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## MISSION STATEMENT

Since 1973, Georgia Tech's Agricultural Technology Research Program (ATRP) has worked closely with the poultry industry, developing new technologies and adapting existing ones for the industry's special needs.

ATRP's mission is to promote the economic growth of Georgia's agribusiness (especially the poultry industry) through:

- Research focused on the development of new technologies that improve productivity and efficiency;
- Exposure of students to the challenges of developing and adapting these technologies;
- Technical assistance to Georgia-based industry members with special problems; and
- Release of information on emerging technologies and improved operational management through newsletters, articles, seminars, and presentations to speed ultimate commercial use.

The program is conducted in cooperation with the Georgia Poultry Federation with funding from the Georgia Legislature.

## ATRP: THE YEAR IN REVIEW

Fiscal Year 2001 saw the Agricultural Technology Research Program (ATRP) make exciting progress on a number of research fronts. Its computer vision research added a number of new features to the systemic screening system while scaling back the size of the imaging cabinet in preparation for its placement on-line at Gold Kist's Carrollton, Georgia, plant. Key among the new features added were the use of cutting edge, high-intensity fluorescent lighting and the addition of a wireless network link to allow personnel in the plant to access the system's data files from anywhere on the plant floor. The project also has a partnership with Meyn Poultry Processing LLC, who is developing a kickoff device that will remove defective product.

The robotics research area saw major changes in the design of the robotic casepacker. The unit was completely redesigned to allow cycle speeds to increase from 30 cycles per minute to 60 cycles per minute. Key in this redesign effort was the incorporation of new computer-aided motion control technology by CAMotion, a high-tech startup company in the Advanced Technology Development Center at Georgia Tech. Combined with the partnership of Cryovac, who is developing a second-generation conveying system to feed trays into the cell and to feed and remove boxes from the cell, the system appears well on its way to addressing a niche need in the industry and has strong commercialization potential.

Work on the intelligent live transfer system also made a significant breakthrough on the method for grasping product, and a partnership was formed with Stork Gamco to develop an automated transfer system to interface between the grasping cell and the shackle line. Likewise, the mobile computing research group completed a full year of testing using a wearable computer system to support HACCP (hazard analysis and critical control point) data collection at Claxton Poultry in Claxton, Georgia. And the biosensor research effort closed in on a newly modified design, which is finally beginning to deliver on the promise of this technology, as did the intelligent deboning system development effort. Finally, the environmental research team made strong headway in understanding the formation of odors from rendering operations and their control while also initiating studies to reduce the volume of water used to rinse birds in processing operations.

In addition to the success of its research activities, ATRP also saw an expansion in the number of partnerships formed with poultry and allied companies. While many were formed around specific research activities, the program witnessed an unprecedented outpouring of corporate support toward the construction of Tech's new Food Processing Technology Research Facility. With the close of Fiscal Year 2001, 10 companies had signed partnership agreements with Georgia Tech, donating nearly \$1 million toward the facility, with four additional companies strongly considering doing the same.

As we enter Fiscal Year 2002, we remain excited by the continued prospects for new technology development in the poultry industry and look forward to not only breaking ground on the new research facility and seeing a number of our research developments transition into commercial successes, but most of all, working more closely with our growing list of partners and supporters.



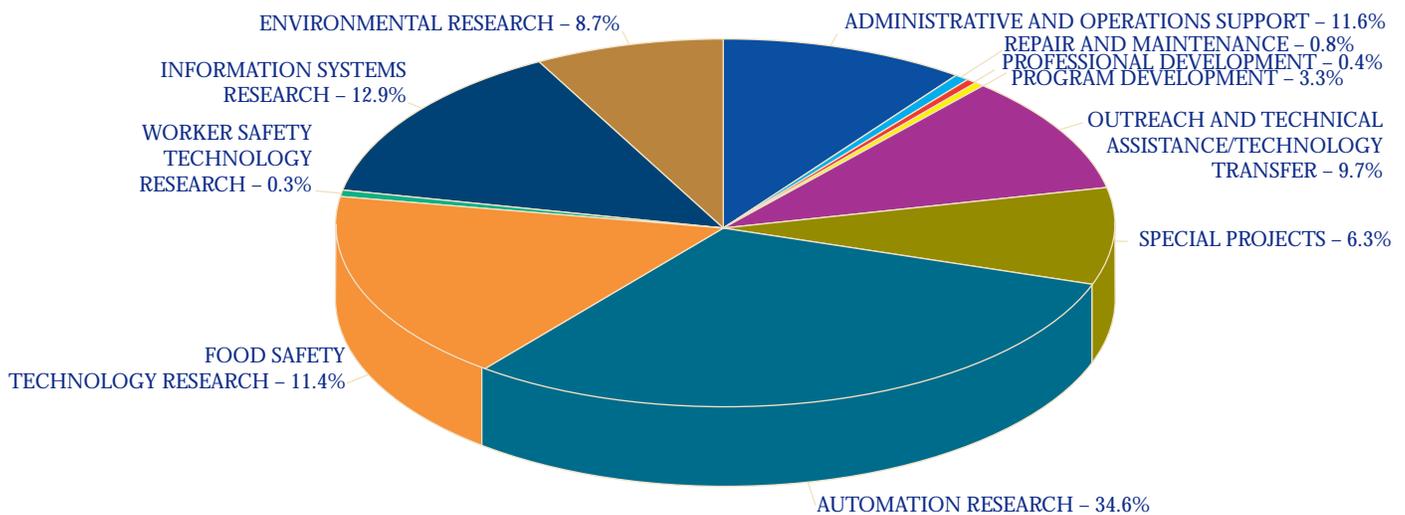
A handwritten signature in black ink that reads "J. Craig Wyvill". The signature is fluid and cursive, written in a professional style.

