABE members Aravind L. Mohan and Chithra Karunakaran, University of Manitoba, Winnipeg, MB, Canada

Grains produced on the farm are transported to primary elevators by trucks and then to the terminal, transfer, or process elevators by rail cars, commonly called grain cars. In the grain industry in Canada, there are about 23,500 grain cars operating, based on the demand. Unloading grain cars involves opening hopper gates at the bottom of the grain cars.

At present, the opening of hopper gates is accomplished manually or semi-automatically. Manual opening of hopper gates is laborious and requires a torque of about 3,500 N-m (2,581 lbf·ft). To increase the operational efficiency, the unloading process has been semi-automated by different opening methods. Manual or semi-automatic unloading is accomplished by fitting a tool into a sprocket of the hopper gate opener and turning it accordingly to open or close the hopper. For instance, an operator from a remote cabin aligns the opening tool with the sprocket. However, there is no control on matching the faces of the tool and the sprocket, leading to a hammering effect, which reduces tool and sprocket life. In addition, the contents of the grain car are not physically checked before unloading. Grain unloaded from a grain car is difficult and expensive to clean because the Canadian system is designed to ship grain rather than receive it. Unloading a wrong car could contaminate part of the system and require additional processes such as cleaning and separation. These problems in grain unloading can be eliminated by automation of the process.

The “Grainobot” is a Cartesian robot equipped with two cameras and an opening tool as the end-effector. The first camera acts as the eye to determine the sprocket location, guides the tool opener to the sprocket opening, and further fine-tunes the position of the tool face with the sprocket. Three lead screws and three slo-sync motors control the tri-axial movement of the robot. The fourth slo-sync motor controls the rotation of the end-effector. A sample of the grain-car content is taken by slightly opening and immediately closing the hopper gates. The sample is identified by taking images using the second camera, and...
images are analyzed before unloading the grain-car.

Successful implementation of this project at the Canadian Wheat Board Centre for Grain Storage Research will benefit not only the grain industry but all industries that transport free-flowing granular materials in hopper cars.

Detecting Fluid Change in Liquid Piping Systems

ASABE member Garrett Chandler, gchandler@uky.edu, University of Kentucky, Lexington, KY, USA

The ability to automate food processing operations provides opportunities to decrease system wastes and increase food safety. It is common industry practice to use the same equipment to process different liquid product streams one after the other. Similarly, water is frequently used to force products through piping systems. The interface between the two products or the water and product is not planar but exists as a length of fluid where mixing has occurred. The distance between the boundaries of this transition region depend on many things, including flow rate, pipe size, pump types, and the rheological properties of both fluids.

Determination of the transition point between fluids in food processing plants is determined either manually by operators who develop a feel for the time required or automatically using reflectance or transmission sensors. Manual determination inherently provides opportunity for product loss, an increase in effluent loading, and possible product contamination. A novel method for determining a transition between fluids has been developed by the Biosystems and Agricultural Engineering Department at the University of Kentucky. It uses a microprocessor-based detection system to measure and analyze the optical transmission of the fluid in real time and determine when a change has occurred.

Processing of the signal by the microprocessor allows the transition point and the length of the transition phase between fluids to be determined. Thus, the fluid can be accurately sectioned into the first fluid, the transition region, and the second fluid. In doing so, process wastes are minimized. The methodology has been found to be so accurate that it can detect the in-pipe transition between water and a clear carbonated soft drink.

One of the key features of this technology is that the sensor does not require in-plant calibration. The derivative-based algorithm capitalizes on the microprocessor's ability to take and store many measurements over a short period of time. There is no need to take the sensor off-line and present it with reference fluids, as the system can be verified in-line using water. Natural system deterioration, such as aging of the light emitter or scratches on the optical components, does not affect its ability to function accurately.

The final testing of the system was completed in May 2005. The sensor technology is patented by the University of Kentucky Research Foundation and will be marketed through Reflectronics, Inc.

Unmanned Robot Tractor Uses RTK-GPS and Attitude Sensor

ASABE members Michio Kise, kise@uiuc.edu, University of Illinois at Urbana-Champaign, Urbana, IL, USA, and Noboru Noguchi, noguchi@bpe.agr.hokudai.ac.jp, Hokkaido University, Sapporo, Japan

The efforts to develop automated or autonomous guidance systems for agricultural vehicles are motivated by the decrease in the farm labor force and the desire for higher production, greater efficiency, and safer operations.

An unmanned agricultural tractor using RTK-GPS and a fiber optical gyroscope-based attitude sensor has been developed at Hokkaido University in Japan. The autonomous guidance system can perform all field operations, including row following, end-of-row turning, and equipment controls, without any human assistance. The platform tractor, developed by a tractor manufacturer and based on a “normal” 56.7 kW (76 hp) tractor, is capable of controlling most tractor functions including steering, braking, gear shifting, throttling, three-point hitch height, and the PTO using a control area network (CAN) based vehicle control unit.

The on-board navigation sensors provide the position and heading angle of the tractor. The RTK-GPS measures the position of its antenna, which is mounted on the cabin directly over the tractor’s center of gravity with ±2 cm (0.8 in.) accuracy. The positioning error associated with the tractor attitude is compensated using the sensor, which measures the roll, pitch, and yaw angles of the tractor. The heading angle is determined, based on the sensor yaw angle, and its drift error is compensated by means of the sensor fusion with the RTK-GPS. To perform end-of-row-turning efficiently, a path creation system is designed
Unmanned robot tractor system consists of a robot tractor, an RTK-GPS, an attitude sensor, and two special pieces of equipment developed for the system to perform complete autonomous operation.

along with a mathematical tractor dynamics model. A path tracking algorithm based on a linear quadratic regulator is implemented for reliably and accurately tracking both straight and curved paths.

Along with the platform tractor, two special pieces of equipment were developed for the guidance system to perform completely autonomously. One of the developed pieces, a variable rate (VR) planter, is equipped with a CAN-based controller to perform site-specific fertilizing in accordance with the application map. The other equipment developed for the guidance system, a VR sprayer, also has a CAN-based controller and is able to control each nozzle individually.

The unmanned robot tractor has successfully performed numerous autonomous field operations at different sites and in different situations, planting on hilly fields and spraying within curved rows, at a travel speed of up to 3 m (9.8 ft) per second with a tracking error of less than 5 cm (2 in.).

High-Efficiency, Low-Cost, Portable Electrostatic Sampler Catches Airborne Bacteria, Viruses, and Spores

ASABE member Bailey W. Mitchell, bmitchell@seprl.usda.gov, Southeast Poultry Research Laboratory, USDA-ARS, Athens, GA, USA

A low-cost, simple, portable electrostatic sampling device (ESD) has been developed for high-efficiency sampling of airborne bacteria, viruses, and spores. The compact, 2-lb ESD is battery operated and housed in a completely waterproof enclosure for easy disinfection. The ESD has good potential as an affordable and sensitive detection method for pathogenic strains of microorganisms or toxins that may be present in small amounts but difficult to recover. It can easily be applied to any area where high-efficiency air sampling is needed.

Previous devices with good-to-high efficiency recovery were typically large and bulky, difficult to disinfect, or expensive – ranging in price from $1,000 to $25,000. Although not yet commercialized, the ESD parts cost only about $50 for the present custom-designed version.

The ESD has been tested extensively in clean lab areas, in exhaust air from poultry houses, and in caged layer rooms with birds infected with *Salmonella enteritidis*, where up to 20-fold improvements have been seen compared to standard settling plates (better performance than a well known and widely used medium-volume impaction sampler costing approximately 100 times as much). It has also been used to capture samples for RT-PCR detection of avian reovirus and plant viruses. If it is operated for two hours or more, it can provide the equivalent of a high-volume air sampler, and it can be operated up to 16 hours with two standard 9-V batteries. It is easy to transport and convenient to place in various locations throughout a space. Its low cost and simplicity make it practical for routine use by hygienists, microbiologists, technicians, etc. The ESD can be used with semisolid or liquid media, water, or metal collectors such that samples could be transferred to RT-PCR for rapid diagnosis of specific organisms. Potential applications include monitoring of animal or horticultural areas, processing
areas, hospitals, public areas, and air quality surveys. A patent application has been filed for the ESD, and it is available for licensing.

Robot Synergy: A Marriage of Engineering and Biology

ASABE member Tony Grift, grift@uiuc.edu, University of Illinois at Urbana-Champaign, Urbana, IL, USA

The Agricultural and Biological Engineering Department of the University of Illinois is pioneering agricultural robotics by integrating concepts from biology and engineering. As a starting point, AgTracker was developed — a rugged, simple, skid steering robot at a manufacturing cost of $500. The main objective of this robot was to demonstrate low-cost crop guidance functionality.

In pursuit of using the synergy among multiple, communicating robots, AgAnts were built. Imagine an AgAnt roaming the field looking for weeds. When a weed plant is detected, the lone AgAnt “calls in the cavalry” to tackle the patch as a group. Similar to real ants, the combined intelligence of the AgAnts army allows for advanced strategies. This would require learning among robots or intelligence evolution, to “grow” the optimal weed management strategy rather than designing one. Even mechanical robotic reproduction comes to mind, but implementation would be a challenge.

The mechanism behind intelligence evolution might be realized as intelligence replication, where virgin robots (or recycled underachieving ones) with blank brains are “educated” using the combined “wisdom of weeding” of two or more successful parents. This evolving robotic ecosystem within a biological one would be a genuine engineering marvel based on the theoretical framework developed by bio-mathematicians and a celebration of the As and B in ASABE.

The idea goes further. Imagine making the natural in-situ resources, such as the weeds, the energy source of the AgAnts. This may sound far-fetched, but recently the University of Western England launched Ecobot II, a flying robot that eats flies for lunch. Along the same line, the Agricultural and Biological Engineering Department is developing an autonomous harvester for Miscanthus, an energy crop, recently introduced in Illinois. Similar to Ecobot II, the robot is powered by the logical, locally available energy source, the Miscanthus crop itself, using a Stirling engine as an energy converter.

The viability of automation technology in agriculture can be demonstrated by building the Autonomous Acre. The project goal is to grow a crop without human intervention. This requires autonomous machinery for tillage, planting, fertilization, scouting, spraying and harvesting, and most importantly, the addition of intelligence to the machines so they can make management decisions that optimize crop yield and minimize environmental impact.

The concept could come full circle by building a bio-based living arrangement where the farming operations are automated and integrated with the living spaces, waste management, animal housing, energy generation, water treatment and housekeeping. This approach utilizes the synergy among robots and to brings together automation, culture, environment, and systems (ACESys), creating a sustainable life support system for current and future generations.

