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;
- 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.
As in past years, Fiscal Year 2009 brought with it several challenges and transitions for both industry and research entities. With economic indicators in decline for all of 2009, the industry persevered in finding ways to control bottom line costs while keeping core business processes functioning. For the Agricultural Technology Research Program (ATRP), FY 2009 also brought some significant organizational changes with the retirement of Craig Wyvill, the long-time Director of ATRP and Head of the Food Processing Technology Division at Georgia Tech. In conjunction with Abit Massey of the Georgia Poultry Federation, Craig was responsible for founding the Agricultural Technology Research Program, and over the past 35 years he has been instrumental in working with the industry to grow this research and outreach program at Georgia Tech. These efforts led to the construction of a new Food Processing Technology facility on the Georgia Tech campus to house the research activities of faculty, staff, and students in the areas of automation, environmental, energy, sensing, ergonomics, and food safety. Upon Craig’s retirement, Gary McMurray was tapped to serve as the new head of the Food Processing Technology Division, which serves as the institutional home for ATRP, and I was tasked with managing this program.

While the state funding declined in FY 2009, ATRP continued to serve the poultry and agribusiness industries in the state with research advances focused on intelligent automation systems, enhancing food safety, assuring workplace safety, waste byproduct conversion, advanced sensing solutions, and fluid disinfection and reuse technologies. This resulted in 6 research prototypes in various states of development and 4 research prototypes being deployed for field testing. In addition to the research activities, the program provided more than 30 technical assists to Georgia-based industry members, generated more than 35 articles and technical presentations, filed 2 provisional patents, 1 full patent, and 1 invention disclosure, coordinated the 2009 National Safety Conference for the Poultry Industry, and provided technology demonstrations related to current research activities to a variety of industry, government, and school groups.

ATRP continues to receive strong support from the state and our industry partners, and I have enjoyed the opportunity to meet and talk with many of our academic and industrial stakeholders in the state. This has led to several exciting discussions of future collaborations focused around critical industry problems. While the state economic picture remains somewhat glum, we are optimistic that we will be able to continue providing excellent service to the poultry and agribusiness industries in Georgia through our research, education, outreach, and technology transfer activities.

As we look back on an eventful 2009, we are extremely grateful for the support that all of our sponsors and supporters continue to provide that make these endeavors possible. And finally, we would like to say “thank you” to Craig Wyvill for his dedicated years of service to the ATRP team, the industry, and the State of Georgia, and we wish him all the best in his retirement.
### Industrial Collaborators

Industrial collaborators help provide direction and support to the specific research projects undertaken. They also participate directly in research projects by providing access to industry facilities for data collection and systems testing and contributing in-kind and cash support on an “as needed” basis.

- **Intelligent Deboning System**
  - Pilgrim’s Pride Corporation
  - Tyson Foods, Inc.
  - Wayne Farms LLC

- **Intelligent Cooking and Freezing System**
  - LMI Technologies
  - Murzan
  - Suzanna’s Kitchen

- **Bioprocessing and Advanced Mixing Technologies**
  - Air Products and Chemicals, Inc.
  - American Proteins, Inc.

- **Chiller Water Disinfection Management Studies**
  - Pilgrim’s Pride Corporation
  - Sanderson Farms
  - Tip Top Poultry, Inc.

- **Foreign Object Detection Technology Studies**
  - Frontier Technologies
  - ScanTech

- **Musculoskeletal Injury Risk Assessment System**
  - Liberty Mutual Research Institute for Safety
  - Various poultry processors throughout the State of Georgia

- **Special Projects**
  - **Cone Line Bone Detection System**
    - Chick-fil-A
    - Wayne Farms LLC
  - **Washdown Robot Endurance**
    - CAMotion, Inc.
    - Cargill Meat Solutions
  - **Overline Inspection System**
    - Gainco, Inc.
    - North Side Foods
  - **UV Disinfection Marinade Challenge Studies**
    - Air Products and Chemicals, Inc.
    - Perdue Farms Inc.
  - **RSS Disinfection Studies**
    - University Collaborator: University of Georgia Poultry Diagnostic and Research Center