J. Craig Wyvill  
ATRP Director

## FINANCIAL SUMMARY

ATRP budget dollars supported five major research focus areas in Fiscal Year 2001: advanced automation technologies, food safety technologies, worker safety technologies, environmental engineering and management, and information systems technologies. In addition, monies were set aside for outreach and technical assistance/technology transfer, special projects, professional and program development, administrative and operations support, and repair and maintenance functions.

**FY 2001 BUDGET MIX (\$1,727,010)**



Two-thirds of the Fiscal Year 2001 program budget was channelled toward research in the five major research focus areas. In addition, half of the remaining program budget was channelled toward outreach and technical assistance/technology transfer and special projects.

## INDUSTRIAL PARTNERSHIPS

ATRP's Poultry Advisory Committee is made up of poultry industry leaders who give their time to help the program identify research topics that best address priority industry needs. The committee meets semiannually to hear updates on program research efforts and to discuss challenges and future direction with program personnel.

### POULTRY ADVISORY COMMITTEE (FISCAL YEAR 2001)

Derrick Arp	Gold Kist Inc.
Bill Baisley	Peterson Farms
Dan Barnes	Degussa Corporation
Jim Brock	Crystal Farms, Inc.
Johnny Burkett	Cagle's Inc.
Bob Burns	ConAgra Poultry
Kevin Custer	American Proteins, Inc.
Phil Dorr	ConAgra Poultry
Mikell Fries	Claxton Poultry Farms, Inc.
Jerry Gattis	Cagle's Inc.
Patrick Johnson	Tyson Foods, Inc.
Ken Long	ConAgra Poultry
Winston May	Crider Poultry
Allen Merritt	Gold Kist Inc.
Larry Miller	Kings Delight, Ltd.
Mohamed Mousa	Rose Acre Farms
Tom Roberts	Gold Kist Inc.
Dale Stoltzfus	Wayne Farms LLC
David Wicker	Fieldale Farms
Joel Williams	Mar-Jac Poultry
Steven Woodruff	WHEE, Inc.

### EX OFFICIO

Abit Massey	Georgia Poultry Federation
Mike Giles	Georgia Poultry Federation
James Scroggs	Georgia Poultry Processors Association
J. Craig Wyvill	Georgia Tech Research Institute

### INDUSTRIAL COLLABORATORS (FISCAL YEAR 2001)

Industrial collaborators serve a very important function in ATRP's research program. They provide the direction needed to tailor research and development activities to specific industry challenges. They also participate directly in research projects by providing technical assistance as well as offering in-kind and cash contributions. Below is a list of industrial collaborators by project for Fiscal Year 2001.

Intelligent Automated Transfer
Gold Kist Inc.
Stork-Gamco, Inc.
Intelligent Cutting
Tyson Foods, Inc.
Advanced Robotics
Gold Kist Inc.
Cryovac
Computer Vision
Gold Kist Inc.
Meyn Poultry Processing LLC
Mobile Information Systems
Claxton Poultry Farms, Inc.
Biosensor Technology
Gold Kist Inc.
Photonic Systems
Ergonomics Research
Tyson Foods, Inc.
Environmental Research
Tyson Foods, Inc.
American Proteins, Inc.
Tiberian Technologies

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**EWAS**

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**TECHNOLOGY TRANSFER**

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## INFORMATION TECHNOLOGY

*ATRP's information technology research program seeks to develop better ways of providing real-time information access for mobile plant personnel. In particular, the research team is focused on developing and adapting computer technologies to provide real-time linkages between manually collected data on the plant floor and databases that construct trend analysis and control strategies. The team's factory automation support technology (FAST) provides this linkage through the use of wearable computer technology, including a compact computer worn on a belt and a miniature, google-mounted computer screen. Such a setup provides mobile plant personnel with the capability to both enter and retrieve information without constraining their ability to move around or manipulate product with their hands.*

*In addition to wearable computers, the information technology team maintains PoultryNet. This advanced Internet information center is designed to provide easy access to poultry-specific resources anytime, anywhere.*