Modular Design Makes Smart Transducers Plug-and-Play Possible

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As an increasing number of microcontrollers, sensors, and actuators are embedded in agricultural machines and processes, efficient system integration becomes a critical issue. A recently developed agricultural bus standard, ISO 11783, provided a platform for mobile equipment communications through controller area networks (CAN), enabling plug-and-play of microcontrollers of different makes, types, and models. However, plug-and-play installation of sensors and actuators remains an unsolved task.

Standardization efforts initiated by the National Institute of Standards and Technology led to the development of IEEE 1451.1-5, the standards for intelligent sensors and actuators,
referred to as “smart transducers.” The smart transducer interface module (STIM) provides up to 255 channels to accommodate sensors and actuators with signal conditioning and processing functions that are generic to each type of signal (analog, digital, pulse, etc.). The transducer electronic data sheet (TEDS) within the STIM stores information on specific transducers to allow self-identification, self-configuration, self-documentation, and self-calibration. The network capable application processor (NCAP) functions as a gateway between a network and the STIM. The transducer-independent interface (TII) provides a network-independent interface between the STIM and the NCAP. Recently, popularly accepted RS-232, RS-485, and USB serial communication protocols have been considered to replace TII.

The smart transducer concept separates the transducer interface from the network interface, hence, dividing the tasks between the transducer manufacturers and the system integrators (equipment manufacturers). While system integrators concentrate on networking of various sensors and actuators through transducer-independent NCAPs, transducer manufacturers can make their specific products generic through appropriate design of network-independent STIM and TEDS. By dividing the tasks, both parties can take advantages of their strengths while avoiding their weaknesses.

Researchers at Kansas State University tested this new concept through the development of a weed-sensing and spray-control system. Among the two novel weed sensors embedded in the system, one used the conventional interface between the sensor and the CAN network, while the second one, designed using the “smart transducer” concept, contained two microcontrollers serving as STIM and NCAP, respectively.

For the smart weed sensor, six light-reflection signals measured at selected wavelengths were acquired, conditioned, and processed in the STIM. The TEDS in the STIM contained a meta TEDS that describes the general information about the sensor, a channel TEDS that defines the individual channels, and a calibration TEDS that contains complete calibration data for each channel. The NCAP was designed specifically for CAN. The smart weed sensor worked well with other components on the CAN network, including a Fieldstar virtual terminal, a GPS, and spray nozzles. Extensive tests have shown that the weed detection rate was higher than 80 percent.

Experience obtained by KSU researchers demonstrated that the IEEE-1451 smart transducer standards can be integrated with agricultural bus standards to provide a flexible solution for system integration. The smart transducer concept extends the modular design approach from the CAN node level to the transducer level. At the CAN node level, microcontrollers made by different manufacturers can be “plugged” into a CAN bus that conforms to the ISO 11783 standard and immediately start to “play.” At the transducer level, various types of sensors and actuators made by different manufacturers can be “plugged” into the CAN network through IEEE 1451-conforming smart transducer modules and start to “play.” Thus, combined use of the IEEE-1451 and ISO-11783 standards may provide complete plug-and-play capabilities for sensors, actuators, and microcontrollers. As precision agriculture technology advances, modular design and plug-and-play capabilities have become a future trend that would be appreciated by sensor manufacturers, system integrators, as well as farmers.

High-Tech Farm Automation for Solid Desert Wood Production

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Potlatch Corp.’s Hybrid Poplar Agroforestry Project in Oregon is rated as one of the most advanced automated large-scale drip irrigation projects in the United States, if not the world. Besides state-of-art automation in irrigation, the project has numerous other automated operational functions that label it as an exceptionally high-tech farm. The project is essentially the world’s largest contiguous drip-irrigated tree farm using technically high-end automated technology to produce solid wood at national and international certified sustainable rates.

In an area with less than 20 cm (8 in.) of total annual

IEEE 1451 system architecture.

Smart weed sensor.
precipitation, this project irrigates a fast-growing desert hardwood using a massive and complex automated irrigation water distribution system for 8 million trees on 7,013 ha (17,330 acres) and leased crops on 1,943 ha (4,800 acres) under pivot irrigation.

The project’s irrigation system has a peak flow capacity of 681,374 Lpm (180,000 gpm) with 66 pumps [total 22,380 kW (30,000 hp)] at 13 different pumping stations. The pipe network consists of 805 km (500 miles) of buried 5-to 183 cm (2- to 72-in.) diameter pipe with the drip tube length of 28,968 km (18,000 miles) with 17,000,000 emitters.

This project is so large and complex that it requires a highly sophisticated supervisory control and data acquisition (SCADA) system. The SCADA system controls and monitors all 170 pumps, 366 individual fields, 105 flow meters, 327 pressure transducers, 1,204 automatic valves, 306 soil moisture sensors, 39 power monitors sensors, 112 timers, 8 water quality sensors, 29 counters, 74 filters, and 46 center pivots. This stand-alone SCADA system consists of two computers installed with the latest in human machine interface software programs and two processors interacting with 153 field processors using spread-spectrum radio telemetry.

In addition, advanced technology and automation is utilized for GIS acquisitions, PDA in-field data collection, a local field Ethernet wire-

less network, log merchandising, information dissemination, and remote satellite/aerial sensing. Using the best available automation technologies allows Potlatch Corp. to maintain a high level of efficiency in its endeavors to produce the most efficient and cost-competitive, high-quality “green” wood products in a sustainable, safe, and environmentally conscientious manner with a minimum of staff.

Agricultural Robots Lead the Way

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Developing smarter machines has long been a goal of engineers and researchers. Over the years, many strange machines have been developed to work in the outdoor environment, but in most cases they have never really achieved their practical objectives as they tried to oversimplify the complexity of the natural environment.

Since 2000, the international AgroTechnology group has been developing mobile robots using a different approach: using behavior to deal with and embrace real-world complexity. A method of analyzing how people behave has been developed and then structured into a form that can be programmed into a machine so that it can behave sensibly in a given context.

These machines are small for safety reasons, highly efficient as they can sense their surroundings, and act according to predefined values. A good example of how this can work is to replace chemical herbicides with a smart mechanical weeder. The result is the same control of weeds but done in a way that does not use any chemicals. Each plant is treated separately by smart machines. This approach is called “Phytotechnology.”
Automated Soil Mapping On-the-Go

One way of making precision agriculture more precise

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One of the main goals for implementing precision agriculture technologies is to manage crop production inputs according to local needs. It has been proven that proper variation in the application of seeds, fertilizers, and other amendments across a field can significantly increase profit and reduce chemical waste. However, the successful implementation of this approach has been limited. Conventionally available yield maps and remote sensing imagery provide information about crop performance in different parts of the field. However, the ability to determine the yield-limiting variability of growing conditions (e.g., soil properties) remains questionable. It has become particularly obvious that manual soil sampling followed by laboratory analysis does not provide an adequate number of key soil property measurements at a reasonable cost. Therefore, the need has emerged for sensors that conduct measurements of soil properties while moving across a field.

During the past 20 years, researchers and manufacturers from around the world have attempted to develop on-the-go soil sensors. Although a large variety of design concepts exists, most current on-the-go soil sensor prototypes involve one of the following measurement methods:

- Electrical and electromagnetic sensors that measure electrical resistivity/conductivity (available commercially) or capacitance affected by the composition of the soil tested.
- Optical and radiometric sensors that use electromagnetic waves to detect the level of energy absorbed/reflected by soil particles.
- Mechanical sensors that measure forces resulting from a tool engaged with the soil.
- Acoustic sensors that quantify the sound produced by a tool interacting with the soil.
- Pneumatic sensors that assess the ability to inject air into the soil.
- Electrochemical sensors that use ion-selective membranes to produce a voltage output in response to the activity of selected ions (e.g., hydrogen, potassium, nitrate, etc.).

It would be great if either commercially available sensors or those under development could generate the output directly
related to a selected soil treatment need. Unfortunately, most of the measurement approaches listed above can be affected by several influential soil properties. For example, popular maps of soil electrical conductivity can be influenced by soil texture, moisture, salinity, organic matter content, or a combination of these factors. Similarly, soil mechanical resistance sensors can detect differences in soil compaction as well as variability in moisture. The recently commercialized automated system for mapping soil pH is able to detect the variability of soil acidity/alkalinity, which does not necessarily represent the lime requirement. Therefore, sensor integration (combining alternative measurement principles) has become a promising direction in current research.

In general, current on-the-go sensors may not necessarily substitute for conventional methods of determining physical and chemical soil attributes. They can, however, help delineate field areas with relative spatial soil uniformity which will make low density conventional measurements more effective. Ultimately, more precise maps of soil treatment needs will become available.

Automating the Detection of Mastitis

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Mastitis is acknowledged as the most common and costly disease in the dairy industry worldwide. Estimated annual losses by the U.S. dairy industry alone amount to between $1.5 and $3 billion. A key factor in reducing these costs is the development of cost-effective methods for earlier detection of the infection, which improves the quality of information for farmers and their advisers, enabling them to make better informed decisions concerning a mastitis management strategy.

While numerous manual tests already exist, they are labor intensive and have limited predictive capabilities. The alternative of laboratory analysis, while providing more accurate data, is more expensive and involves a delay in obtaining results while the infection can progress. However, the development of online sensor technologies represents an alternative solution capable of automating the data collection process. Potential benefits include reduction in the cost of data collection and improvement in the quality of information by increasing in the number of real-time data points.

This is particularly beneficial for mastitis detection because it enables it to be monitored as a process. Monitoring the process, rather than the condition, is key to effective mastitis management, particularly since the cow is potentially capable of self-healing.

To assist in understanding this process Sensortec proposes a Mastitis Cause-Effect Spectrum that outlines the up-front biological causes and downstream physiological effects that occur as an infection progresses. The company is working on a range of online sensor technologies that span this entire spectrum.

Its AE50 award-winning Quarter Conductivity sensor is capable of detecting tissue damage about 1.5 milkings before sub-clinical mastitis progresses to the clinical stage. Its online SCC sensor technology is capable of earlier detection, at the stage when the cow’s immune response system is beginning to fight the infection. Earlier evidence of immune response activity, when pre-clinical mastitis is about to become sub-clinical, is also possible using a Milk Amyloid A sensor, which Sensortec is developing with Tridelta Developments to detect acute phase proteins in milk.

