

# Agricultural Technology Research Program

## Engineering Tomorrow's Poultry Industry



**Fiscal Year 2000  
Annual Report**  
July 1, 1999 to June 30, 2000

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### **Mission Statement**

**To promote the economic growth of Georgia 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.**

## ATRP: THE YEAR IN REVIEW



The new millennium saw Georgia's poultry industry faced with a number of pressing challenges. Downward market pressures forced many companies to sell product at or below cost, putting increased pressure on firms to reduce costs. An overheated U.S. economy led to a tight labor market, making it increasingly difficult for many processing plants to maintain full staffing. Poultry farm waste management practices came under intense regulatory scrutiny after a national spotlight focused attention on negative environmental impact concerns from confined animal feeding operations (CAFOs). And continuing efforts to reform federal food safety inspection received a setback from a Court of Appeals ruling that reshaped the face of the HACCP-based Inspection Models Project.

Such challenges serve to emphasize the continuing need for process and technology innovation. The industry has to maintain a continued focus on achieving higher levels of efficiency and productivity to remain competitive. Toward that end, the Agricultural Technology Research Program (ATRP), in Fiscal Year 2000, made significant progress in pushing new technology frontiers for the industry. Its efforts to develop new computer vision, robotics, and mobile computer systems neared completion with field trials and commercialization plans well underway. Efforts to develop a new generation of "intelligent" processing systems and advanced sensors began delivering progress that harbors thoughts that the feasibility of these "next generation" tools will soon be demonstrated. And its continued studies in the environmental and workplace safety fields have begun generating new options for the industry to consider in areas that are attracting national visibility.

To further enhance these efforts, plans have been put in place to construct a new Food Processing Technology Research Building. This building is expected to become a national focal point for collaborative research into new high-tech tools for poultry and other food processing industries. The project is progressing well, with the State of Georgia committing over \$4.3 million and Georgia Tech an additional \$1 million. An industrial fund-raising effort has also secured \$980,000 in pledges thus far from 10 corporate partners and has hopes of attracting an additional \$3 million.

As the architect proceeds with schematic designs for this exciting structure, and our research teams' progress with their developments, we want to thank our state and industry sponsors and partners for their continuing support and let them know we are excited about the future of this dynamic industry and remain committed to pursuing the innovative developments that will be needed to address not only the challenges of today but those of tomorrow as well.

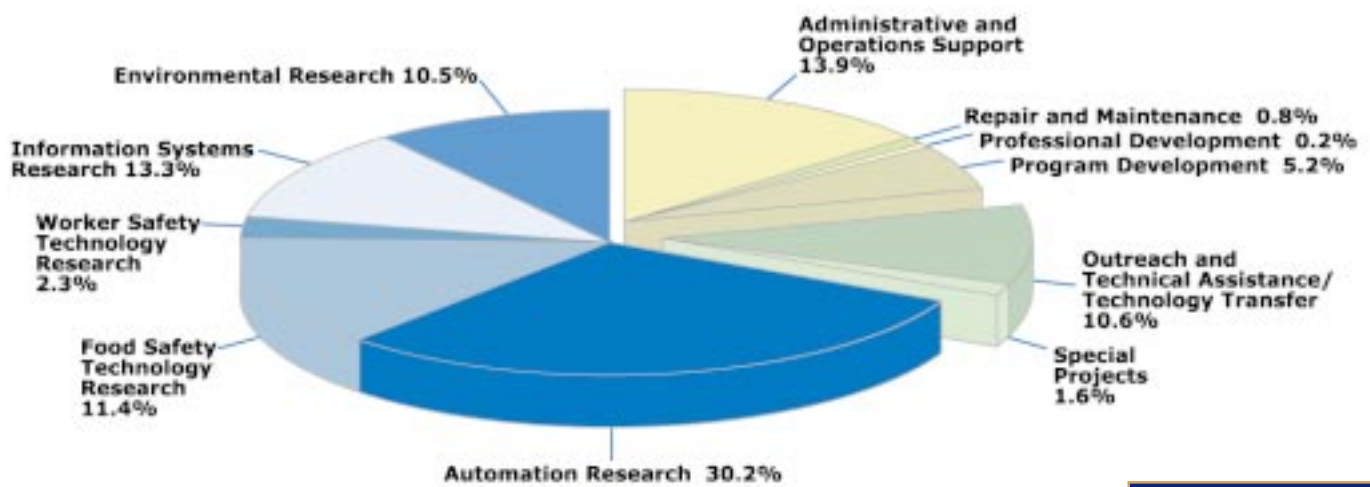
A handwritten signature in black ink that reads "J. Craig Wyvill". The signature is written in a cursive, flowing style.

J. Craig Wyvill  
ATRP Director

# FINANCIAL SUMMARY

ATRP budget dollars supported five major research focus areas in Fiscal Year 2000: 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 technology transfer, special projects, professional and program development, administrative and operations support, and repair and maintenance functions.