### WEARABLE COMPUTER TECHNOLOGIES

During FY 2001, researchers achieved the sustained, successful implementation of Tech's wearable-computing technology in Claxton's poultry processing plant in Claxton, Georgia. The technology itself uses a number of off-the-shelf hardware, custom software, and years of human-computer interface design research to create a robust HACCP (hazard analysis and critical control point) data-collection tool. The system withstood the harsh poultry processing environment, enabling quality assurance personnel to electronically harvest HACCP temperature data using a voice-activated, hands-free, data-collection tool. Along with researchers from Carnegie Mellon University and the Massachusetts Institute of Technology, Georgia Tech also hosted the fourth International Symposium on Wearable Computing in Atlanta, Georgia.



### POULTRYNET – AN INTERNET INFORMATION CENTER

PoultryNet continues to enjoy growing popularity by attracting between 350-400 unique visitors per day. PoultryNet is an advanced, Internet-based, information network for and about the poultry industry. At its core is a powerful search engine designed to improve the way poultry-related information is extracted on the World WideWeb. PoultryNet offers on-screen translation into five languages, links to poultry-related information provided by other search engines, customizable poultry statistics, a mechanism by which poultry professionals may directly contact researchers at Georgia Tech, and a forum by which poultry professionals may candidly discuss issues related to the poultry industry. This tool can be accessed at <http://poultrynet.gatech.edu>.

## AUTOMATION RESEARCH

*Today, poultry plants are turning to automation technologies for a number of reasons, key among them are cost containment, product quality improvement, and increased productivity. For more than a decade now, ATRP's automation research program has strived to develop and ultimately release commercially viable automation concepts to the poultry industry. Today, ATRP researchers are focusing R&D efforts on four innovative projects. They are:*

- *evaluating, developing, and testing affordable robotics systems that can perform material-handling functions at processing line speeds;*
- *developing a new generation of smart processing machines;*
- *designing and developing an automatic live-bird transfer machine; and*
- *developing and testing machine-vision systems for evaluating food product quality automatically.*



### ROBOTICS FOR POULTRY PROCESSING

After years of research and development, ATRP researchers are closing in on an automated casepacking system that shows great promise for commercialization. In conjunction with a FoodPAC (Food Processing Advisory Council)-funded research initiative, ATRP researchers have modified their successful first-generation robotic system to pack poultry trays into cases at the end of the weigh/price/label line in a poultry slaughter plant. In particular, researchers have rebuilt or upgraded joints, modified the electronics panel, redesigned the conveyor system, modified structural components, and enhanced the gripper to handle over-wrapped packages weighing more than 2-1/2 pounds. Early laboratory tests indicate the modified system is capable of meeting the industrial performance standard of packing 50 trays per minute. Gold Kist is supporting this modification effort, while Cryovac and CAMotion have joined the team to introduce innovation and to pursue product commercialization.



**INTELLIGENT CUTTING SYSTEM FOR DEBONING MEAT**

Smart deboning technology is making headway in providing an automated alternative for deboning poultry in processing plants. ATRP researchers have developed a test cell consisting of a robotic knife, a force torque sensor, and an image sensor. Experimental work thus far has centered on examining the cuts necessary for breast deboning, specifically the wing cut, which has proven difficult to automate. With knowledge of bird anatomy and physical measurements, researchers have estimated nominal trajectories for the cuts as well as the required forces to make the cuts. They have also developed techniques to locate anchor points for the trajectories, incorporating force monitoring in the robot control. Initial results are promising.



**INTELLIGENT LIVE-BIRD TRANSFER SYSTEM**

The program continued to make progress in its efforts to develop an automatic live-transfer system for transferring live birds from moving conveyors to shackle lines. The team initially conducted tests with live broilers at the University of Georgia (UGA) to assess the impact of backward-facing birds on system performance. Results proved the speed of bird rotation impacts the excitability of the birds. The system design was subsequently revised to take into account this finding and the general production requirements and implementation issues for a typical processing plant. Using analytical simulations and experiments with live birds at UGA, the design transformation yielded a semi-automated, computer-controlled system that grips and inverts a sequence of singulated live birds regardless of their orientations (forward- or backward-facing). Recent experiments have suggested that both forward- and backward-facing birds can be grasped and inverted using the same grasper and rotational tracks. Project researchers also found a commercial partner, Stork Gamco, who has tentatively agreed to support the development by building a transfer device for moving the grasped bird to a moving shackle line.



**MACHINE VISION FOR QUALITY ASSESSMENT**

In conjunction with a separate FoodPAC project, researchers are using advanced machine vision technology to screen for systemic defects on the kill line in a poultry slaughter plant. Researchers developed a new software program called SWEISAL to perform this task. The program detects cadavers, overscalds, unbled, and birds with septicemia. During on-line field tests at Gold Kist's Carrollton, Georgia, plant, the system detected systemic defects at an accuracy rate of more than 98 percent. The system is also capable of detecting broken wings, bruises, small birds, mishung birds, and empty shackles. These defects are all logged into a database for examination and statistical tracking purposes.