### ATRP Poultry Advisory Committee

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

- **Mark Ham**
- **Marna Schmidt**
- **Ken Smith**
- **Rory Morris**
- **Jerry Straughan**
- **Steve Snyder**
- **Charlie Westbrook**
- **Barry Cradic**
- **Bill Crider**
- **David McEver**
- **Gus Arrendale**
- **Steve Smith**
- **Jim Petersen**
- **Gary Floyd**
- **Wayman Hollis**
- **Bobby Wiley**
- **Shaun Morris**
- **Joel Williams**
- **Bob Vimini**
- **Michael Crump**
- **Ken Long**
- **John Naes**
- **Doug Lee**
- **Jamie Usrey**
- **David Austin**
- **Angela Bradach**
- **Lisa Guilmet**
- **Andy McLeod**
- **Matt Brass**
- **Tom Frost**
- **Ex-Officio**
- **Bill Boone**
- **Mike Giles**
- **Abit Massey**
- **Louise Dufour-Zavala**
- **Doug Britton**
- **Gary McMurtry**
- **Michael Lacy**

- **Mark Ham**
  - Cagle's Inc. (Chair)
- **Marna Schmidt**
  - Air Products and Chemicals, Inc.
- **Ken Smith**
  - American Proteins, Inc.
- **Rory Morris**
  - Cagle's Inc.
- **Jerry Straughan**
  - Cal-Maine Foods Inc.
- **Steve Snyder**
  - Claxton Poultry Farms
- **Charlie Westbrook**
  - Cobb-Vantress, Inc.
- **Barry Cradic**
  - Crider Poultry Farms
- **Bill Crider**
  - Crystal Farms
- **David McEver**
  - Fieldale Farms Corporation
- **Gus Arrendale**
  - FMC FoodTech
- **Steve Smith**
  - Gainco, Inc.
- **Jim Petersen**
  - Georgia Power Company
- **Gary Floyd**
  - Hall Equipment Company
- **Wayman Hollis**
  - Harrison Poultry Inc.
- **Bobby Wiley**
  - Keystone Foods LLC
- **Shaun Morris**
  - Mar-Jac Poultry, Inc.
- **Joel Williams**
  - Perdue Farms Inc.
- **Bob Vimini**
  - Pilgrim’s Pride Corporation
- **Michael Crump**
  - Pilgrim’s Pride Corporation
- **Ken Long**
  - Pilgrim’s Pride Corporation
- **John Naes**
  - Sanderson Farms
- **Doug Lee**
  - Stork Food Systems
- **Jamie Usrey**
  - Tip Top Poultry, Inc.
- **David Austin**
  - Tyson Foods, Inc.
- **Angela Bradach**
  - Tyson Foods, Inc.
- **Lisa Guilmet**
  - Tyson Foods, Inc.
- **Andy McLeod**
  - Victory Foods
- **Matt Brass**
  - Wayne Farms LLC
- **Tom Frost**
  - Georgia Agriculture Innovation Center
- **Ex-Officio**
  - **Bill Boone**
  - Georgia Poultry Federation
  - Georgia Poultry Federation
  - Georgia Poultry Laboratory Network
  - Georgia Tech Research Institute
  - Georgia Tech Research Institute
  - University of Georgia
Intelligent Deboning System

Researchers completed preliminary modeling and testing of key cutting control techniques for their Intelligent Deboning System, which they believe will allow automated deboning systems to match if not exceed the yield and quality performance of the best manual deboning processes. Specifically, the team developed a system to identify the initial cutting point and specify the nominal cutting trajectory. This system is known as the tendon prediction system. In order to identify the initial cutting point, the team developed an algorithm that can accurately predict that point as well as the internal structure of the joint based on the location of three key points on the bird. In the past, the team has manually located these points and passed that data to a program that calculated the initial cutting point. During FY 2009, the team implemented an image processing cell to automatically identify these key points on the bird. The image processing algorithms and the imaging cell were developed and successfully tested individually. The entire work cell will be validated in FY 2010.

The team also focused on the development of a key technology required to automatically perform the wing cut—the real-time identification of bone material prior to cutting into or through a bone. Fast force-based feedback that identifies bone material is critical given the complexities of cutting through the product with its natural variation in material properties and the interactions of the blade with the product. Initial tests demonstrated the system's ability to recognize bone during a cut, and in FY 2010, the team will focus on the development of a control algorithm to guide the blade around the bone without cutting through the bone while still cutting the tendons. In addition, the development of an active wing manipulation system was initiated. Researchers began the development of models for the musculoskeletal system of the bird as well as the biological joints that more accurately represent the motion of the joints in the bird. This work would allow the system to predict the joint location based on the position and orientation of the wing tip.