Sensortec is also developing patented technology resulting from research undertaken by AgResearch. This technology is based on measurement of lactate in milk. As a by-product of anaerobic metabolism, lactate appears to be linked to the beginning of an infection. Bacteria entering the udder via the teat canal multiply given optimal conditions for growth. This metabolic activity and subsequent immune response uses oxygen in the udder thereby inducing anaerobic conditions. Lack of oxygen causes lactate production proportional to the amount of metabolic activity. As the infection progresses, the levels of activity and lactate increase.

These technologies are being developed in parallel on an AMS installation as part of the Greenfield research project in which Sensortec is a joint venture partner with New Zealand’s dairy research organization, Dexcel Ltd. Collecting data from these sensors at every milking enables its research scientists to build a unique database that will give them a better understanding of the mastitis process. Their unique insight into this process will facilitate earlier detection of mastitis and create opportunities for development of earlier non-antibiotic treatments.

Sensing and End-Effector for a Robotic Tomato Harvester

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Fresh produce provides valuable nutritional needs and a psychological boost for crews of long-term space missions. Labor requirements to grow and harvest the crops, however, must be reduced through automation to allow the crew to perform other tasks. A robotic tomato harvester was developed for continuous, selective picking of mature tomatoes. The goal of this project was to develop a sensing unit and a robotic hand unit that could be integrated with a commercial robotic manipulator for the automated tomato harvesting task. Machine vision algorithms were developed to determine sizes and locations of mature tomatoes including those that are partially occluded by leaves, stems, or branches. An end-effector subsystem, including a four-finger prosthetic hand and an embedded hand controller, was designed and assembled for the tomato picking, holding, and placing task. By integrating the custom-designed machine
vision system (eye), an end-effector (hand), a commercial robotic manipulator (arm), and a mobile platform (feet), the robotic tomato harvester was evaluated for its tomato picking performance.

Robot guidance for the tomato picking operation was done by identifying locations and sizes of harvestable tomatoes. Fast machine vision algorithms were developed to identify red tomatoes even when they were partially occluded by tomato branches. The cord construction algorithm had a 42:1 speed advantage over a conventional Hough transformation in identifying partially occluded tomatoes. Harvesting obstacles such as a stem located between a mature tomato and the robot hand were also identified to improve tomato picking performance.

The purpose of the end-effector is to pick one fruit at a time from a tomato plant and deposit it for storage or transport. A suction cup was used to first secure a fruit and bring it out of the plant foliage without tangling. To detach a fruit from a plant, the fruit was caged by the fingers instead of firmly grasped before pulling away from its parent plant to reduce fruit damage. First joints of the four fingers were closed to cage a fruit. The end-effector consists subsystems for vacuum/suction, grasping, mechanical power transfer, and vision hardware.

The developed machine vision system and end-effector were mounted on a commercial robotic arm (UPJ, Motoman Inc., West Carrollton, Ohio). Duplex communication between the machine vision (main) computer, the robot controller, and the hand controller were established. The use of a suction cup to secure fruits reduced the accuracy requirement in detecting fruit location that in turn allowed significantly faster fruit detection operations.

This project demonstrates a case in which an agricultural task is automated by building on the state-of-the-art robotic and machine vision technologies. The sensing and picking capability of the robotic tomato harvester has been demonstrated in laboratory and commercial greenhouse environments. Success rates of tomato fruit sensing and picking were better than 95 and 85 percent, respectively. Improvement of a previously designed robotic hand resulted in a 50 percent weight reduction. Overall, the system worked as designed in terms of its ability to locate and harvest mature tomatoes. Work will continue to improve the cycle time for harvesting each tomato and the dexterity of the end-effector in handling tomatoes.

This project was supported by a research grant from NASA John F. Kennedy Space Center. ASABE member John Sager served as the NASA program manager for this project. The robot manipulator was supplied by Motoman Inc. Jack Justice served as the project manager.

Weeding Robot is Autonomous

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Weeds are a major problem in organic farming in The Netherlands. While there is sufficient equipment available to control the weeds between the rows, weed control in the rows (intra-row weeding) still requires a lot of manual labor. This is especially the case for slowly growing, shallowly sown crops like sugar beet, carrots, and onions. The required labor for manual weeding is expensive and hardly obtainable. If a weeding robot could replace this labor, this could mean an enormous stimulus for organic farming. At Wageningen University, such a weeding robot is currently being developed. This weeding robot, autonomous at field level, should be able to replace manual weeding in sugar beet fields.

First, a platform was developed with a diesel engine, hydraulic transmission, four-wheel drive, and four-wheel steering. For navigation, both machine vision and DGPS will be used. DGPS will indicate if the weeding robot is outside the field, inside the field at one of the headlands, or inside the field and not at the headlands. In the last case, the weeding robot should be driving along the rows, and therefore the robot will be equipped with a vision-based row detection system based on Hough transform. In a test in a greenhouse, it was shown that the deviation between crop rows found by this detection system and their manually determined positions was less than 25 mm at normal weed infestation.

The plan is to finish the autonomous navigation and control of the weeding robot, and then test it in a sugar beet field. Adding an intra-row weeding system is planned for next year. The ultimate test will be to show that it is possible to weed an entire sugar beet field autonomously by a weeding robot.
At Early Growth Stages: Machine Vision-Based Automated Corn Plant Population and Spacing Measurement

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Recent studies have shown that plant population and spacing variability have a substantial effect on corn yield. Thus, an automated corn plant population and spacing sensing system may provide a key layer of field variability information useful for crop management. In this regard, plant geneticists have shown a fundamental interest in understanding the population performance of new genetic lines, while precision planter manufacturers want to know the performance of planter design in establishing uniform plant spacing and emergence prior to release of new planters. Obtaining this type of information was typically done manually until researchers from Iowa State University (ISU) and the University of Illinois took on the challenge to fill this gap. From their work, real-time machine vision systems have been developed to automate the measurement processes of plant population and spacing for corn plants at early growth stages.

The key technology involved in the development of these sensing systems is video image processing as crop rows are remotely sensed by a video camera mounted on a small vehicle or a manually pushed cart. Image processing algorithms have been developed to optimize the performance and computational efficiency of video frame sequencing and plant identification to meet the requirements of measurement accuracy and real-time capability. As a result, these plant population and spacing sensing systems are able to perform real-time video analysis at travel speeds up to (6.4 kph) 4 mph. In validation tests, the sensing system estimated the number of plants in row sections with an RMSE of 6.2 percent across V3 to V7 growth stages, while the spacing measurement achieved sub-centimeter level accuracy.

Such automated sensing solutions are excellent examples of sensor and information technologies making unique contributions to the agricultural industry, especially in the areas where cost and tedium can be an inhibitive factor for the same task to be done manually. The authors are currently working on improvements in system reliability and plan to extend the system functions to work with other crops such as soybeans and cotton. In addition, the algorithms developed in these systems have a potential in a broader range of applications, particularly in robotic arable farming areas such as automated field (crop, weed, soil) scouting and precision treatments for high-value crops at individual plant level. Under this context, robotic vehicles which will serve as sensor platforms are currently being developed at ISU.

Nanotechnology

The possibilities of a new science

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Nano is a prefix derived from the Greek word for dwarf, and it means one-billionth of something. So a nanosecond is a billionth of a second, and a nanometer is a billionth of a meter. So what? What is so special about nano?

Nanometers are extremely important because they are on the scale of atoms. Atoms typically are one-tenth of a nanometer, one Angstrom. Small molecules, such as water molecules, which are three atoms, are a fraction of a nanometer. Bio-molecules, or proteins, which contain thousands of atoms, are on the order of several nanometers. DNA, which contains millions of atoms, is 1,000 nanometers. While we have known all of the above for some time, today we actually operate at this scale. We can truly see and manipulate at the scale of a nanometer. We have tools that give us both the eyes, if you will, and the hands to engineer at the scale from which life derives. And this gives us very exciting opportunities.

One tool in particular — the scanning tunneling microscope, an invention created at IBM Research, Zurich — opened up the area of nanotechnology. As a derivative of the scanning tunneling microscope, the atomic force microscope was created in the ‘80s. Now there are a range of tools that allow us to have artificial eyes and hands at the nanometer scale. It is fantastic: we have an unprecedented ability to change and tailor materials “from the bottom up.” Nanotechnology builds the world, atom by atom, and we are putting together atoms one at a time!

About 10 years ago, a now-famous picture appeared in newspapers and magazines in which “IBM” was spelled out in atoms. Xenon atoms were used, and I believe they were moved up the area of nanotechnology. As a derivative of the scanning tunneling microscope, the atomic force microscope was created in the ‘80s. Now there are a range of tools that allow us to have artificial eyes and hands at the nanometer scale. It is fantastic: we have an unprecedented ability to change and tailor materials “from the bottom up.” Nanotechnology builds the world, atom by atom, and we are putting together atoms one at a time!

About 10 years ago, a now-famous picture appeared in newspapers and magazines in which “IBM” was spelled out in atoms. Xenon atoms were used, and I believe they were moved on a copper surface — a dramatic demonstration of our capabilities at the atomic level.

Today, in the realm of electronic devices, we can shrink to scales where only a single electron passes from one end of a
transistor to the other. And this demonstrates only some of the possibilities that are out there.

The importance of such applications was recognized in the '90s by the Clinton administration and the National Technology Science Advisory Council, which put together an interagency working group on nano-scale science and technology and recommended the National Nanotechnology Initiative.

Nanotechnology is a top research priority of the Bush administration as well. The budget for 2005 provides, roughly, $1 billion in federal research spread across a wide range of agencies, including the National Science Foundation (the biggest one), the Department of Defense, The Department of Energy, the National Institutes of Health and Commerce, and NASA. To a lesser degree the USDA, the Environmental Protection Agency, the Department of Justice, and Homeland Security are also included. This is a broad research portfolio funded at a significant level.

In 2003, President Bush signed into law the 21st Century Nano-Technology Research and Development Act, which underwrites the activities of the National Nanotechnology Initiative.

The potential of nanotechnology is, of course, recognized not only in the United States but across the world. Europe, the Far East, Asia, India, and Korea in particular also have major research initiatives in nanotechnology. And not only governments but industries, like IBM, Hewlett Packard, and 3M, have long recognized the importance of nanotechnology and made significant efforts.

More and more inventions have nanotechnology in their titles. The New York Times recently ran an article stating that the U.S. Patent and Trademark Office now recognizes nanotechnology as a separate item, designated as class 977. In the research community, there is tremendous excitement about many expected applications, both technological and commercial. The range includes electronics, communications, automotive, aerospace, materials, chemicals, pharmaceuticals, manufacturing, energy technology, space exploration, the environment, national security, and of course, health care and other life sciences.