## ENVIRONMENTAL RESEARCH

*Helping the poultry industry improve waste management systems is at the heart of ATRP's environmental research program. As time goes on, environmental regulations are expected to become even more stringent, and waste costs will likely rise. Poultry processors will be faced with the challenge of finding new, more effective methods for reducing waste and for treating, managing, and disposing of waste-water. ATRP is responding to this need with a strong program in waste management research that is focused in two areas:*

- *water use and quality*
- *processing byproduct waste management*

*The environmental research team also assists industry in the area of environmental regulation. Food processors are facing ever-expanding, permit filing requirements and other procedures not uniquely developed for the industry. In this area, ATRP environmental researchers are dedicated to helping the industry understand and comply with all applicable regulations.*



### WATER USE AND QUALITY

Following recent trends in increased water consumption, efforts accelerated on examining hydraulic and organic loadings associated with primary and further processing. The goal was to identify technologies and opportunities for reducing water use and to increase the industry's understanding of process impacts on water recycle/reuse options. *WARP® The Water Auditor* software was updated to include a draft database edition designed to assist managers with tracking water use daily, weekly, monthly, quarterly, annually, or during a user-defined period. Additionally, studies were initiated to reduce water usage in bird washers using novel spray technologies. Researchers reviewed issues associated with understanding the mechanisms for contaminant removal with final bird washers and during sanitation. Preliminary work indicates that a Taylor vortex reactor may be useful for determining the shear associated with removing contaminants from surfaces, and that the results of this research could be useful in evaluating alternative spraying and sanitation procedures.



### PROCESSING BYPRODUCT WASTE MANAGEMENT

ATRP researchers worked with personnel at American Proteins in Cumming, Georgia, to assess the presence of odors and VOCs (volatile organic compounds) in stack gas discharge from rendering plants along with associated control technologies. Researchers designed an on-site, air-sampling system that allows sampling of scrubber inlet and outlet air streams on a 24-hour basis during three- to five-day periods throughout the course of several months. Experimental equipment was placed inside a cargo trailer to provide flexibility for sampling at several locations. Focusing initially on sulfur-based compounds because of their higher odor-generating potential, the research team looked for indications that might lead to a problem. Initial results indicated that sulfur compounds are present in the scrubber inlet air and generally removed by scrubber operations. Those sulfur compounds are captured in the scrubber blow-down and treated in the wastewater system. Researchers plan preliminary evaluations of wastewater systems to determine whether sulfur-based compounds captured in the scrubber blowdown are eventually emitted as nuisance odors.

## SAFETY RESEARCH

*The food processing industry's concern for both the safety of plant workers and the safety and quality of food products continues to garner strong attention. Employers are seeking new techniques for predicting and preventing injuries to employees. Plant laboratories are seeking rapid microbial analysis capability to check food products for possible contamination before they exit processing operations. ATRP safety researchers are actively tackling these challenges with two dynamic systems:*

- *a biosensor for rapid microbial detection*
- *an ergonomic work assessment system*



### BIOSENSOR FOR RAPID MICROBIAL DETECTION

ATRP researchers made significant progress in the development of a biosensor for continuous, real-time monitoring of various foodborne pathogens. A concerted effort was made this past year to refine the chemistry behind the surface antibody-antigen interaction. In particular, selection of a high-affinity, commercially available antibody, attachment of the antibody to the optical waveguide, and optimization of the assay conditions were investigated. The team also explored a novel method using x-ray photoelectron spectroscopy to determine the amount of antibody bound to the waveguide surface. Recent experimental tests achieved good reproducibility of results in laboratory measurements of *Salmonella typhimurium* control samples, which is a primary step before further efforts to increase sensitivity and decrease assay time can be undertaken. The research team redesigned the optical systems and mechanical packaging of the sensor, making it more stable, quicker to set up, and easier to operate. A software upgrade, presenting an enhanced graphical user interface and real-time data analysis, was accomplished as well.



### ERGONOMIC ASSESSMENT FOR WORKER SAFETY

The ergonomics team successfully completed testing of its innovative ergonomic work assessment system (EWAS). The team completed field tests at Tyson's Buena Vista, Georgia, processing plant. EWAS was used to monitor knife forces, wrist movement, wrist flexor and extensor activity, and cutting duration in three workers performing three separate cuts at the plants pre-established work height. One minute of data was collected every 1-2 minutes for approximately 20 minutes for each of the three cuts. The cuts included the wing cut, tender pull, and whole leg debone. The total data collected at the plant represented approximately 50 cuts per worker, per cut type, for a total of 150 cuts per worker and 450 cuts for the three workers already tested. Data analysis software, originally designed to analyze the data for just two cuts on-line, was modified to analyze longer time periods of collection and a totally different cut. The most significant pieces of information remain peak forces on the knife, absolute range of motion at the wrist, wrist angles associated with peak cutting forces, mean EMG (electromyogram) in both wrist flexors and wrist extensors, and duration of the cutting task.