The team's next steps are to refine the prototype to allow for more integrated control testing, including the use of 3D imaging technology. The 3D imaging is critical in the placement of the blade at the start of the cut. Researchers believe the Intelligent Deboning System could potentially help the poultry industry lower costs, achieve higher yields, and improve product safety by reducing the amount of bone or bone chips remaining in the product.

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Industrial Collaborators: Pilgrim’s Pride Corporation; Tyson Foods, Inc.; Wayne Farms LLC

Intelligent Cooking and Freezing System

Researchers developed an Intelligent Cooking and Freezing System to monitor the thermal mass flow moving into a cooking or freezing process. Key areas of activity were software development, heat transfer model development, and the construction of a framework to hold the system in place over a specific oven. Two major software tasks were completed. First, a system was devised to synchronize the infrared surface data and 3D height profiling cameras and collect matching images from both cameras. Second, an algorithm was developed that can identify single products by their 3D size and shape characteristics even when products are touching or overlapped. Researchers also developed a heat transfer model of chicken breasts that accurately predicts the final end-point temperature given the process parameters and the 3D shape.

Working with industrial partner Suzanna’s Kitchen, researchers collected some preliminary data over a processing line at Suzanna’s processing plant. Due to high levels of activity at the front of the cooking process, the best location for the profiler was determined to be between the cooking and freezing process on the line. Enclosures used for previous non-contact temperature monitoring research were re-used for the infrared camera and electronics and integrated into a sheet metal framework. The effects of the cooking process on individual pieces are difficult to determine once they have been disturbed by a transfer process. So, researchers decided to conduct the measurement on a very short section of processing belt coming out of the oven before the products fall onto the transfer belt. The entire system is placed over this short exit region of belt at a height that will allow 100% inspection.

Researchers will perform on-line testing of the system in FY 2010. Ideally, the system should be able to identify individual products and detect arrangement issues such as overlapping product. Thermal heat and mass transfer models along with the current oven cook profile will then be used to estimate final cook temperature of the product flow by volume.

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Bioprocessing and Advanced Mixing Technologies

The ATRP Food Safety, Environment and Energy Technology group seeks to address food processing environmental challenges via innovation that integrates product safety and energy considerations. FY 2009 efforts included separations research for value-added byproduct recovery and advanced mixing research under higher volumetric flow rates.

Researchers adapted current industrial refining processes used for oils and fats to improve the separation of feedstock fractions from brown grease and stabilized poultry fat. Solvents were selected to cover a wide range of polarities to evaluate separation of water (polar) and non-polar (oil, solids, and wax) constituents. The solvents ranged in polarity, as measured by dielectric constants, from Phosphoric acid (>80) to Canola oil (3.1). Analysis quantified the fractions of interest (i.e., oil/triglyceride, wax) as well as the less desirable fractions (i.e., water, solids, and saponified insolubles). With additional sampling for free fatty acids, six separate carboxylic acids were quantified in selected fractions of 68 samples, resulting in approximately 800 analyses. Separation research identified promising refining methods for improving value-added fractions of interest from waste materials. More work is needed to understand these results, especially with regard to the characterization of brown grease FAME (fatty acid methyl esters) solids and the implication that has on solvent selection and FAME post-processing.

Concurrently, the research team developed several approaches for process temperature control in high-shear mixers and higher volumetric flow rates in the Georgia Tech Advanced Mixing System (i.e., Taylor vortex). Advanced mixing research results were promising, although limited as the motor RPM ranges available only allowed operations in a narrow series of Taylor numbers as compared to the broader range believed to be applicable. Preliminary numerical simulations indicate that the system supports an order of magnitude increase in axial flow rates through a continuous flow reactor while maintaining Taylor vortices found advantageous for UV disinfection or other chemical, photochemical, and filtration applications. The project team anticipates conducting further research and experiments with a high-shear Taylor vortex system in FY 2010.

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Industrial Collaborators: Air Products and Chemicals, Inc.; American Proteins, Inc.

Chiller Water Disinfection Management Studies

Researchers examined current chiller water disinfection management practices in an effort to define best management practices (BMPs) that enhance chiller efficiency as well as safety, quality, and yield. To begin, researchers reviewed the most common chiller designs and disinfection chemicals used in poultry processing plants. They found three major chiller designs (auger-93%, drag, and spin), three major chemicals used for disinfection (hypochlorous acid, peracetic acid, and monochloramine), and three major chemicals used to manage pH (carbon dioxide gas, citrus acid, and sulfuric acid).