Two-thirds of the Fiscal Year 2000 program budget was channelled toward research in the five major research focus areas. In addition, one-third of the remaining program budget was channelled toward outreach and technical assistance/technology transfer and special projects.



**\$1,679,957**

## 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 Board meets semiannually to hear updates on program research efforts and to discuss challenges and future direction with program personnel.

### **POULTRY ADVISORY COMMITTEE (Fiscal Year 2000)**

Derrick Arp	Gold Kist Inc.	Patrick Johnson	Tyson Foods
Bill Baisley	Peterson Farms	Ken Long	ConAgra Poultry
Dan Barnes	Degussa Corporation	Winston May	Crider Poultry
David Bleth	Dutch Quality House	Allen Merritt	Gold Kist Inc.
Jim Brock	Crystal Farms, Inc.	Larry Miller	Kings Delight, Ltd.
Johnny Burkett	Cagle's, Inc.	Mohamed Mousa	Rose Acre Farms
Bob Burns	ConAgra Poultry	Tom Roberts	Gold Kist Inc.
Kevin Custer	American Proteins, Inc.	David Wicker	Fieldale Farms
Phil Dorr	ConAgra Poultry	Joel Williams	Mar-Jac Poultry
Mikell Fries	Claxton Poultry Farms	Steven Woodruff	Gold Kist Inc.
Jerry Gattis	Cagle's, 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 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 2000.

#### **Intelligent Automated Transfer**

Gold Kist Inc.

#### **Intelligent Cutting**

Tyson Foods, Inc.

#### **Advanced Robotics**

Gold Kist Inc.

#### **Computer Vision**

Tyson Foods

Gold Kist Inc.

#### **Mobile Information Systems**

Claxton Poultry

Cell Computing

#### **Biosensor Technology**

Gold Kist Inc.

#### **Ergonomics Research**

Tyson Foods, Inc.

#### **Environmental Research**

Harrison Poultry

Sylvest Farms

# FISCAL YEAR 2000 PROJECT REVIEWS



**INTELLIGENT AUTOMATED TRANSFER**



**INTELLIGENT CUTTING**



**ADVANCED ROBOTICS**



**COMPUTER VISION**



**MOBILE INFORMATION SYSTEMS**



**BIOSENSOR TECHNOLOGY**



**ERGONOMICS RESEARCH**



**ENVIRONMENTAL RESEARCH**



**POULTRYNET - ONLINE RESOURCE**



**OUTREACH AND TECHNICAL ASSISTANCE**



**TECHNOLOGY TRANSFER**



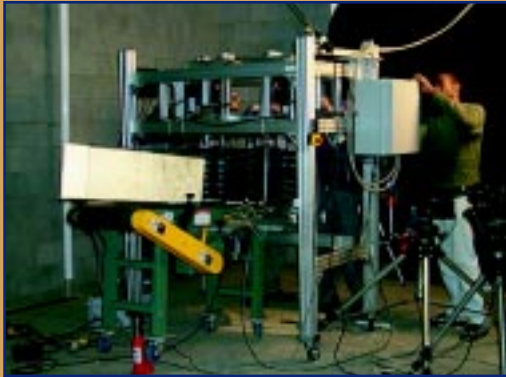
**REMOTE DATA INTERCHANGE STANDARDS**



**FOOD PROCESSING TECHNOLOGY RESEARCH BUILDING**

# INTELLIGENT AUTOMATED TRANSFER

The program made significant strides this past year in its efforts to develop an automatic live-hang system for transferring live birds from moving conveyors to shackle lines.



**Project Co-Directors:**  
**Kok-Meng Lee**  
**Richard Carey**  
**Michael Lacy, UGA**  
**A. Bruce Webster, UGA**

**Project Team:**  
**Wiley Holcombe**  
**Jeffrey Joni**  
**Sean Thomas**  
**Xuecheng Yin**

This past fiscal year, the research team initially focused its efforts toward identifying key operating parameters that significantly influence the success of the live-bird inverting process for the prototype design. These operating parameters are the bird's visual reflexes, the incoming posture and orientation of the bird, the conveyor inclination, the drum inclination with respect to the conveyor surface, and the bird's relative body-to-feet velocity. Because it is difficult to capture the legs of a backward sitting broiler, it was decided to try to design a system that would take forward-oriented birds. Using 120 birds (57 female and 63 male), 12 different test trials were conducted at the University of Georgia to study the effects of conveyor inclination ( $0^\circ$ ,  $7.5^\circ$ , and  $15^\circ$ ), bird vision (hooded and unhooded), and angles between compliant grasper and conveyor ( $75^\circ$  and  $90^\circ$ ) on bird presentation to the grasper and on shackling success. Ten forward-oriented broilers were tested in each of 12 setup combinations. The results show that the birds' visual responses to the mechanical graspers and the conveyor incline for a specific speed and coefficient of friction have significant effects on the birds' entry postures.

The team then focused on designing and testing practical illumination techniques to minimize the birds' visual reflexes and developing methods to lift the hocks of the birds by controlling the birds' body-to-feet velocity differences.