## OUTREACH AND TECHNOLOGY TRANSFER

*The goal of ATRP's industry outreach program is to provide information, education, and assistance that will help the poultry industry continue to grow and prosper. The program supports a wide variety of services, including traditional publications, workshops, trade-show exhibits, computer-based informational and educational materials, and telephone or on-site engineering support for companies in the state of Georgia.*

*Specifically, ATRP communications specialists produce PoultryTech, a newsletter distributed three times a year at no charge to subscribers, which discusses emerging issues, research updates, and news briefs. Program staff members also produce articles and research updates that are carried by industry trade magazines and newspapers. The program also maintains a website with links to news articles and stories related to program activities. In addition, research results are reported in technical reports and papers, and an annual report is issued each year. The program regularly assembles exhibits at industry gatherings and trade shows that display updates on research activities and technical prototypes, and conducts annual workshops on key topics such as plant safety and maintenance enhancement. Lastly, ATRP personnel provide technical assistance to firms and individuals needing help of an engineering nature within the state of Georgia. Many of these assists involve on-site visits, and a growing number focus on understanding regulatory compliance issues.*



### OUTREACH

ATRP once again participated in the International Poultry Exposition, the Georgia Poultry Federation Spring Meeting, and the Night of Knights, preparing exhibits for all three. ATRP also helped design, assemble, set up, and operate the PoultryWorld exhibit (toured by 40,000 visitors) at the Georgia National Fair (see special projects - pg. 15). In conjunction with the Georgia Poultry Federation, the National Chicken Council, and the National Turkey Federation, ATRP hosted the 2001 Safety Workshop for the Poultry Industry, attracting 60 safety professionals from across the United States. The program also coordinated the 2000 Poultry Maintenance Symposium with *Poultry* magazine, which drew 26 attendees from across the United States, Canada, and the Netherlands.

**TECHNICAL ASSISTANCE**

Thirty-three technical assists were provided this past year to firms and individuals in the poultry industry across the state. These assists range from simple inquiries regarding information or help needed to address a problem to extensive on-site consultation (focusing on environmental, safety, workplace efficiency, and other issues) in which researchers collect data and provide a full report of their findings and recommendations. The program uses input from these assists to gauge situations calling for new research initiatives.



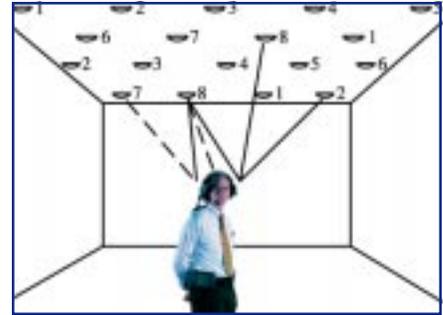
**TECHNOLOGY TRANSFER**

ATRP continued an active technology transfer program. *PoultryTech*, its triannual newsletter, which covers the program's research advances in automation, environmental, and safety endeavors, experienced steady readership and a modest subscription increase. *PoultryTech* articles were reprinted in *Poultry International* and *World Poultry* magazines. Program research projects were also covered in feature articles for *WATT PoultryUSA*, *Poultry Times*, *Meat Processing News On-line*, *Food Processing Magazine*, and *Impact* (a Georgia Tech publication). The second *Annual Report* was published and well received. The website was further enhanced, specifically with the addition of project videos.



## SPECIAL PROJECTS

*ATRP also conducts a number of projects designed to assist special informational or educational needs in the industry or to lay the foundation for a new research initiative in the years to come. This past year four special projects were undertaken: one to explore augmented reality as a potential new research thrust area; one to assist the industry with its educational Poultry World initiative; and two to provide the industry with additional information on feasible alternative poultry usage schemes and the economic impact of the poultry industry on the state's economy.*



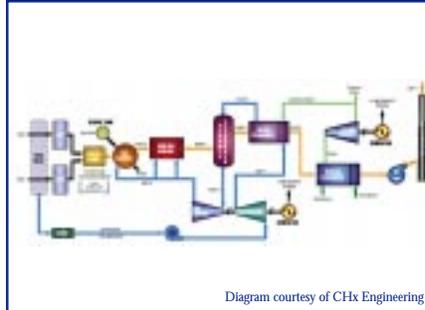
### **DEVELOP AUGMENTED REALITY ENVIRONMENTS FOR MAINTENANCE SUPPORT IN PLANTS**

Integrating state-of-the-art, commercial off-the-shelf (COTS) equipment, ATRP researchers constructed a room-sized indoor mobile augmented reality (AR) environment. Using a wearable computer, a COTS tracking system, a see-thru, head-mounted display, and a detailed model of the environment and objects within it, the team created a prototype application, demonstrating the potential of AR in a manufacturing environment. In this room, two concepts were explored: registration of static information on stationary objects (i.e., labels on equipment distributed throughout the room) and the integration of virtual moving objects in an AR world (virtual objects realistically moving around real objects). This technology offers many potential uses in the maintenance and repair of machinery in processing plant environments.