Take, for example, information technology. We’ve seen computers get smaller and more lightweight. Every year, one is able to buy a computer that is twice as powerful as the one from last year and costs the same or less. This trend will continue, basically driven by technological advances.

Computer circuits in transistor structures have become even smaller since they were introduced in the early ’60s. But what is more remarkable is the merging of transistor-processing elements with sensing and actuating elements, moving toward more intelligent and autonomous systems. And there is a broad cache of applications for these systems.

There are ongoing efforts, sponsored by the Defense Advanced Research Projects Agency, dubbed “Smart Dust” where, within 1 m³, there will be energy storage and energy harvesting capabilities much like solar cells. Each of these specks of “dust” will have sensors (light and acoustic), and they will be able to communicate with each other. One application will be to distribute “smart agents” in the environment for all kinds of monitoring. If something goes wrong, let’s say an oil spill, a sensing element can call for help. The military is very interested in this application. Dust could be sprinkled over a battlefield, recognizing intruders and directing interceptors where they are needed.

We will see many advances in mundane applications as well. Take, for example, home carpets. Carpets will recognize where people are, and then configure the lighting in houses through distributed sensor networks.

Most significant in nanotechnology is the ability for humans to engineer on the same scale as mother nature. We can sequence DNA. We have started to manipulate the genetic code, which will have tremendous applications for the way diseases are recognized and medical delivery handled. Currently, when you get sick, you swallow a pill, the medication spreads throughout your body, and hopefully it finds the place where it is needed (and doesn’t do too much damage to some other part of the body). In the future, we’ll see medications engineered to target only the places where they are needed. One can envision a nanoparticle that encapsulates medication with biomolecules that selectively bind only to those cells — like cancer cells — where they are needed. And, coincidentally, the National Cancer Institute has a major initiative underway called nanomedicine.

Beyond specific applications like cancer treatment, this technology has great potential. It is speculation, but nanotechnology could even affect the way we think about medical care in general. For the most part, medical care is reactive. You get sick, which means, most likely, that the disease is in some advanced state, and then you end up treating the symptoms instead of treating the cause. There is much ongoing research to find what causes disease, e.g., changes in normal metabolic processes and other fairly complicated processes that signal the onset of a disease.

With this in mind, a new field of biology is emerging: systems biology. It involves creating circuit models for metabolic processes, which will eventually lead to detecting specific reactions. When we have the ability to detect and monitor thousands of different reactions, they can be put together in a circuit model and analyzed to see whether or not something is normal or abnormal. Doctors will be able to begin treating disease at an earlier stage, when the network fails, and instantly target specific links in this network to disrupt a cycle that could lead to disease. Medicine will become more predictive and preventive and more personalized as metabolic processes differ from person to person.

Nanotechnology puts us in an exciting but also frightening position. In the future, we will be able to see each other’s genetic makeup, which involves ethical questions about what we will do with this information. The ethical nature of nanotechnology is under major consideration by the National Nanotechnology Initiative and the National Science Foundation, and being at the forefront of any discussion on the ethical and societal implications of nanotechnology will shape the future, just as the technology itself will.
Calling All Mentors

ASABE is pleased to bring you the ASABE Online E-Mentoring Program. The program, which will give preprofessional and young professional members the opportunity to be paired with a career mentor, is in its final phase of development and requires your help for completion. Before we launch the program, we need to create a registry of members already established in their careers who are willing to serve as mentors. If you think you have some time to lend your thoughts and expertise to the future leaders of ASABE, we want to hear from you.

Why mentor?

When you were a student, you probably received first-rate technical training from academic programming, but what you also needed was the benefit of experience that could only be found on the job. As a mentor, you are in the unique position of having students benefit from your experience. You are able to help them get the right training and find their place in the engineering work world.

Young professionals may face a different set of issues today but also need the benefit of a mentor who can give them practical career advice on the day-to-day problems facing them in the workplace.

As a mentor, you can make a difference.

What's involved in mentoring a student or young professional?

We ask that you contact your mentee every other week during the year as work or school schedules permit. Since this is an online program, you may contact your mentee at any time. Whether you wish to take the next step and meet face-to-face is between you and your mentee.

You must be willing to initiate discussion and freely give advice and guidance based on your experiences as an engineer and your mentee's learning needs and development areas. You are expected to be the expert in this relationship or, if need be, help the mentee find access to the appropriate experts.

How are mentors and mentees matched?

Each mentor will be asked to electronically provide a brief profile detailing his or her work experience, technical interests, and contact information. This profile will be assigned a random number and posted online (behind the password-protected, member-only section of the ASABE Web site) without name or contact information.

Prospective mentees will then use an online search tool to identify mentors whose profiles most closely fit their career interests. The mentee then completes an online application. ASABE staff evaluates the application and pairs the applicant with an available mentor. Matches are made on a first-come, first-serve basis. The mentor and mentee are then contacted by e-mail and provided with each other's names, company or school, relevant background information (as provided), and e-mail addresses.

Ready to be a mentor? Please log into the ASABE member-only home page and click the E-Mentoring link to complete your profile. Once we have a sufficient number of mentors in the database, we will encourage preprofessional and young professional members to search for a mentor.

Questions? Please contact Mark Crossley at crossley@asabe.org, 800-371-2723 or 269-429-0300, extension 323.
A WORD FROM THE PRESIDENT

Would You Go If They Paid You?

ASABE President Otto J. Loewer, Director, University of Arkansas Economic Development Institute

“Would you be willing go to an ASABE Annual International Meeting if they paid you?” I was asked that question about 40 years ago when I was an undergraduate at Louisiana State University (LSU). The winter meeting that year was to be held in New Orleans, and the LSU faculty were looking for some local students to serve as ASABE “gofers” (go for this, go for that, etc.). While I didn’t attend, my fellow students conveyed their pleasure and surprise in seeing more than 1,000 agricultural engineers in one place, especially in a city just 75 miles away. Somehow, our profession didn’t seem so small to me anymore.

Since the winter of 1971, as a Purdue graduate student, I’ve attended all but one of the ASABE Annual International Meetings. Without exception, each one has been worth far more to me than its cost and often in totally unexpected ways. The recent Tampa meeting was no exception.

My Tuesday afternoon schedule was a continuation of the “wall-to-wall” meetings that the president-elect attends to gain greater insight into activities of those who really make things happen in ASABE – the members. Little did I know that in the next two hours or so I was to have an extraordinary experience, an epiphany if you will.

This all began innocently enough when I participated in a discussion with the ASABE past presidents. They were there in force, perhaps 12 to 15 of them, continuing to serve our profession so well in so many different capacities. As I surveyed the room it dawned on me that I knew practically all of these individuals fairly well, and in some cases very well. I’d had one as a teacher, two others as my department head, another as an ABET reviewer, and had worked with others as peers in university research, extension, and administration.

I asked them: “If today you were to begin serving as ASABE president for the next year, what would you strive to do?” Wow! I got some great responses. “Define the science that underpins our engineering profession,” one said. “Develop the literature that defines our profession’s expertise,” said someone else. “Explore the opportunities that new technologies offer us,” said another. “Put all this together in a way that our profession can more effectively market itself,” one replied, and “Actively lead the profession where its needs to go regarding a particular theme,” one answered. There were other good replies as well. I was impressed! Furthermore, I thought, I need to give more thought to what they told me.

Leaving this meeting, I visited with a group on the opposite side of the age and experience spectrum, the Young Professionals. Another “Wow!” was in order. There was literally a standing-room-only crowd of bright young minds and faces eager to be major contributors to our profession and to take leadership responsibility in making ASABE relevant to their future successes. Again, I was impressed! Likewise, I couldn’t help but remember all the benefits that ASABE has given me over the years. My first faculty job resulted in part from an ASABE contact session. The many opportunities to present and publish papers were in part because of ASABE. And the network of individuals that would shape and guide my career came largely through my professional association with ASABE members. And, these remembrances were represented by the past ASABE presidents who had spanned much of my career.

Later that evening, I made the decision to spend my year as ASABE president leading an effort to identify those things that differentiate us from other engineering professions.

I made the decision to spend my year as ASABE president leading an effort to identify those things that differentiate us from other engineering professions.
ASABE Career Center New Member Benefit

ASABE is pleased to announce the launch of the ASABE Career Center, a new online resource designed to connect agricultural, food, and biological industry employers with the largest, most qualified audience of our industry professionals.

Begin using the ASABE Career Center now to make employment connections! Visit www.asabe.org/careers.

Job Seekers

• The ASABE Career Center is dedicated exclusively to the agricultural, food, and biological engineering industry, and it’s free.
• Receive automatic notification of new jobs matching your criteria.
• Post your resume — confidentially, if preferred — so employers can actively search for you.

Let the ASABE Career Center help you make your next employment connection.

Employers

• Post your job to the largest exclusive audience of agricultural, food, and biological engineering industry professionals.
• Conduct online management of job postings including activity reports.
• Access to a searchable resume database.
• Check out competitive job posting pricing.

Questions? Contact Mark Crossley at crossley@asabe.org.

Virginia Tech Receives Award

The Department of Biological Systems Engineering (BSE) at Virginia Tech received the university’s 2004 Exemplary Department Award. During ceremonies held in November 2004, the BSE Department was presented with $10,000 and a plaque.

Each summer, the BSE Department conducts the National Science Foundation Research Experience for undergraduate programs, which teaches students about the research process and encourages them to pursue graduate studies.

“This program has effectively linked undergraduate education with research and scholarship, impacting not only our graduate program, but those of many other universities,” says Saied Mostaghimi, department head.

Students who nominated the department for the award stressed the importance of the faculty-student interaction, noting that faculty members put student understanding of the project before the completion of the work, making it possible to learn much more. More than 30 percent of BSE students gain research experience as undergraduates.

Mark Your Calendars for Portland, Ore.

The 2006 ASABE Annual International Meeting will be held at the Oregon Convention Center in Portland, July 9-12.

The convention center is an ideal venue for an ASABE meeting. It is located within Portland’s city center, right around the corner from restaurants, tax-free shopping, cultural attractions, and entertainment. MAX light-rail makes getting around easy. It can pick you up or drop you off at the convention center and take you just about anywhere downtown for free!