Next, they conducted a chiller concentration change case study. A two-stage, counter-flow immersion chiller was periodically monitored for variations in pH, free chlorine, and total chlorine concentrations during the initial 2 hours of bird loading. The data indicated that the chiller reached a chemical steady state after 2 hours of operation. In addition, the chiller water was characterized for solids loading. The preliminary results indicated that the total suspended solids loading was mainly organic matter, while the inorganic solids loading was found to be near 45%. However, currently there are no reliable on-line sensors that measure solids buildup during chiller operation. Researchers believe more field data from different facilities using different chemical and operational procedures will be needed to gauge industry standards.

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Musculoskeletal Injury Risk Assessment System

Researchers, in conjunction with the Liberty Mutual Research Institute for Safety, have developed an Ergonomic Work Assessment System (EWAS) designed to help the poultry industry reduce musculoskeletal injuries associated with the wrist. EWAS measures the posture, grip force, and muscle exertion of a worker while cutting tasks are performed on a poultry deboning line. During FY 2009, the research team continued to improve the EWAS system through various hardware and software updates and modifications. The process of integrating the Liberty Mutual knife into the data capture system was begun, while the addition of a wrist goniometer method for synchronizing the data was completed. Other low-cost alternatives were explored and proven viable for making a function data capture system that could be deployed in each plant. A validation study was also conducted by comparing the EWAS system to the Vicon motion capturing system, which is a standardized measure for collecting this type of data in a laboratory setting. Results indicated that although the EWAS system is not highly sensitive to fine movement changes, it is adequate in capturing gross movements. Based on this, researchers maintain that the EWAS system is sufficient for collecting data on how workers move while performing cutting tasks in a poultry processing plant.

The team’s next step is to conduct a large-scale study involving participants from several plants with varying levels of experience and expertise. This study will test the capabilities of the system and begin to lay the foundation for the development of new employee training programs and improved worker rotation schemes. The impact of fatigue on a worker’s posture and exertion and the effect on overall yield will also be investigated.

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Industrial Collaborators: Liberty Mutual Research Institute for Safety; Various poultry processors throughout the State of Georgia

Foreign Object Detection Technology Studies

The feasibility of using ultrasonic holography for on-line screening of foreign objects in meat products was investigated. Holographic ultrasound is an extension of ultrasonic imaging that allows the extraction of 3D information that provides a more accurate description of the products being conveyed in the product stream, thus allowing for better detection of foreign material.

In its current state, this technology is better suited for those products in which the meat is or has to be in some kind of liquid. Examples include marinated materials or product that is moved through via a pumping system that uses a fluid as the carrier material. The system could also detect if ice and temperature changes in the fluid are readily apparent. Another potential application is the inspection of package seal integrity. Assuming the packages could be immersed and the sensing conducted at a very high resolution, it might be possible to assess the integrity of the seals.

Finally, it was demonstrated that the system works very well with foods that have been completely blended (baby foods, applesauce, etc.). The system was able to see completely through plastic containers and most fully blended contents. Any foreign materials such as dense plastics, metals, and wood were easily detected visually. Tests also showed the technology was successful at discriminating between plastic and bone fragments embedded in a breast fillet. Researchers note, however, these early tests also revealed noticeable sensor noise, thus suggesting that the technology, while promising, needs further development.

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Industrial Collaborators: Frontier Technologies; ScanTech
**Cone Line Detection System**

Researchers demonstrated a new approach for the automatic screening of bone on the cone line providing an opportunity not only to assist in finding missed bones but also providing real-time monitoring of production yield. The Missed Bone Screening System uses a special cone with internal illumination that has the effect of backlighting the frame (skeleton) so that it appears like an x-ray image. The main bones that are of interest are the clavicle and the fan bones. The system was tested off-line and showed promise for implementation in a production environment. Initial results indicated there is a 0.5% chance that the system would reject a product without bone fragments, and a 7.5% chance that it would pass a product with bone fragments.