The illumination control used was a low-400 nm illumination (blue light) to image the posture of the bird on the moving conveyor before it entered the grasping mechanism. The design was experimentally tested with live birds and suggests that structured bird illumination can significantly minimize the variability of the initial postures.

The work directed at lifting the hocks of the birds by controlling the birds' body-to-feet velocity differences resulted in the development of a simulation algorithm for assessing the effects of the design changes on the leg kinematics. Based on the observation from the numerical simulation, the team performed preliminary experiments to examine what effect drum-speed control has on bird-hanging accuracy. The results were compared to design performance using a two-step velocity profile against that of a constant drum speed. Preliminary study results indicate that the success rate can be improved by controlling the speed profile of the grasper on the basis of the birds' initial posture.

## INTELLIGENT CUTTING

The main focus of the intelligent cutting project was to continue development of a prototype device for automatically making the cuts necessary to assist in automated deboning processes.



This past year's work sought to build on the achievements of the previous year's efforts. Previously the project team looked at several aspects of the cutting problem, sensing, trajectory generation, and cutting tools along with forces and torques required for performing the required cuts. In addition, they also examined people performing the task to see what they could learn from them in terms of different approaches. The general idea was that researchers would try to correlate good cuts (i.e., best yield) with their trajectories and force-torque profiles. They accomplished this by using a system for motion tracking. From these studies, the team determined that trajectories for the cutting path need to be anchored to reference points on the carcass, which then need to be determined dynamically for each bird to accommodate the size and shape variability.

A possible reference is the acromium process, where the scapula and clavicle come together just above the socket for the humerus. Unfortunately, this point is not visible from the surface, and the team had to look at imaging approaches using morphology to estimate its location. Tests of this technique showed accuracies of about 3 to 4 mm using a robot to locate the positions.

Other concepts were also investigated, where instead of using a cut similar to the one done on the existing semiautomated machines to remove the whole butterfly, a trajectory would be used that would split the butterfly. The cutting technique is also important to the operation, and researchers did a preliminary investigation on the tools that would be most suitable to automate the cutting process. They looked at the use of conventional, reciprocating, and circular blades. One conclusion from this study was that it would be difficult to use a conventional blade in the automated operation, as it would require fairly complicated control motions. Along with these tests, the team also looked at the forces and torques that were generated and now have an idea of the order of magnitudes to be expected in these operations. The next step in the project will involve preliminary trials using the concepts generated from these earlier efforts with the end goal being a prototype device.

### Project Co-Directors:

Wayne Daley

Kok-Meng Lee

### Project Team:

Tian He

Gwangcheol Park



## ADVANCED ROBOTICS

This year's robotics research was focused on two specific areas: testing of the visual servoing algorithms for the control of robotic devices and the development of additional devices for the grasping of bone-in product.



**Project Director:**  
**Gary McMurray**

**Project Team:**  
**Wiley Holcombe**  
**Andy Pfeiffer**  
**Jenelle Piepmeier**  
**Herman Sasmita**  
**Sean Thomas**

To demonstrate the key attributes of the visual servoing software, an Adept One robot was set up under visual servo control. This system was assembled using stereo vision to control three degrees of freedom on a six-degree-of-freedom robot.

The performance of the Adept One robot under visual servo control was tested under varying conditions. Both static and dynamic targets were tested using this setup. Within the test cell the conveyor had a control box that allowed the operator to not only manually vary the speed of the conveyor but also change the direction the conveyor was moving.

The performance of the system was observed to be better at lower speeds. One of the problems experienced with the faster moving target was that the system had little time to converge to a solution due to the restricted field of view of the robot. It was also very noticeable that the slow update rate of the system adversely affected the performance of the system.

The grasping work focused on the development of an end effector capable of grasping boned product. The task selected was to move drumsticks from a moving conveyor and place them in a tray pack. The first task for the grasping work was to review concepts from last year and add new ones. Fifteen new concepts were added.

From this grouping, the team narrowed the concepts to seven that showed true promise. A series of experiments were performed on these seven: rolling, constraining, side insertion, grabbing, static releasing, conveyor releasing, and pivoting. These experiments were carried out sequentially to test the assumptions and to prove the concepts.

From these tests, three modified concepts were selected that embodied the elements of handling needed in an integrated gripper design. These modified concepts were: double pusher, grabber, and grabber line.

Three conclusions were reached from these development efforts: although the prototype was conceived to fit onto an existing production line, its implementation may require some necessary changes in the production line; a different gripper may be needed for each of the four cut parts generated by an eight-piece cut-up machine; and a successful tray-packing system will require a pick-and-place machine in addition to a gripper.

# COMPUTER VISION

**The major activity of the computer-vision project this past year was a field evaluation of an on-line system for performing bird-by-bird grading at a station after the chiller.**



The major focus of the computer-vision project this past year was to evaluate the research prototype installed at the conclusion of Fiscal Year 1999 at the Tyson Foods facility in Cumming, Georgia. The vision system was designed to do post-chill grading. Under this study, the system was operated for a period of seven months and studied for system reliability and performance accuracy. During these trials, the unit encountered only one serious failure, the loss of a solid-state relay that controlled the power to the system. This showed that with proper care and maintenance it is possible to have reliable long-term operation of a design of this type in broiler processing plants.