Come get a first-hand look at Portland’s unmatched natural beauty. You will realize that this isn’t only a great place to be, but a great place to have an ASABE Annual International Meeting!
Four Scholarships Awarded to Outstanding ASABE Student Members

ASABE annually presents four scholarships to ASABE student members enrolled in an ABET or CEAB accredited agricultural/bioystems engineering program. This year’s recipients are Patrick L. Henry, Kyle J. Baumgartner, Amy K. Good, and Trisha L. Culbertson.

ASABE Foundation Scholarship

Patrick L. Henry, a junior in the Agricultural and Biological Engineering Department at The Pennsylvania State University, was selected to receive the 2005 ASABE Foundation Engineering Scholarship.

Henry was presented the $1,000 grant on Sept. 1, during the Penn State student/faculty picnic. This scholarship is made possible by the generous contributions of ASABE members through the ASABE Foundation.

A two-year member of ASABE, Henry will graduate May 2006 with a bachelor of science degree in agricultural and biological engineering with an emphasis on machine systems engineering. His goal is to work in the agricultural machinery industry developing new and improving existing products.

Baumgartner Receives Adams Scholarship

Kyle J. Baumgartner, a senior in the Agricultural and Biosystems Engineering Department at Iowa State University, was selected as the recipient of the William J. Adams Jr. and Marijane E. Adams Scholarship for 2005. Baumgartner will be presented the $1,000 scholarship during the fall meeting of the ASABE Iowa Section.

A three-year member of ASABE, Baumgartner played an active role in the design and production of several biomass harvesting machines at Iowa State. His work along with other team members, on an award-winning AE50 anhydrous ammonia manifold project, has led to a patent for which 500 manifolds have been sold.

Baumgartner plans to graduate in May 2006 with a bachelor’s degree in agricultural and biosystems engineering. His goal is to apply his knowledge in the design and development of agricultural machinery that will help farmers be more productive, generate a higher income, and ultimately to improve and maintain the environment.

This scholarship is made possible by the generosity of Mr. and Mrs. William J. Adams, Jr., of San Jose, Calif., through the ASABE Foundation. It is intended for students interested in careers in agricultural machinery product design.

Merriam Scholarship

Amy K. Good, a junior in the Biological and Agricultural Engineering Department at Kansas State University (KSU), was selected as the recipient of the 2005 John L. and Sarah G. Merriam Scholarship. This scholarship is intended for students who have demonstrated a special interest in soil and water engineering.

Good received the $1,000 scholarship during the KSU Biosystems and Agricultural Engineering Departments awards and recognition program held May 6. She will also be recognized during the Oct. 14 Kansas Section Annual Meeting.

Good plans on graduating in December 2006 with a bachelor’s degree in biological and agricultural engineering in the environmental option, with a special emphasis on study in soil and water engineering. A two-year member of ASABE, Good served the KSU student branch as secretary and scribe. Good will be working as an undergraduate researcher on a field project at Konza Prairie Biological Station for her Engineering Honors Research Project.

The scholarship is made possible by the generosity of Mr. and Mrs. John L. Merriam of San Luis Obispo, Calif., through the ASABE Foundation.

ASABE Student Engineer of the Year Scholarship

Trisha L. Culbertson, a senior in the Biological and Agricultural Engineering Department at Kansas State University (KSU), was selected to receive the 2005 ASABE Student Engineer on the Year Scholarship.

Culbertson received the $1,000 scholarship during the KSU Biosystems and Agricultural Engineering Departments awards and recognition program held May 6. She will also be recognized during the Oct. 14 Kansas Section Annual Meeting.

Culbertson, who plans to graduate in May 2006, is enrolled in the environmental option with a secondary major in natural resources and environmental sciences. For the past three years, she has served in officer positions in the student branch as well as president this past year. A four-year member of ASABE, Culbertson placed second in the Preprofessional Undergraduate Poster Competition and competed in the KSU 1/4-Scale Tractor Student Design Competition.

The scholarship is made possible by the generosity of the late Roger R. and Laura M. Yoerger through the ASABE Foundation.
A Special Anniversary Salute to our Longtime ASABE Members!

25 YEARS

David B. Ampratwum
Gary A. Anderson
Thomas A. Bacheller
Alvey Bass
Robert E. Bassler, Jr
Abdallah Bazzara
Robert S. Beaulieu, Eng.
Ronald Raymond Birr
Paul Thomas Blotter
Thomas P. Book
L. Gregory Brenneman
Edward C. Kirchner
Ahmad Khalilian
Albert T. Kersich
Hiroaki Kawakita
Whoa Seug Kang
Glenn W. Kahle
Vinod Kumar Jindal
Glen W. Kahle
Whos Seug Kang
Hiroyuki Kawakita
Albert T. Kersich
Ahmad Khalillian
Bradley A. King
Edward C. Kirchner
Bruce E. Kroecker
James Kruse
Rodney D. Lair
David L. Lansdowne
Norman R. Layman
Gary Lemert
Michael Lentz
David L. Lienemann
Robert Fleming
MacGregor, Jr.
William Harold Mains
Joseph W. Marek
Thomas Henry Marek
Ronald L. Marlow
Paul A. Mauer
Marshall Joe McFarland
Brian R. McMahon
Samuel G. McNeill
Raymond Merala
Daniel John Meyer
Paul A. Meyer
Gauri Shankar Mittal
Michael R. Moore
John Robert Morgan
Martin E. Neff
Thomas E. Nelson
Mark W. Otteson
Victor W. E. Payne
Douglas R. Penny
Dean Eric Petersen
Kenneth P. Phillips
Stanley E. Prussis
Virendra M. Puri
Steven J. Raabe
Robert Dale Ridoutt
David A. Ritchie
Gonzalo Roa
David K. Robson
Dennis M. Roe
Mathias J. Rombakens
Ramesh Pallu Rudra
Brian J. Runde
Jerry Sandau
Thomas F. Scherer
Bradley J. Schmidt
Paul Robert Schuck
Roy Scudder
Stephen Wayne Searcy
Mark Seeley
W. David Shoup
Dennis P. Strand
Mark A. Stumborg
James D. Summers
Marion Don Swanner
Horacio A. Tablad
Ernest W. Toller
Anthony W. Tyson
Travis B. Unterzuber
Shrinivasa K. Upadhyaya
Bruce L. Upchurch
Bert Van Dalsen
Ian D. Walker-Munro
Martin D. Walter
Gary L. Warnholz
James K. Weeden
James W. Wiencek
Todd Williams
Bruce N. Wilson
John W. Worley
Brian Wright
Don L. Yarbrough
Pedro S. Zazueta
Robert J. Zimmerman

40 YEARS

Roger H. Alaishie
Daryl C. Anderson
F. Charles Baird
George T. Baragona
Billy J. Barfield
Leonard L. Bashford
J. B. Berg
John B. Borrelli
Harold L. Brewer
Herbert L. Brodie
Robert S. Broughton
John R. Busch
Roger W. Curry
Larry M. Curtis
Jerry L. Dover
Kenneth R. Drayton
Dwight E. Eisenhauer
Phillip C. Hammar
Arvid L. Hawk
Donald L. Henderson
John K. Higgins
Edward A. Hiler
Thomas E. Hitzhusen
James K. Koeliker
Lennart E. Lindahl
J. Donald MacAulay
Harvey B. Manbeck
Karolyn E. Mannschreck
Russell J. Memory
John A. Miller
Richard A. Nicolai
George F. Oelschlager
Don C. Peterson
Donald H. Pettengill
George R. Prince, Jr
George A. Puzyey
A. Razqi Qazi
Rixon J. Rafter
Ismael Remus
Clarence W. Richardson
John C. Sager
Chitaranjan Saran
John W. Schlechter
Rollin D. Schneider
Robert E. Schott
John I. Seaberg
Joseph M. Sheridan
Mark Harold Sickman
Donald C. Slack
David B. Smith
Billy S. Steele
Vincent E. Sweat
John M. Sweeten
Paul J. Thornton
Jeffrey N. Tullberg
Bobby L. Tyson
Brah P. Verma
Linus R. Walton
Rex Weigand
Brian West
Robert D. Wismer
Dale Wm. Zimmerman

50 YEARS

Herbert W. Colwill
Phillip D. Coombs
Calvin O. Cramer
Elmer E. Croisant
Thomas M. Daniel
Donald L. Day
Niel A. Dimick
Bruce J. Firth
James M. Francis
Howard D. Hadler
Bill L. Harriott
Scott L. Hedden
William Hugh Johnson
Jack Keller
E. Gordon Kruse
Deane M. Manbeck
Rodney O. Martin
William G. Moore
Kenneth A. Rowen
Morris E. Schroeder
John I. Sewell
John C. Stephens
Bill A. Stout
Herbert D. Sullivan
Lynn O. Twedt
Nickolas E. Westman
Robert H. Wilkinson
Gerald C. Zober

60 YEARS

Wesley F. Buchele
George B. Duke
R. Bruce Hopkins
Leland E. Morgan

61 YEARS

Sherwood S. DeForest
John B. Dobie
Norman A. Evans
Irby S. Exley
Milton T. Hedquist
Sol D. Resnick
Robert R. Roth

62 YEARS

Everett H. Davis
Elisha A. Henningsson
Gerald L. Kline

63 YEARS

Norman B. Akesson
Albert M. Best

64 YEARS

Alvin C. Dale
Charles W. Geelan
Dale E. Kirk
Ausmus S. Marburger

65 YEARS

Craig W. Cannon
Myron G. Cropsby
Raymond C. Fischer
Harold E. Gray
S. Milton Henderson
Ernest L. Munter
Arnold B. Skromme
Norris P. Swanson

66 YEARS

Donald E. Kuska
George H. Larson
William J. Prommersberger
Russell M. Ramp
Francis M. Roberts
Jerome W. Sorenson, Jr

67 YEARS

Weldon O. Murphy
Paul H. Rofkar
Ervin W. Schroeder

68 YEARS

Harold H. Beatty
Lawrence H. Skromme

69 YEARS

Ernest H. Kidder

70 YEARS

E. Paul Jacobson

72 YEARS

Merle W. Bloom
Wayne H. Lowry

74 YEARS

Albert V. Krewatch
George B. Nutt

75 YEARS

George B. Nutt
Albert V. Krewatch

76 YEARS

R. Paul Jacobson

77 YEARS

Samuel E. Nelson

78 YEARS

Raymond F. Nelson

79 YEARS

Geoffrey E. Nelson

80 YEARS

Raymond F. Nelson

81 YEARS

W. Jack Ridout, Jr

82 YEARS

Lee A. Jakeway

83 YEARS

Wendell C. Hunt

84 YEARS

Kenneth W. Hummel

85 YEARS

Eduardo A. Holzapfel

86 YEARS

Richard W. Helms

87 YEARS

David L. Lienemann

88 YEARS

James R. Lienemann

89 YEARS

Dennis M. Roe

90 YEARS

Robert F. Robson

91 YEARS

Joseph A. Roberts

92 YEARS

Dennis D. Robson

93 YEARS

J. W. Robson

94 YEARS

Margaret W. Robson

95 YEARS

James A. Robson

96 YEARS

W. Robert Robson

97 YEARS

Robert W. Robson

98 YEARS

James H. Robson

99 YEARS

William H. Robson

100 YEARS

B. Robson
ASABE Fellow Leroy K. Pickett, P.E., was recently named a 2005 Outstanding Alumnus in Purdue University's Department of Agricultural and Biological Engineering. This award honors Pickett for significant professional or educational contributions in areas involving agriculture, engineering, or technology. Pickett received his Ph.D. in agricultural engineering from Purdue University in 1969.