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**Industrial Collaborators:** Chick-fil-A; Wayne Farms LLC

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**Overline Inspection System**

Researchers evaluated and tested the operation and robustness of a next-generation design of an Overline Inspection System for food product screening. Specifically, the entire dome section was replaced with a high-density polyethylene sheet contained within a stainless steel frame. This design decision not only reduces the cost and complexity of the system, but it also allows for rapidly changing the dimension of the system design in order to accommodate food processing lines with different configurations. This means that the dome does not have to be re-designed for each different processing application. In addition, instead of a stainless steel tray with a polycarbonate window, the system’s entire lighting fixture is now contained in a polycarbonate tube. The shape of the tube makes it such that no water or contaminants will be able to accumulate on the surfaces. The tube is also filled with nitrogen so that there will be no condensation forming on the electronics.

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**Industrial Collaborators:** Gainco, Inc.; North Side Foods

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**RSS Disinfection Studies**

Researchers participated in planning efforts that resulted in controlled studies of three different litter disinfection approaches for RSS (runting and stunting syndrome): an electrostatic spray application of an established commercial disinfectant (conducted by a commercial vendor), normal spray application of a powerful new antiviral agent (Poultry Diagnostic and Research Center – PDRC), and application of an ozone gas between the litter and a cover blanket (GTRI). Results showed no efficacy for severely affected birds from those treatments. Sanitation and disinfection are believed to reduce the burden of challenges caused by multiple infectious organisms. Reovirus vaccines can prevent the stunting and poor feed conversions that occur with pathogenic reovirus infections, although there are no current immunizations that will prevent RSS. PDRC vaccine research continues.

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**University Collaborator:** University of Georgia Poultry Diagnostic and Research Center
Technology Transfer and Outreach Activities

ATRP continued an active Technology Transfer Program in FY 2009. The program received a 2009 APEX Award of Excellence in the Annual Reports-Print category for its 2008 Annual Report. Three issues (Environmental, Safety, and Automation) of the program’s newsletter PoultryTech were published in FY 2009. Several articles were reprinted in the trade press. Subscriptions to the newsletter totaled more than 1,450 subscribers, including 220 subscribers from foreign countries. A full-length feature article on “Robotic Evolution,” highlighting the program’s washdown-ready robot and its use for packing fresh meat products, appeared in the October 2008 issue of Meat & Poultry magazine. ATRP was also featured in the The National Provisioner magazine’s Tech Journal Series Poultry Processing 101 in January 2009. Research staff also produced more than 35 articles/technical presentations and generated 1 invention disclosure, 1 patent, and 2 provisional patents.

ATRP once again participated in the development of an Issues Kit on Poultry Industry Workplace Safety for the U.S. Poultry & Egg Association. The kit highlights the many safety challenges the industry has faced over the years, interventions employed to address them, and educational endeavors and collaborations with the Occupational Safety and Health Administration. The program also provided support to the Information Systems Seminar for the U.S. Poultry & Egg Association. In addition, ATRP provided tours of the Food Processing Technology Building and demonstrated research projects to approximately 175 students, representing groups from area elementary, middle, and high schools, as well as numerous industry and government groups.

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Technical Assistance

Thirty-eight technical assists were provided to firms and individuals in the poultry industry across the state. These assists included simple inquiries regarding information or help needed to address a problem and extensive on-site consultations in which researchers collected data and provided a full report on their findings and recommendations. The program uses input from all assists to gauge situations calling for new research initiatives.

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Categories

Energy: 3
Environmental: 20
Safety: 3
Workplace Efficiency: 3
Other: 9
Trade Publications


Journal Articles

Conference Proceedings


Lectures and Presentations


Wyvill, J.C. 2008. Food processing technology research activities at the Georgia Tech Research Institute. Visiting group from the Georgia Governor’s Office of Planning and Budget, Atlanta, GA, August 11.

Wyvill, J.C. 2008. Food processing technology research at GTRI. Visit by the Vice Chairman of the House Appropriations Committee on Higher Education for the Georgia House of Representatives, Atlanta, GA, September 3.


Wyvill, J.C. 2008. Deployment of technology and innovation to Georgia’s manufacturing sector: food processing technology research at the Georgia Tech Research Institute. Meeting of the Georgia House and Senate Study Committee on the Future of Manufacturing in Georgia, Atlanta, GA, November 12.


Invention Disclosures
Daley, W.D.R. Technique for bone screening.

Provisional Patents
Daley, W.D.R. Technique for bone screening.

Stewart, J.M. Thermal mass screening system.

Patent