As part of the performance evaluation, researchers tried to compare the performance of human graders with that of the machine. They did this by comparing the decisions made by the prototype system programmed with a suitable algorithm with those made by plant graders grading for bruises. The test results were mixed due to poor grader-to-grader consistency.

As part of the reliability evaluation, researchers focused on the effect of various environmental parameters such as temperature and dirt accumulation on performance. They found that temperature has a significant effect on the light outputs that they were able to compensate for while on-site. Dirt accumulation did not seem significant and did not affect system performance.

Researchers also explored emerging technologies and their likely impact on system performance and costs. Low-cost cameras are rapidly becoming commonplace, and researchers evaluated the performance of these devices for conducting machine-vision tasks. They found them to provide visually pleasing images with discernible contrast for various features, but were unable to complete the evaluation to fully quantify their results.

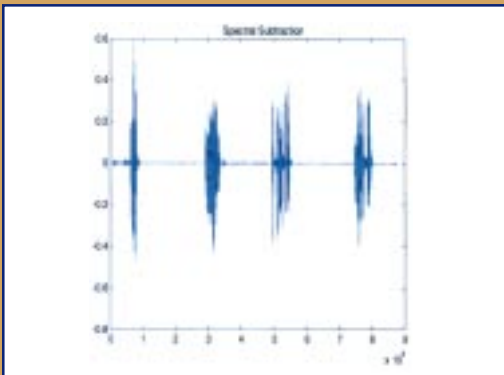
The field trial illustrated that the technology is ready for deployment in poultry processing facilities. There are issues remaining, however, related to plant-specific standards and how they are coded in the machines to maintain enough flexibility to accommodate the different modes of operations and quality grades that plants may want to assign.

**Project Director:  
Wayne Daley**

**Project Team:  
Doug Britton  
David Stahl  
Tracy Westeyn**

## MOBILE INFORMATION SYSTEMS

The focus of mobile information systems research was to refine the design of a prototype wearable system that addresses the growing needs of the industry in the collection and maintenance of HACCP data.



**Project Director:**  
**Chris Thompson**

**Project Team:**  
**Erfan Ali**  
**Bernie Markel**  
**Tom McKiln**  
**Jennifer Ockerman**  
**Scott Robertson**

The mobile information systems project focused on refining the system to be used in field trials at Claxton Poultry. The research team approached this challenge in a multidimensional manner, focusing on hardware, software, algorithms, and systems integration. Although the team was unable to install the complete system at Claxton in Fiscal Year 2000, significant progress occurred on all fronts.

After studying the needs of Claxton's QA/QC operation, it became apparent that the project needed to focus on two areas: developing an easy to use interface for the plant to customize the HACCP applications on its own, and making the speech recognition more robust in the presence of high-background noise.

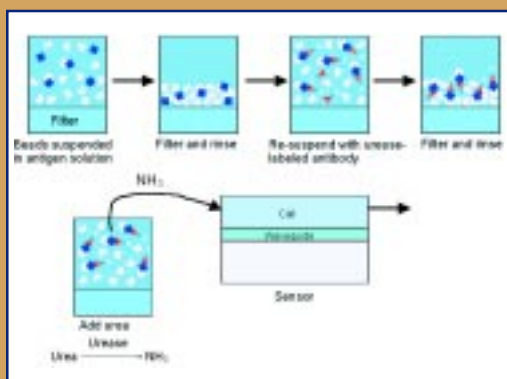
Interface development focused on voice recognition in high-noise environments and on utilizing the latest wireless technology standards. The voice interface allows users to manipulate the computing environment with their voice and provides both visual and auditory confirmation. This means that QA/QC technicians enter information (such as a temperature or a product to inspect) through voice entry and that piece of information is both displayed on a headset or hand-held monitor and confirmed with an auditory message. At this point, every aspect of the interface, including user log-in, is voice-enabled and hands-free. The team also employed emerging wireless standards to allow for real-time data transmission. These standards allow data collection in any environment equipped with a wireless access point, which means that this data-collection tool does not require complex infrastructure modifications. Currently, the voice-activated, data-collection tool runs on a wearable computer, and a pen-based version runs on a hand-held Windows CE device.

On the enhanced speech recognition front, the team performed a literature review of state-of-the-art digital filtering techniques. From all of the digital filtering work uncovered, it was concluded that Martin's Algorithm offered the best possibility of improving speech recognition in high-noise environments.

The team also looked at computer platform options for the system. In conjunction with a commercial computer board supplier, Cell Computing, the team completed the production of a next-generation wearable hardware platform. Although highly advanced, the resulting product proved beyond the capabilities of the team to completely debug. The product was, therefore, abandoned in favor of a commercially available design found in the marketplace.