**BUILD PERMANENT  
STRUCTURE FOR  
POULTRY WORLD  
EDUCATIONAL EXHIBIT**

In June 2001, Iron City Construction, Inc., of Blacksburg, South Carolina, donated a 40' X 55' building resembling a poultry growout house as a permanent structure for Poultry World to replace the 60' X 20' tent used in the past to house the exhibit. Lextron, Inc., a poultry equipment company, donated the equipment to construct a 12' X 20' miniature growout area, complete with drinker and feeder systems, as well as a five-ring feed bin outside the building to complete the look and feel of a real poultry house. Cagle's Inc. coordinated both donations. Southland Wood Products, Ness Rentals, Warner Robbins Supply Co. Truss Division, and Wheeling Corrugated Inc. also donated building materials and equipment.



**EVALUATE THE  
FEASIBILITY OF  
ALTERNATIVE USAGE  
SCHEMES FOR POULTRY  
LITTER IN GEORGIA**

Another special project undertaken in FY 2001 was an evaluation of alternative litter usage options for Georgia. The study, conducted with special funding from the state of Georgia secured by the Georgia Poultry Federation, focused first on the current supply of poultry litter in the state and identified regions of estimated surplus and deficit in the state. It then reviewed current usage practices in the field followed by a detailed look into eight alternative usage options that would allow more extensive usage of any surpluses. Several of these options, broadly categorized into two areas (electric power generation and fertilizer production), are the focus of ongoing projects in other regions of the country to address surplus situations. The study attempted to define each option's suitability to Georgia's basic surplus litter need and identified, where possible, the estimated cost and payback for each. It concluded that while two of the options hold strong promise for Georgia, there is a need to define better ways of pinpointing the volume of excess litter actually available, the cost of collecting the litter, and a fair compensation price for the litter that helps ensure farmers will support its release to a long-term recovery scheme.

Estimated 2000 Economic Impact of the Poultry Industry on Georgia (in millions of dollars)			
	Direct	Indirect and Induced	Total
Total Economic Impact	\$ 5,361	\$ 8,156	\$ 13,516
Employee Compensation	\$ 1,360	\$ 2,394	\$ 3,754
Local Gov't. Revenues	\$ 7	\$ 147	\$ 154
State Gov't. Revenues	\$ 106	\$ 188	\$ 294
Employment	47,873	77,407	125,280

**UPDATE THE ECONOMIC  
IMPACT ESTIMATES FOR  
THE INDUSTRY ON THE  
STATE'S ECONOMY**

As part of a recurring special project, Georgia Tech conducted an update on its assessment of the economic impact of the Georgia poultry industry on the state of Georgia. Using both government census data and survey information collected from the industry, the study employed an economic model to estimate the industry's impact on Georgia. The results were an overall economic impact of \$13.5 billion, with local and state tax revenues of nearly a half billion dollars and combined direct and indirect employment impacts totaling \$125,280. As a percentage of Georgia's economy, the poultry industry was found to account for more than 3.1% of state employment and 2.2% of state taxes.

## PUBLICATIONS AND PRESENTATIONS

### BOOKS, CHAPTERS, MONOGRAPHS

Walsh, J.L. 2001. International environmental standards based on ISO 14000. *In: Maynards Industrial Engineering Handbook*. (K.B. Zandin, ed.). McGraw-Hill, New York. 5<sup>th</sup> Edition. Chapter 6.9, pp. 6.151-6.169.

### TRADE PUBLICATIONS

Colar, A. March 2001. Not your typical robot. *WATT PoultryUSA* 2(3):42, 44.

McKlin, T.E. and S. Swaminathan. Spring 2001. Automation omnipresence: remotely monitoring automation systems. *PoultryTech* 13(1):6-7.

Wyvill, J. Craig. August 6, 2001. Capitalizing on advances of information age. *Poultry Times XLVIII*(16):4.

### JOURNAL ARTICLES

Ockerman, J. and A. Pritchett. 2000. A review and reappraisal of task guidance: aiding workers in procedure following. *International Journal of Cognitive Ergonomics*. 4(3): 191-212.

Walsh, J.L., C.C. Ross, and G.E. Valentine. June 2001. Food processing waste. *Water Environment Research* 73(4).

### THESES/DISSERTATIONS

Joni, J.H. 2000. Quasi-static force analysis of an automated live-bird transfer system. M.S. Thesis, Georgia Institute of Technology. pp. 88.