Before retiring in 1998, Pickett served as a product safety and regulation engineer at Case Corp. for all East Moline Plant products including combines, cotton pickers, corn heads, rigid cutter bar, windrow pickup, and flexible cutter bar headers.

A 44-year member of ASABE, Pickett has served on the Board of Directors and as technical vice-president of the Society. He was recognized as an ASABE Fellow in 1998.

ASABE Fellow Calvin B. Parnell, Jr., P.E., has been selected as the inaugural holder of the Endowed Chair in Cotton Engineering, Ginning, and Mechanization at the College of Agriculture and Life Sciences and the Dwight Look College of Engineering at Texas A&M University. Parnell will provide leadership in areas of teaching, research, and technology transfer. The focus of his teaching and mentoring of students will be to maintain the flow of graduates into leadership positions in this industry. His research will focus on current problems affecting the cotton industry.

Parnell joined the Biological and Agricultural Engineering Department in January 1974 as an extension cotton ginning and mechanization specialist. Prior to coming to Texas A&M University, he was a research engineer with the USDA Cotton Ginning Research Laboratory. In 1978, he moved from the Extension position to Associate Professor with responsibilities for teaching and conducting research. In the past 26 years, he has progressed to his current rank of Regents Professor. Parnell has more than 34 years experience working with the cotton industry. In 2002, he was appointed Director of the Center for Agricultural Air Quality Engineering and Science. A 41-year member of ASABE, he was elected a Fellow in 1995.

CSBE/SCGAB Fellows Elected in 2005

Digvir S. Jayas, P. Eng. In recognition of outstanding contributions to the engineering profession, in all aspects including academic, research and international activities. Jayas currently holds a Canada Research Chair, Tier 1 at the University of Manitoba. He is world-renowned for his research on drying, storing, handling and quality monitoring of grains and oilseeds and for his expertise on mathematical modeling of stored-grain ecosystems. His innovative research on the modeling of heat and mass transfer in the stored-grain ecosystem can provide verification and rejection of various model assumptions and predictions during a relatively short period, compared to the usual modeling of natural ecosystems. Jayas served as CSBE/SCGAB president during 2003-04.

Chandra A. Madramootoo. In recognition of outstanding contributions to engineering for agricultural, food, and biological systems through service to CSBE/SCGAB and ASABE. His activities include extension, teaching, research, and consulting in soil and water engineering. He is known worldwide for his work in irrigation and drainage. Madramootoo’s interests in reducing non-point source pollution have led to investigations on improved irrigation and drainage practices. He has set up elaborate, highly instrumented and sophisticated large-scale field experimental facilities to assess and quantify the environmental benefits of subirrigation. Madramootoo is the Founding Director of the Brace Centre for Water Resources Management, a research center in water management.

Ramesh P. Rudra, P. Eng. In recognition of his outstanding contributions to the engineering profession in the areas of soil and water conservation, and non-point source pollution. One of Rudra’s major contributions has been the development of GAMES and GAMESP computer-based models for the management of watershed soil erosion, sediment, and phosphorus, and the development of GDVFS, a computerized tool for site-specific design of vegetative filter strips to protect stream water quality. His research contributions have brought national and international recognition to hydrologic processes, watershed modeling, source water protection, and nonpoint-source pollution research. He is a professor at the School of Engineering, University of Guelph.
CSBE/SCGAB Names 2005 Award Winners

Maple Leaf Award
Abdel E. Ghaly, P. Eng. For his many contributions and leadership services to the profession. Ghaly is a professor at Dalhousie University, Halifax. He has provided service to the engineering profession through teaching, innovative research, leadership, and service. Ghaly has applied his expertise in many areas of agricultural and biological engineering in advancing training and human resource development, farm mechanization, post harvest handling and storage of crops, rural housing, and improving the lives of people worldwide by training personnel and agricultural engineering professionals to introduce appropriate levels of modern agro-technology that are compatible with their local environment. Ghaly served as CSBE/SCGAB president in 2000-2001.

Young Engineer of the Year Award
Carol Plouffe, P. Eng. For outstanding contributions to the field of soil, crop, and machine interactions and in recognition of his dedication and work ethic. Plouffe currently leads the soil dynamics activities at John Deere & Co., Moline, Ill., providing support for the agricultural, earthmoving, and consumer equipment divisions. He was recently awarded the Ag Innovation Award for leading the design and implementation of the new John Deere indoor soil bin. This tool is used to measure and improve machinery performance. His research also promotes finite and discrete element modelling of soil/crop systems to enable greater use of virtual analysis methods in developing new machine designs.

John Turnbull Award
Ron D. MacDonald, P. Eng. For outstanding contributions to building systems engineering through his extension and consulting engineering activities. He is also recognized for his 12-year service to CSBE/SCGAB as treasurer and as regional director in 1985-86. MacDonald is president of the consulting firm Agviro which is located in Guelph, Ontario, Canada. The firm, founded in 1993, provides livestock environmental consulting services throughout North America and overseas. MacDonald has completed several research projects for firms developing products used for improving the livestock environment. He has been heavily involved with the adoption of radiant tube heaters for swine facilities.

Jim Beamish Award
Sietan Chieng, P. Eng. For significant contributions in soil and water engineering as a teacher, researcher, and consulting engineer. A professor at the University of British Columbia, Sietan has demonstrated the effects of water table control, both subsurface drainage and subirrigation, on crop growth and drainage water quality. His models simulate solute transport in cultivated soils and demonstrates their usefulness in real world applications. Chieng simplified the subsurface drainage system design procedures by using his multi-correlation design chart. He also pioneered the use of computer-aided drafting for subsurface drainage systems. He is co-author of the British Columbia Agricultural Drainage Manual.

John Clark Award
Stefan Cenkowski, P. Eng. For outstanding contributions to biological systems engineering through teaching and research in drying theory and bio-processing activities. A professor at the University of Manitoba in Winnipeg, Cenkowski has made significant contributions to the fundamental understanding of the drying process in superheated steam. His research into elimination of spores and extraction and oil quality from sea buckthorn berries is beneficial to the burgeoning sea buckthorn industry and the functional foods and nutraceuticals industry. In addition, a small-scale electric-micronizer was developed for pulse crops.

Glenn Downing Award
Bernard Panneton, P. Eng. For contributions to engineering for agricultural, food, and biological systems through service to CSBE/SCGAB and innovative research activities. Bernard is an engineer and research scientist for Agriculture and Agri-Food Canada, Horticultural Research and Development Centre in Quebec, where he specializes in spray application technology and precision farming. His research has reduced pesticide use and sprayings in agricultural crops as well as reduced the negative impacts of pesticide use on air (drift) and soil. Panneton received a patent for the RÉCUPAIR system. In precision agriculture, he pioneered the development of yield mapping systems for various horticultural crops and worked on farm management tools based of GPS and geographical information systems.
WELCOME NEW MEMBERS

ASABE welcomes the following new members who joined the Society, reinstated a lapsed membership, or upgraded to full membership from student/preprofessional membership in May, June, and July. When available, the member’s place of employment has been provided. Please join us in extending a warm welcome to these new and returned members of our Society.

New Members for May

Roxanne K. Adeuya, Purdue University
Stephen Hill Mends Aikins, Kwame Nkrumah University of Science and Technology
Bo R. Allvin, Pertin Instruments AB
Thorak Andriyanto, Polatonik
Massimiliano Antonini
Paul Bakken, Woods Equipment Co.
Roberto N. Barbosa, Louisiana State University
Kristina S. Beard, Aqua Engineering
Jennifer C. Beddoes, USDA-NRCS
Marcelo J. Belmonte, Bodega Trapiche
David Bennick, DeLaval Direct Distribution
Venkata S. Bodapati, University of Kentucky
Robert A. Brad, University of Saskatchewan
Andrea W. Brett, Erler & Kalinowski Inc.
Robert Bruce
Ali Cansun, Uzel Makina San S.A.
Jeremy C. Cantrell, University of Kentucky
J. Derick Cermak
Lide Chen, Iowa State University
Anastasia E. M. Chinshire, University of Delaware
Vui Kiong Chong
Bob Coates, University of California
Zahra Colley, Auburn University
David R. Collins, National Environmental Services Center
Lonnie E. Dalrymple, Dalrymple & Associates
Michael D. Dawson, University of Delaware
Kendrick J. Domingue, Louisiana State University
V. M. Duraisamy, Tamil Nadu Agricultural University
Peter C. Flynn, University of Alberta
Emad Ghafoori, University of Alberta
Alaine Margarete Guimaraes, University of Florida
Stephen Guth, National Rural Electric Cooperative Association
Wayne A. Hable, Darley Pump
Ralph W. Hanson
Xiuming Hao, Agriculture Canada
April L. Hiscox, University of Connecticut
Robert E. L. Holmes, Gearmore Inc.
Takanori Hoshino, University of Arizona
Kang Tae Hwan, Hokkaido University
Ryoei Ito, Mie University
Takasi Iwahori, Hokkaido University
Emily P. Jenkins, University of Maryland
Anie John, Indian Institute of Horticultural Research
Sarah A. Kelso, University of Manitoba
Lav R. Khot, Iowa State University
Phil Shik Kim, Konkuk University
Praveen Kolar, University of Georgia
Paul Kupke
Ming-Cheih Lee, Kansas State University
Grant T. MacDonald
Brad M. Matanin, Virginia Tech
Morinobu Matsuo, National Institute of Livestock and Grassland Science
Susan M. McNulty-Atwater, Rich Products Corp.
Ebenezer Mensah, University of Science and Technology
Carl Messier, Alstom
Peter Meszaros, Corvinus University of Budapest
Driss Mezghouthi, ICS-Canahal
Randall D. Mitchel, New Mexico State University
Patrick Millo, Africa University
Glenn C. Morrison, University of Missouri
Amanda E. Mortl, University of Florida
Francis M. Murphy, Pioneer Pole Buildings Inc.
Amer A. Najm II
Jade A. Nield, USDA-NRCS
Ard Nieuwenhuizen, Wageningen University-FTE
Goutam Nistala, Louisiana State University
William J. Northcott, Michigan State University
Charles Ogborn, Packer Engineering Inc.
Stephen N. Ondimu, Osaka Prefecture University
Rodrigo M. B. Penteado, Rodrigo Menna Barreto Penteado
Sirisha Polsapalli, Louisiana State University
Thunyarat Ponthagarkul, Pennsylvania State University
Giuseppe A. Provenzano, University Di Palermo
P. Rajkumar, Tamil Nadu Agricultural University
Samarth S. Rathore, University of Illinois
Jarah S. Redwine, CH2M Hill
Pipat Reungsang, Iowa State University
Jonah F. Rimsah, Goodtimes Ltd.
Timothy Ruiz, SKF Industrial Division
Dawn M. Sedorovich, Pennsylvania State University
Prabhakar Sharma
Bernard Sheff, Sheff and Sons Engineering, PLLC
Guanghua Shi, Ministry of AgricultureSupervision & Testing Center of Animal Husbandry Environmental Quality
Chad M. Sievers, Agricultural Consulting Services Inc.
Joao B. Soares, Universidade de Brasilia
Robert Sullivan, USDA-NRCS
Janakiram N. Swamy, University of Kentucky
Venkatachalum Thirupathi, Tamil Nadu Agricultural University
Michael J. Vassallo, Pennsylvania State University
Gabriel G. Vazquez-Amable, Purdue University
Rangaraju Visvanathan, Agricultural Engineering College & Research Institute
Tony L. Wahl, U.S. Bureau of Reclamation D-8560
Paul S. Wang, University of Idaho
Jianping Wang, Henan University of Science & Technology
Timothy A. Wilcox, University of Illinois
Melinda J. Wolanin, University of Kentucky
Tom Yuriick
Arthur K. Zawadzki, University of Idaho
Jianrong Zhang, Georgia Tech Research Institute
Min Zhang, Southern Yangtze University
Yi Zheng, University of California