# BIOSENSOR TECHNOLOGY

ATRP's biosensor project focused on continuing the development of an instrument that satisfies the demanding objectives of a rapid (no sample enrichment) and sensitive assay for pathogen detection.



**Project Director:**  
**David Gottfried**

**Project Team:**  
**Daniel Campbell**  
**Janet Cobb-Sullivan**  
**Paul Edmonds**  
**Nile Hartman**  
**Catrena Higginbotham**

Work this year focused on testing and enhancing a reusable sensor design conceived in Fiscal Year 1999. That design employs a combination of affinity chromatography with an enzyme-linked immunosorbent assay for the detection of whole bacteria or soluble protein antigens. The method utilizes small glass beads conjugated with a polyclonal antibody within a disposable cartridge for the capture of the antigen analyte, urease (urea → ammonia) as the enzyme linked to secondary antibody, and amplified ammonia-detection chemistry on the waveguide surface. Unlike a direct detection approach that uses a bioreceptor element in intimate contact with the signal transducer, this indirect approach employs a sensitive chemical sensor to detect the product of an enzyme-linked immunoassay. Over the past year, significant progress has been made in the assay development. Although initial designs for the sensor relied on vapor-phase detection of the ammonia produced, early in the year it was determined that sensitivity to atmospheric water vapor (humidity) made the detection chemistry unsuitable for the team's purpose. Much of the remaining year was devoted to developing and testing new aqueous-phase, ammonia-detection chemistry.

In anticipation of field testing, the team also sought to determine typical pathogen contamination levels at several locations within a poultry processing plant. Researchers initiated a collaborative study with an industrial partner (Gold Kist, Inc.) to evaluate the biosensor for detecting specific pathogens, *Salmonella* species and *E. coli* (generic strains), at designated sites in a poultry processing facility. Each sample was split, with one portion analyzed for viable organisms, using standard plating techniques on media that are selective and/or differential for the bacteria named above. The other portion of each split sample was analyzed in Gold Kist's laboratories, using a battery of biochemical tests.

From a review of the data for all samples, the research team was able to determine that the contamination level for bacteria is less than 100 bacterial cells/ml in most samples. A contamination level of greater than  $10^3$  bacterial cells/ml was detected on only two dates for *E. coli*, while a level of  $10^3$  bacterial cells/ml was detected on only one date for *Salmonella*.

## ERGONOMICS RESEARCH

**ATRP's ergonomics research team focused on field tests using the Ergonomic Work Assessment System (EWAS).**



Fiscal Year 2000 saw the Ergonomic Work Assessment System move to a second plant location for field studies.

At Tyson's plant in Buena Vista, Georgia, EWAS was used on-line to monitor the knife forces, wrist movement, and wrist flexor and extensor muscle activity of three workers. The workers performed three separate cuts at their chosen work height. One minute of data was collected every 1 to 2 minutes for approximately 20 minutes for each of the three cuts. The cuts included the wing cut, tender pull, and total thigh debone. Data represent approximately 50 cuts per worker, per cut type, for a total of 150 cuts per worker and 450 cuts for the three workers 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, and mean EMG (electromyogram) in both wrist flexors and wrist extensors.

The team also resubmitted a proposal to NIH/NIOSH for a three-year study related to cumulative trauma disorders in the poultry industry. The proposal includes the use of EWAS for in-plant, on-line monitoring of 10 outcome measures during two different cuts to evaluate the effect of work height on worker performance. The team submitted a Technical Note on EWAS to the Journal of Applied Biomechanics and received conditional acceptance. Modifications are currently being made at the request of the Editor. Final reports were also made to Gold Kist Inc., regarding the team's conclusions related to the data collected in Fiscal Year 1999 pertaining to the influence of work height on environmental loads during deboning.

**Project Co-Directors:**  
**Robert Gregor**  
**Dwight Waddell**

## ENVIRONMENTAL RESEARCH

**In the environmental area, research focused on water and wastewater impacts from HACCP requirements, with a secondary focus on environmental cost identification and management.**



Environmental efforts this past year focused on three challenges facing the poultry industry: environmental aspects of pathogen-reduction interventions; emerging environmental regulatory issues; and optimizing wastewater treatment processes based on environmental cost allocations.

On the pathogen-reduction intervention front, researchers continued efforts to develop an accurate method for characterizing the formulation of disinfection by-products (DBPs) in chiller water. After repeated failures this past year to detect even spiked samples of DBPs using conventional analysis methods, the team focused on trying to replicate an approach used by Haddon and co-workers (1996). They chlorinated chicken breast meat and then leaf fat. Ultrapure chlorine gas was bubbled into deionized water, and then the mixture was circulated in a closed-loop system. The chlorinated water was tested using spectrophotometric methods for residual chlorine concentration. For meat suspensions, sample analysis consisted of gas chromatography. For leaf fat suspension, a third analysis consisted of liquid-liquid extraction gas chromatography/mass spectrometric (GC/MS). None of the methods tried produced detectable results, and the study effort was put on hold pending further review.