### CONFERENCE PROCEEDINGS

Lee, K.-M. 2000. Kinematic analysis of a high-speed live broiler transfer mechanism. *Proceedings of the 2000 Japan-USA Symposium on Flexible Manufacturing Systems*, Ann Arbor, MI, July 23-26. On CD-ROM.

Lee, K.-M., J. Joni, and X. Yin. 2000. Imaging and motion prediction for an automated live-bird transfer process. *Proceedings of the ASME Dynamic Systems and Control Division-2000*, November 5-10, Orlando, FL. Vol. 1. pp. 181-188.

Lee, K.-M., J. Joni, and X. Yin. 2001. Compliant grasping force modeling for handling of live objects. *Proceedings of the 2001 IEEE/ICRA*, Seoul, Korea, May 21-26. On CD-ROM.

Ockerman, J.J. and A.R. Pritchett. 2000. Reducing over-reliance on task guidance systems. *Proceedings of the Human Factors and Ergonomics Society 44<sup>th</sup> Annual Meeting*, San Diego, CA, July 29-August 4. Vol. 1. pp. 1-4.

Ockerman, J.J. and A.R. Pritchett. 2000. Procedure context to aid workers in appropriate procedure following. *Proceedings of the Third International Topical Meeting on Nuclear Plant Instrumentation, Control, and Human-Machine Interface Technologies*, Washington, DC, November 13-16. On CD-ROM.

Wyvill, J.C. 2000. Recent advances in high technology innovations for poultry processing. *Proceedings of the 35<sup>th</sup> National Meeting on Poultry Health and Processing*, Ocean City, MD, October 18-20. pp. 80-86.

### LECTURES AND PRESENTATIONS

Campbell, D.P., J.M. Cobb-Sullivan, and D.S. Gottfried. 2000. Integrated optic interferometric biosensor: a comparison of direct and indirect sensing. *Gordon Research Conference on Bioanalytical Sensors*, Andover, NH, July 23-28.

Daley, W.D. 2000. Next generation processing. What will it look like? *Alabama Poultry Federation Processors Conference*, Birmingham, AL, September 13.

Daley, W.D. 2001. Machine vision: developments in systems, algorithms, and techniques. *University of Georgia, Poultry Disease Laboratory Lecture*, Athens, GA, February 5.

Edmonds, P. 2001. In-vitro Comparison of a PCR method and a commercially available kit to differentiate live from dead *Listeria monocytogenes*. *Meeting of Southeast USA Regional Section, AOAC International*, Atlanta, GA, April 25.

**LECTURES AND PRESENTATIONS (CONTINUED)**

- Fratto, G.W. 2000. Plant safety roundtable discussion. Poultry Maintenance Symposium, Atlanta, GA, September 21.
- Fratto, G.W. 2001. Recordkeeping. 2001 Safety Workshop for the Poultry Industry, Birmingham, AL, June 8.
- Gottfried, D.S. 2000. Rapid detection of *Salmonella* using an immunoassay-based biosensor. International Association of Food Protection Annual Meeting, Atlanta, GA, August 6-9.
- Higginbotham, C., D.S. Gottfried, J. Cobb-Sullivan, D. Campbell, and R. Browner. 2000. Sol-gels: an innovative alternative to conventional sensor technology. Federation of Analytical Chemistry and Spectroscopy Societies Annual Meeting, Nashville, TN, September 22-30.
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- McKlin, T.E. and E. Geter. 2001. Into the maelstrom: mobile intelligent support for humans. Black Data Processors Association-Charleston Savannah River Area Chapter 4<sup>th</sup> Annual IT Conference, Augusta, GA, April 27-28.
- McKlin, T.E. 2000. Future systems/internet. 2000 Poultry Maintenance Symposium, Atlanta, GA, September 21-22.
- Ockerman, J.J. 2001. Wearable computers: concepts, applications, and studies. TransQuest of Delta Airlines, Atlanta, GA, June 22.
- Thompson, J.C. and T.E. McKlin. 2000. Emerging technologies in the mobile information age. 2000 U.S. Poultry & Egg Association Information Systems Seminar, Myrtle Beach, SC, August 6-9.
- Walsh, J.L. 2000. Odor control research report. U.S. Poultry & Egg Association Byproducts Seminar, Nashville, TN, October 13.
- Walsh, J.L. 2000. Wastewater and odor management. Fats and Proteins Research Foundation, Rancho Mirage, CA, October 23.
- Walsh, J.L. 2001. Managing odors at industrial operations. Georgia Water & Pollution Control Association Industrial Conference, Atlanta, GA, March 14.
- Walsh, J.L. 2001. Management systems: quality, environmental, and energy. Georgia Industry Association's 9<sup>th</sup> Annual Members' Meeting, Sea Island, GA, June 2.
- Walsh, J.L. 2001. RMP-industry implementation update. 2001 Safety Workshop for the Poultry Industry, Birmingham, AL, June 7.
- Wyvill, J. Craig. 2001. Ergonomics: where do we go from here? Georgia Poultry Processors Association Quarterly Meeting, Atlanta, GA, April 3.
- Wyvill, J. Craig. 2001. Poultry processing: delivering quality, value-added products at an economical price. The Rotary Club of Gainesville, Gainesville, GA, April 9.