New Members for June

Bless Adotey
Fahad F. Al-Jadaa, Al-Khoyaef Commercial Co.
Wayne P. Anderson, Minnesota Pollution Control Agency
Taiwo Arowosegbe, U.S. Army
Michael A. Bakken, JOR Engineering Inc.
David R. Bartimus, GKN Walterscheid
James C. Boykin, USDA-ARS
Christian J. Brodbeck, Auburn University
Matthew D. Brown, USDA-NRCS
Benali Burgoa, California Polytechnic State University
Daniel G. Butler, Riceland Foods Inc.
Mireille Cabou
Anna R. Charron, Louisiana State University
Rubens Duarte Coelho, University of Sao Paulo
David Cuzzolino, The Australian Wine Research Institute
Gustavo Togeiro De Alckmin
Dhalin Dharani Dharan, Kerala Agricultural University
Ben N. Dillon, Ben Dillon Farms
Hans Duerrchen, Wood-Mizer Inc.
Martin Luther J. Eleria, Supply Oilfield Services Inc.
Robert R. Fransk
Nathanael L. Gingerich, University of Illinois

Amer A. Najm II
Jade A. Nield, USDA-NRCS
Ard Nieuwenhuizen, Wageningen University-FTE
Goutam Nistala, Louisiana State University
William J. Northcott, Michigan State University
Charles Ogborn, Packer Engineering Inc.
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P. Rajkumar, Tamil Nadu Agricultural University
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Jarah S. Redwine, CH2M Hill
Pipat Reungsang, Iowa State University
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Min Zhang, Southern Yangtze University
Yi Zheng, University of California

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Martin Luther J. Eleria, Supply Oilfield Services Inc.
Robert R. Fransk
Nathanael L. Gingerich, University of Illinois
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September 2005

New Members for July

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Kevin R. Heffin, Texas Agricultural Experiment Station
Ovragh Kashef, Florida West Coast RC&D
Hyo-Jung Kim, LS Cable Ltd.
S. Kulanthaivasami, Tamil Nadu Agricultural University
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Yuhong YH Li, University of Minnesota
Chuzhao Lin, ProAct Microbial
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Tapan B. Pathak, University of Florida
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Glen Sapilewski, Novariant
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Mark S. Servinsky, Servinsky Engineering
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Bruce R. Shearer, MacDon Industries Ltd.
Jacques Sinoncelli, Bio-Energy Systems
Jessica J. Skinner, Agricultural Consulting Services
Aaron Weber
G. Dale Wesson, Florida A&M University
Fanlun Xiong, Institute of Intelligent Machines
Herbert E. Zirschky

Completed Projects

New Standard

ASAE S583 MAY2005, Safety for Agricultural Front End Loaders. This document was originally drafted by members of the Canadian Standards Association (CSA) and ASAE as a CSA standard. CSA approved the standard and requested that an ASAE standard also be developed. The standard addresses safety hazards to operators and bystanders related to fatalities, injuries, and property damage caused by loads lost from loaders, and by loader attachments separating from raised loaders. The purpose of the standard is to establish safety requirements for the design of the machinery.

Revised Standard

ANSI/ASAE S392.2 APR2005, Cotton Module and Transporter Standard, was revised to better meet current industry practices and future needs. For more information, contact the ASABE Standards Department, 2950 Niles Road, St. Joseph, MI 49085-9659; 269-428-6331 or 269-429-0300 ext. 315, fax 269-429-3852.
Assistant or Associate Professor — Stored Product Engineering

Nature of Position: 60% Research; 25% Extension; 15% Teaching.

Conduct research in storage, handling, and processing of agricultural commodities and value-added products, including product quality and security. Establish a nationally recognized research program with internal and extramural support. Provide leadership for outreach programs in stored grain management, and extension. Work with extension educators, agricultural producers, industry professionals, farm organizations, and university researchers to address stakeholder needs. Provide curricula, training, and support for extension educational programming. Contribute to the enhancement of Oklahoma’s agricultural and food industries. Teach in support of the Biosystems Engineering degree programs. Actively participate in graduate education through recruiting and advising M.S. and Ph.D. students. Work collaboratively with faculty in Biosystems and Agricultural Engineering and other units in the Division of Agricultural Sciences and Natural Resources (DASNR) and the College of Engineering, Architecture and Technology. Contribute to the Plant Enterprises team of the DASNR Second Century Initiative. Opportunity to benefit from an excellent research education infrastructure including the Stored Product Research and Education Center and the Food and Agricultural Products Research and Technology Center.

Qualifications: Earned doctorate in Biosystems Engineering, Biological Engineering, Agricultural Engineering, or a closely related engineering discipline. Eligible to be licensed as a registered professional engineer or an engineering intern. Expertise desired in at least one of the following areas: stochastic hydrology, ecological engineering, low impact development, or an engineering intern. Experience required in the physics and applications of biosensors and instrumentation systems. Solid background desired in the biological and chemical sciences, with application to sensors. Candidates must have excellent speaking and writing skills, an ability to teach effectively in the classroom and in various extension settings, and a desire to work collaboratively in an interdisciplinary environment.

Employment Conditions: Full-time, 11-month, tenure-track faculty appointment at the rank of Assistant Professor or Associate Professor. Rank and salary commensurate with qualifications.

Assistant Professor — Biosensor Technologies

Nature of Position: 75% Research; 25% Teaching.

Conduct research on developing and adapting biosensor technologies, including biological and biochemical sensors, to enhance the safety of food and agricultural products. Investigate the incorporation of technically and economically feasible sensor and control systems in the production, storage, processing, and monitoring of agricultural commodities and value-added products. Establish a nationally recognized research program with internal and extramural support. Contribute to enhancing the efficiency and security of Oklahoma’s agricultural and food industries. Teach courses in support of the undergraduate Biosystems Engineering degree program. Actively participate in graduate education through recruiting and advising M.S. and Ph.D. students, with the opportunity to teach graduate courses. Opportunity to work collaboratively with faculty in Biosystems and Agricultural Engineering and other units in the Division of Agricultural Sciences and Natural Resources (DASNR) and the College of Engineering, Architecture and Technology, as well as the College of Arts and Sciences, the College of Veterinary Medicine, and the Tulsa-based OSU Center for Health Sciences. Through the DASNR Second Century Initiative, opportunity to contribute to multidisciplinary teams addressing plant, animal, food, and environmental topics.

Qualifications: Earned doctorate in Biosystems Engineering, Biological Engineering, Agricultural Engineering, Electrical Engineering, Chemical Engineering, or a closely related engineering discipline. Eligible to be licensed as a registered professional engineer or an engineering intern. Experience required in the physics and applications of biosensors and instrumentation systems. Solid background desired in the biological and chemical sciences, with application to sensors. Candidates must have excellent speaking and writing skills, an ability to teach effectively, and a desire to work collaboratively in an interdisciplinary environment.

Employment Conditions: Full-time, 11-month, tenure-track faculty appointment at the rank of Assistant Professor. Salary commensurate with qualifications.

Assistant Professor — Hydrologic and Ecological Engineering

Nature of Position: 75% Research; 25% Teaching.

Conduct research on effective and economical systems for pollution prevention and control, ecosystem restoration, and water resource management. Apply engineering principles to the study of terrestrial and aquatic ecosystem interactions. Address the protection and restoration of in-stream systems through control of erosion and storm water runoff from urban development, agricultural production systems, and forested lands in order to minimize the cost of meeting environmental regulations. Establish a nationally recognized research program with internal and extramural support. Teach courses in support of the undergraduate Biosystems Engineering degree program, particularly the Environment and Natural Resources option. Actively participate in graduate education through recruiting and advising M.S. and Ph.D. students, with the opportunity to teach graduate courses. Opportunity to work collaboratively with faculty in Biosystems and Agricultural Engineering and other units in the Division of Agricultural Sciences and Natural Resources (DASNR), the College of Arts and Sciences, and the College of Engineering, Architecture and Technology. Contribute to the Natural Resource – Quality and Management team of the DASNR Second Century Initiative. Opportunity to benefit from multidisciplinary interactions with hydrologists, soil scientists, foresters, environmental engineers, geomorphologists, zoologists, geographers, political scientists, and economists.