On the regulatory compliance front, confined animal feeding operations (CAFOs) drew regulatory attention as state and federal environmental agencies pushed for new regulations. Over the past year, Tech researchers attended a number of public meetings to participate in discussions about water quality, monitoring activities, and assessment of data collected relating to poultry farm operations. As a result of these meetings, Tech engineers are working with the industry to formulate and refine response plans in this area. In addition, they are conducting a parallel feasibility study on alternative uses of poultry litter to take advantage of additional by-product values.

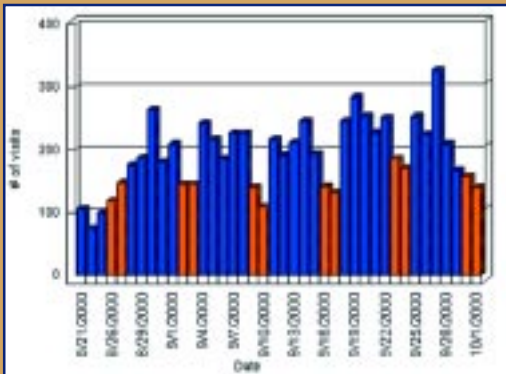
Finally, on the wastewater treatment optimization front, researchers completed field studies, this time in a further processing plant, generating cost performance data and targeting high-concentration waste stream segregation opportunities.

**Project Director:**  
**John Pierson**

**Project Team:**  
**Damon Ellis**  
**Robert Wallace**

# POULTRYNET - ONLINE POULTRY INFORMATION RESOURCE

Since its debut in January 1998, Tech researchers have continued to maintain and expand PoultryNet, an advanced Internet information center designed to be a global reference point for poultry-related information.



**Project Director:**  
**Tom McKlin**

**Project Team:**  
**Kyle Crawford**  
**Richard Strauss**  
**Chris Thompson**  
**Joe Thompson**  
**Gong Wang**

PoultryNet is an information avenue for the poultry industry, allowing immediate, electronic access to a wealth of web-based, poultry-related documents. PoultryNet currently allows users to search and browse approximately 55,000 documents. The efforts of this past year have centered on building an information-sharing community among visitors to the website. This manifests itself in that pertinent requests for assistance are shared among all visitors to the site; participants may join in a discussion list (made available in both web-based, e-mail, and newsgroup form); users have the ability to recommend new poultry-related websites; users may modify statistical data on-screen tailored to their own needs; and a calendar of events is available to which users may add information. All of this is made available to users along with PoultryNet's browsable and searchable index of poultry sites.

Maintenance on the whole continued as normal with the addition of new websites. New site additions were based on new sites discovered by the PoultryNet team and on requests from users to add sites to the searchable index. This process is mostly automated but still requires a person to evaluate a site before adding it to the list of indexable websites. Further, links to nonexistent websites are periodically removed, and the team has extended the number of websites linked to PoultryNet.

Based on field services analysis done in conjunction with the Georgia Poultry Lab, the PoultryNet team learned of the importance of delivering up-to-date information to field service technicians. This requires more than the ability to view data (such as an information gatherer would with PoultryNet) but requires that field service technicians contribute data that they will use for future analysis as well as receive data based on their immediate need. A prototype was generated that allows the display and collection of information over Internet-enabled cell phones.

Finally, the PoultryNet team has led three outreach activities. Two workshops on searching for information on the World Wide Web have been given; one at the 2000 Safety Workshop for the Poultry Industry and again at the Poultry Maintenance Symposium. One presentation on future technologies and the World Wide Web has been given at the 2000 Information Systems Seminar.

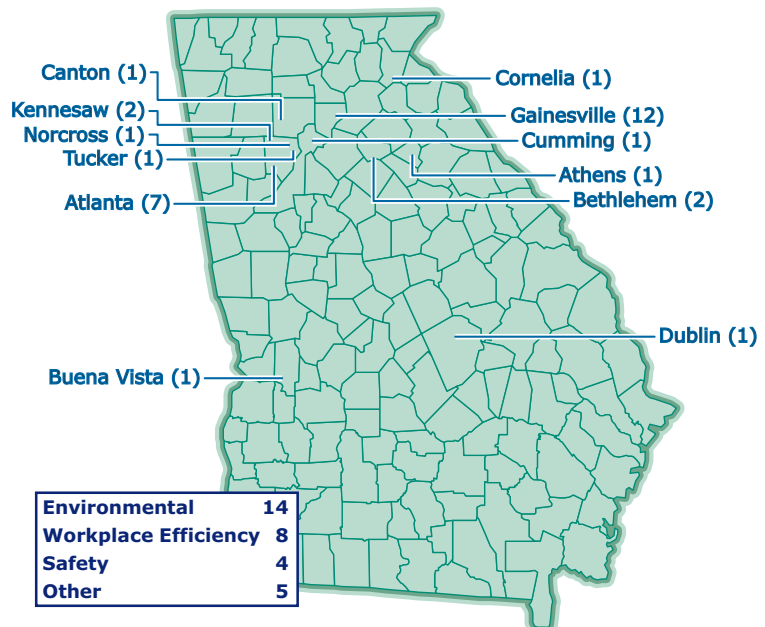
# OUTREACH AND TECHNICAL ASSISTANCE

ATRP's outreach and technical assistance efforts continued to address the general educational and specialized request needs of the poultry industry through workshops, one-on-one assists, and exhibitions.