**INVENTION DISCLOSURES**

- Lee, K.-M. Design considerations for prototyping an automated live-bird transfer system for applications in a production setting.
- Daley, W. and D. Britton. Method for fruit, vegetable, and other natural product inspection.
- Daley, W., D. Britton, R. Carey, T. Smith, and B. Leverett. Imaging system for natural product inspection.

## ATRP'S FIVE-YEAR PLAN

The five-year goal of the Agricultural Technology Research Program (ATRP) at Georgia Tech is to continue to provide state-of-the-art applied engineering research and service to the poultry industry.

The research program will continue to focus on automation, information technology, environmental, and safety areas, while service activities will continue to concentrate on broad information dissemination and one-on-one general assistance. Automation/electronics research studies over the next five years will begin focusing more heavily on integrated automation systems. These technologies offer major opportunities to further enhance productivity in the poultry industry. This includes developing additional advanced sensor technologies.

Information technology research studies will expand their focus on enterprise integration and internal support services. Mobile computers will continue to form the backbone of efforts to link operations across the factory floor with wearable applications staying in the forefront to improve the electronic availability of data to computer control systems. The program will also focus on innovative control platforms that utilize neural networks, fuzzy logic, and perform control functions at real-time speeds for processing applications. In addition, work will begin toward developing artificial reality tools to assist in creating new visual tools to enhance information transfer for support and training.

Environmental research studies will focus on emerging technologies that help to reduce water usage and waste generation. Furthermore, these studies will continue to focus on enhancing the program's understanding of how operations work and ways to further optimize them. Water usage is an area that has experienced rapid growth in recent years as plants turn to additional product-rinsing steps to control product microbial quality. Minimizing this additional water demand is essential as water resources continue to be squeezed around the state. Waste minimization also continues to be a national focus area, and the poultry industry has an opportunity to further enhance its image as an efficient user of resources.

Safety research will continue to take two paths. Personnel safety research will focus on continuing to find ways to reduce the risk of worker injury. The current research into risk quantification is a bold initiative and one that should pay dividends for years to come. The industry needs a better scientific base for assessing the true risk of injury. Product safety research, on the other hand, will attempt to develop technologies that open new opportunities for on-line screening and control over process and product quality. The development of new HACCP (hazard analysis and critical control point) control technology also remains a major new program thrust area.

Finally, ATRP will continue to actively support industry needs through its technical assistance program and will use newsletters, seminars, research reviews, topical reports, research reports, technical papers, and articles in industry trade publications to transfer its research findings. The program will also work to promote a better understanding of and appreciation for Georgia's dynamic poultry industry and will work to promote the increasing opportunities for engineering and technical careers in the industry.

## FOOD PROCESSING TECHNOLOGY RESEARCH FACILITY

Working with the Georgia Poultry Federation and the Governor's Traditional Industries Program for Food Processing, Tech refined plans to construct a 45,000-sq. ft. Food Processing Technology Research Facility next to the Tech campus.

Ongoing research in the facility will give industrial partners access to a university faculty and student workforce that has experience in addressing processing technology problems and systems design issues. While faculty and students from Georgia Tech will dominate this workforce, it is the goal of the facility to establish collaborative working relations with faculty and students from other universities and government research agencies, and encourage them to use this facility to support their research activities.



This facility will also provide an opportunity for equipment companies and food/poultry companies to interact collaboratively in the early stages of new technology development without putting undo pressure on them to either deliver or buy a system. The facility will provide space to set up test cells to demonstrate new products unproven in commercial plant settings.



The facility is expected to become a focal point for tours by visiting school children, industry groups, and outside dignitaries and help to highlight the changing nature of the food processing industry and its growing dependence on technology. Plans call for interactive electronic exhibits in the building lobby to help broaden the exposure of visitors to the challenges being faced by this industry. In addition, the facility plans to provide Internet access to school groups seeking to conduct virtual tours.

### CORPORATE DONORS AS OF JUNE 30, 2001

- American Proteins, Inc.
- Cagle's Inc.
- Claxton Poultry Farms, Inc.
- ConAgra Foods Inc.
- FMC Corporation
- Gold Kist Inc.
- Mar-Jac Poultry, Inc.
- Seaboard Farms, Inc. (now a part of ConAgra Foods Inc.)
- Stork Gamco, Inc.
- The Conti Group (Wayne Farms LLC)

As of the close of FY 2001, a Summer 2002 groundbreaking is targeted.

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