Qualifications: Earned doctorate in Biosystems Engineering, Biological Engineering, Agricultural Engineering, Ecological Engineering, Civil Engineering, or a closely related engineering discipline. Experience desired in post-harvest processing and/or the safety and security of stored products. Candidates must have excellent speaking and writing skills, an ability to teach effectively, and a desire to work collaboratively in an interdisciplinary environment.

Employment Conditions: Full-time, 11-month, tenure-track faculty appointment at the rank of Assistant Professor. Salary commensurate with qualifications.

Application Deadline: Screening of applications for all three positions is anticipated to begin on October 17, 2005. Applications will be accepted until candidates are selected for these positions.

Application Process: Interested, qualified persons must submit application packet consisting of resume, transcripts, and a list of at least three references with contact information to:

Faculty Search — (Position title)
Dr. Ronald L. Elliott, Professor and Head
Biosystems and Agricultural Engineering Department
Oklahoma State University
111 Agricultural Hall
Stillwater, OK 74078-6016
Phone: (405) 744-5431; Fax: (405) 744-6059
Email: relliott@okstate.edu

Oklahoma State University is an Affirmative Action/Equal Employment Opportunity Employer committed to Multicultural Diversity. Women and minorities are encouraged to apply.
NATIONAL PORK PRODUCERS COUNCIL

Job Title: Director of Environmental Policy

The National Pork Producers Council (NPPC) is a nationally recognized agriculture trade association that serves as the global business voice and advocate of the U.S. pork industry. NPPC’s Washington Public Policy Center manages the government relations and communications program that is responsible for successfully developing, monitoring and influencing the legislative, regulatory, trade and political agenda for U.S. pork producers in the nation’s capital.

NPPC is recruiting a seasoned, results-oriented professional with strong leadership skills to fill the newly created position of Director of Environmental Policy. The Director will develop and implement policies, programs, and initiatives for a broad cross-section of environmental and conservation issues facing U.S. pork producers. The successful candidate will possess the appropriate experience and ability to be an effective leader and environmental policy advocate for the swine industry.

Duties and Responsibilities: The Director will join an established team of government relations professionals in NPPC’s Washington, D.C. office. He/she will deliver passionate leadership and strategic vision with regard to environmental and conservation policy. The Director will report directly to the Vice President of Public Policy.

Primary responsibilities will include:

- Monitoring and advising on environmental and conservation policy issues such as water quality, air quality, new environmental technology development, carbon sequestration, and global warming
- Making oral and written presentations to educate staff, Congress, and investors on environmental and conservation issues
- Directing and coordinating research projects, studies, and investigations
- Managing the NPPC Environmental Policy Committee
- Drafting regulatory comments
- Tracking Concentrated Animal Feeding Operations (CAFO) rulings and litigation
- Coordinating policy for the 2007 Farm Bill
- Preparing and executing the mission area’s operating budget
- Speaking to the national news media and communicating with investors
- Contributing to organization and industry publications

The Director will act as a high-profile liaison and representative, explaining and advocating NPPC policy, programs, and initiatives to investors, media, industry stakeholders, other agricultural organizations, and regulatory authorities at the state, federal, and international levels.

Qualifications and Experience: The successful candidate should have achieved 6 to 10 years of relevant experience with an agricultural organization, a swine operation, an agribusiness company, a law firm, or a government agency. He/she should possess skill in interpreting relevant laws, policies, procedures, rules and regulations. An undergraduate degree in a scientific, environmental related field or equivalent experience is required (an advanced degree or JD is welcomed). Applicant must possess excellent public speaking, analytic and organizational skills. Position will require travel.

Compensation: NPPC offers a competitive salary structure based on experience and qualifications with 401-K benefits, a retirement plan, and health insurance.

Applications: Interested candidates should submit a detailed resume and cover letter to Tim Redd, NPPC, 122 C St. NW, Suite 875, Washington, DC 20001. Email: reddt@nppc.org. Fax: (202) 347-5265.

NPPC is an equal opportunity employer. The successful applicant must pass a drug test as a condition of employment.

UNIVERSITY OF WISCONSIN - RIVER FALLS

Dean, College of Agriculture, Food and Environmental Sciences (CAFES)

The University of Wisconsin-River Falls (UW-RF) invites applications/nominations for CAFES Dean. The Dean is principal academic and administrative officer of the College and oversees and supports the faculty including hiring, retention, tenure and promotion. The CAFES mission is excellence in undergraduate education with one of the largest undergraduate enrollments among non-land grant universities. For more information on CAFES visit the College web site at http://www.uwrf.edu/college-of-agriculture. View full position description and application process at http://www.uwrf.edu/hr/admin_cafes_dean.htm. Review of applications will begin on October 1, 2005, and continue until the position is filled. AA/EOE

A full service environmental consulting firm operating in the Southeastern US is accepting applications for 3 positions in our Wilmington, NC office: Geologist (GIT/GP), Licensed Soil Scientist and Wetland Scientist. Please send resume with reference to position desired to Human Resources, P. O. Box 2522, Wilmington, NC 28402.

Agricultural Pollution Prevention: Public Service Representative faculty position open at the University of Georgia. See http://www engr.uga.edu/News_and_Events.php?active=News%20and%20Events for more information. Applicants should submit a letter of application, curriculum vitae, college transcripts and names of four references to: Dr. Mark Risse, Department of Biological and Agricultural Engineering, the University of Georgia, Athens, GA 30602-4435, voice: 706-542-9067, fax:706-542-1886, e-mail: mrisse@engr.uga.edu. Applications received by September 30, 2005 are assured of consideration. EO/AA institution.

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FOOD ENGINEER with Master’s of Science degree in food safety engineering with five years of experience in consulting, industry, and academy. Interested in internship for fall 2005. Graduating from the Biological and Agricultural Engineering Department at Texas A&M in August 2005. Areas of expertise include dairy products, microbiology, and food irradiation with knowledge of all the areas of agriculture and computers. Bilingual in English and Spanish. Bachelor’s degree from Escuela Agricola Panamericana. Looking for opportunities preferably in processing of dairy products and in the Midwest area, but willing to relocate or perform other tasks if needed. W-1052

AGRICULTURAL ENGINEER seeks public or private position in Florida as Remote Sensing/Image Processing/GIS Analyst or Specialist. More than 10 years consulting and university-research experience in agricultural/natural/cultural resources mapping applications of remote sensing (via aircraft/satellite–multispectral, hyperspectral, thermal), GIS (ERDAS, RSI, ESRI), and positioning (GPS, GPR, LIDAR); also RS/GIS coordination and datamodel/metadata issues (FGDC, NASA). Office/career: MS Word, Corel, and Adobe. Available May 2005. W-1051

POSITIONS WANTED

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The University of Wisconsin-River Falls (UW-RF) invites applications/nominations for CAFES Dean. The Dean is principal academic and administrative officer of the College and oversees and supports the faculty including hiring, retention, tenure and promotion. The CAFES mission is excellence in undergraduate education with one of the largest undergraduate enrollments among non-land grant universities. For more information on CAFES visit the College web site at http://www.uwrf.edu/college-of-agriculture. View full position description and application process at http://www.uwrf.edu/hr/admin_cafes_dean.htm. Review of applications will begin on October 1, 2005, and continue until the position is filled. AA/EOE

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September 2005

Resource
Not long ago, the California Occupational and Health Standards Board finalized a regulation to prohibit hand weeding practices — something which became common when regulations banned the use of short handled hoes in 1975. While the case against hand weeding has political overtones, few professionals would argue that sustained stooping or kneeling postures do not produce musculoskeletal injuries.

California alone employs nearly one million hired farm workers per year, accounting for an estimated 25 percent of production costs. We know California hired workers in agriculture bear the brunt of injuries (73 percent as compared to family workers at 27 percent). Of all occupational illnesses or injuries for farm workers, musculoskeletal disorders (MSD) are the most common and among farm workers, back strain accounts for 39 percent of all strains and sprains.

We know that work-related musculoskeletal disorders (MSD) have been rising in incidence and account for a majority of workers’ compensation dollars. Reviews of national and regional workers’ compensation records revealed that about 20 percent of claims were filed for back injuries, and low-back pain is the most frequently cited cause of disability in persons aged 45 or less. Research suggests that low-back injuries result in more time lost from work than non-back injuries. Back injuries also account for a significant portion of workers’ compensation costs.

Very few studies have seriously examined the effects of stoop labor. This is partially because these tasks have been eliminated in most industries. Today, they are primarily found in agriculture and some construction jobs. This lack of background data led the Agricultural Ergonomics Research Center at the University of California to sponsor a conference, “Stooped Postures in the Workplace” in July of 2004, with support from the National Institute of Occupational Safety and Health. This two-day international conference was held in Oakland, Calif., and attracted about 90 participants from North America, Europe, and Asia. The proceedings have been published.

Other published articles on the subject of low-back disorders conclude data indicating that persons working in stooped postures are at high risk of developing low back disorders. Biomechanical studies of the correlation between workplace factors and low-back disorders link the biomechanical factors characteristic of working in stooped postures with high risks of low-back disorders in large industrial populations. It is no surprise that several different industries, that have a high percentage of work being performed in stooped postures, also report a high incidence of low-back disorders.

Some ergonomic interventions to reduce the duration and degree of stooped postures have been developed or are under development. Studies have generally shown that kneeling or sitting is an ineffective alternative to stooping since these postures have even higher risks of low back disorder. Many agricultural jobs requiring stooped postures have not proven applicable to mechanization due to technical and economic limitations. The delicate nature of many fruits and vegetables make mechanical harvest technically difficult and/or economically unviable. However, new designs, such as the Ortomec elevating spring mix harvester, show that possibilities do exist for developing machines that redefine the ergonomics of the working environment.

Few low-cost, practical interventions exist for jobs requiring stooped postures. Worse, there appears to be very little organized research aimed at inventorying and assessing either individual stoop interventions or even stoop intervention strategies. To date, most successful ergonomic interventions (handles for nursery workers, smaller bins for wine grape harvest, specialized carts for rose budding, etc.) have been very specific to the particular task, and this will probably continue to be case.

We anticipate that the ban on hand weeding may just be the “tip of the iceberg” and that ergonomically sound engineering interventions are urgently needed to address current agricultural stoop labor tasks.

ASABE member John Miles is professor in the Department of Biological and Agricultural Engineering, University of California-Davis, One Shield Ave., Davis, CA 95616 USA; 530-752-6210, fax 530-752-2640, jamiles@ucdavis.edu.

Views expressed in this article are those of the author and do not represent the official position of ASABE.
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