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 (enjoyed by more than 40,000 visitors) at the Georgia National Fair, providing visitors with a better understanding of Georgia's poultry industry. In conjunction with the Georgia Poultry Federation, the National Chicken Council, and the National Turkey Federation, ATRP hosted the 2000 Safety Workshop for the Poultry Industry, attracting some 105 safety professionals from across the United States and the program's first international visitor, a participant from Ghana, West Africa. The program also coordinated the Poultry Maintenance Symposium with *Poultry* magazine. The Symposium drew nearly 30 attendees from across the country.

Thirty-one technical assists were provided during Fiscal Year 2000 to firms and individuals in the poultry industry located in 12 cities across Georgia. These assists ranged from simple inquiries regarding information or help needed to address a problem to extensive on-site consultation (focusing on environmental, workplace efficiency, safety, and other issues) in which researchers collected data and provided a full report of their findings and recommendations. The program uses input from these assists to gauge situations calling for new research activities.



A significant number of Environmental Assists were transferred to a new program operated by the Georgia Environmental Partnership.

**Project Director:**  
J. Craig Wyvill

**Project Team:**  
Program Staff



# TECHNOLOGY TRANSFER

**ATRP's Technology Transfer efforts continued to disseminate information about program activities through print, video, and digital mediums.**



**Project Director:**  
**Angela Colar**

**Project Team:**  
**Sheron Meyers**  
**Steven Thomas**  
**J. Craig Wyvill**

*PoultryTech*, ATRP's triannual newsletter, which covers the program's research advances in Automation, Environmental, and Safety endeavors, experienced more than a 44 percent increase in annual subscriptions, from approximately 1,700 to 2,450. *PoultryTech* articles were reprinted in external publications, including *Meat International* and *Poultry Times*.

The Wearable Computer (Mobile Information Systems) research program and the Biosensor project received feature coverage in more than 23 publications. The Wearable Computer, in particular, was featured in such notable magazines as *Control*, *Electronics Now*, *The Electron*, *Assembly*, *U.S. Tech*, *Training & Development*, *Poultry & Egg Marketing*, and *Inside Technology Training*. The Biosensor was also taped for an evening news food safety segment. WGNX CBS-Atlanta filmed footage of the biosensor at work in Gold Kist's processing plant in Carrollton, Georgia. In addition, the Wearable Computer system was featured in a WXIA-TV Atlanta (NBC affiliate) news segment.

Three articles were also written for *Broiler Industry/WATT PoultryUSA* magazine, focusing on Wearable Computing, Machine Vision, and Farm Computer technologies. The first program Annual Report was produced, and the program's website was redesigned.

# SPECIAL PROJECT: REMOTE DATA INTERCHANGE STANDARDS

In Fiscal Year 2000, ATRP researchers undertook a special project to open standards for industry communication with remote computer systems and devices.

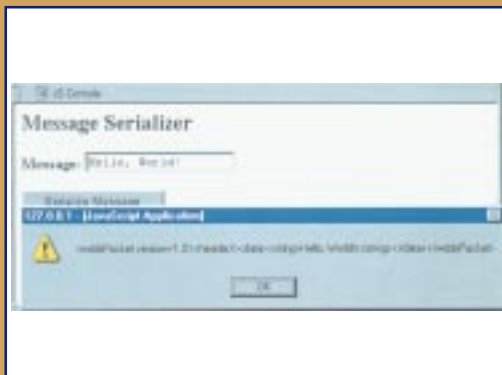
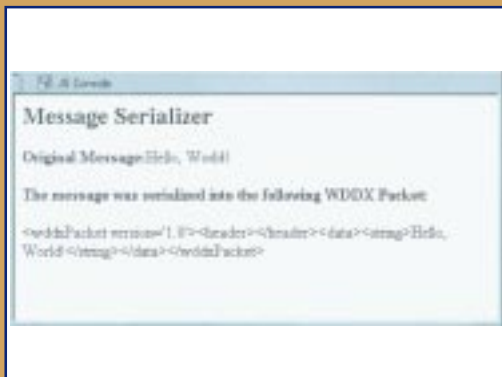
```
A string packet:
<wddxPacket version="0.9"><header><data><string>Hello, World!
</string></data></wddxPacket>

Another string packet:
<wddxPacket version="0.9"><header><data><string>Hello, <char
code="0c"> World!</string></data></wddxPacket>

A number packet:
<wddxPacket
version="0.9"><header><data><number>5</number></data></wddxPacket>

A dateTime packet:
<wddxPacket version="0.9"><header><data><dateTime>68-4-18T00:
50</dateTime></data></wddxPacket>

A boolean packet:
<wddxPacket version="0.9"><header><data><boolean
value="false"></data></wddxPacket>
```



The poultry industry has increasingly begun deploying environmental control systems for many of its production operations, i.e., farms, layers, hatchery, etc. Originally designed as stand-alone computer systems, little or no thought was given to standard methods of remotely accessing these systems and/or exchanging data with them. Consequently, as integrators move to develop centralized data analysis centers, they find themselves having to build custom and proprietary interfaces to the myriad of equipment vendors deployed in the field. This is both costly and inefficient in terms of manpower and technology. This project was a first step to creating and identifying universally agreed upon, easy to implement, open, and well-documented methods of remotely accessing the data collected by these systems.

In approaching its goal, the project team attempted to bring together industry participants to define an open standard for the exchange of information with remote devices. In doing so, the team identified the Internet/World Wide Web as the fundamental building block of any remote data-interchange application of the future and sought to explore technology that leverages this resource. This led the team in the direction of XML, the latest standard for vendor-neutral data interchange. From there, the team examined a number of implementations and finally settled on a completely open-source standard termed WDDX (Web-Distributed Data Exchange). This technology is available to support all of the standard web-development languages and can easily be ported to new platforms as they emerge.

The WDDX format was created to address the kind of challenge facing the poultry industry. The idea is to be able to read any kind of data — whether it be a single number or a complex structure of arrays within other arrays — and turn it into a chunk of text. That chunk of text is kept in the WDDX “format” and can be passed around from place to place with near-reckless abandon. When it is time to actually use the data again, it can be read from the WDDX format back to the way it was before the whole process began.

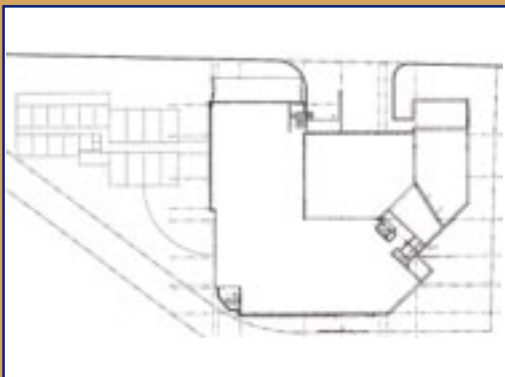
Remaining at the conclusion of this project was the need to market the WDDX concept throughout the industry with the goal of getting vendors to commit to employing it as a “standard.”

**Project Director:**  
**Chris Thompson**

**Project Team:**  
**Bernie Markel**  
**Tom McKlin**  
**Scott Robertson**

# FOOD PROCESSING TECHNOLOGY RESEARCH BUILDING

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



The facility will be a world-class research center for collaborative food processing technology development, an educational facility for academic research and public interaction, and a facility designed to attract technology firms interested in developing new products for this exciting and dynamic industry.

As part of the Fiscal Year 2000 planning cycle, a proposal was submitted through the Governor's Food Processing Advisory Council (FoodPAC) seeking \$4.1 million in funding from the state to go along with a \$200,000 planning grant in Fiscal Year 1999. FoodPAC gave its full support to the request, and the Governor and Legislature subsequently approved the full amount, which when combined with Tech's commitment of an additional \$1 million, provided more than half of the funds needed for the \$9.4 million project.

In Fiscal Year 2000, a capital campaign fund-raising effort was initiated to try and secure an additional \$4.1 million in corporate and private donations. The campaign has subsequently netted pledges and checks totalling \$980,000 from 10 corporate partners as of July 1, 2000, with more still in discussion.

The architect firm of Leo A Daly was hired in Fiscal Year 1999 and completed the programming phase of the building in Fiscal Year 2000. The building will have approximately 30,000 square feet of assignable space, of which one-third will be office space and the remaining two-thirds laboratory space. The laboratory space will feature six specialized laboratories: automation technology, information technology, human factors, food safety, environmental, and bioprocessing. In addition, the building will feature electronic interactive exhibits in the lobby for visitors and school children to learn more about processing technologies. The building will also contain a 50-seat auditorium for industry seminars, symposiums, workshops, and meetings.

At the end of Fiscal Year 2000 the architect had initiated schematic design efforts for the structure, which is expected to be completed by Summer 2002. Because fund raising is not yet complete, a two-phase construction schedule was developed to allow groundbreaking for Phase I to begin in the Summer of 2001. The facility will be located in Tech's new North Avenue Research Area at the intersection of North Avenue and Northside Drive.

**Project Director:**  
**J. Craig Wyvill**

**Architectural Firm:**  
**Leo A Daly**

## **Corporate Donors as of July 1, 2000**

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

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# PUBLICATIONS AND PRESENTATIONS

## Conference Presentations (continued)

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- Daley, W.D. Technique for defect detection in grading process and machine control in poultry processing using electronic imaging.
- Gottfried, D.S. and D.P. Campbell. Amplified enzyme-linked immunoassay with waveguide detection of acetaldehyde.
- Lee, K.-M. Mechanical live broiler inverter.

## 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 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.

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