

Agricultural Technology Research Program



2010 ANNUAL REPORT



E N G I N E E R I N G T O M O R R O W ' S P O U L T R Y I N D U S T R Y

ATRP 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.

For the Agricultural Technology Research Program (ATRP), fiscal year 2010 was a year of introspection. It provided an opportunity to review and then affirm the mission of the program as well as begin the process of defining the program's vision for the future. It became clear that ATRP's direction should be linked to the broader collective vision for the future of poultry operations both here in Georgia and the country. This culminated in the question, "what will poultry production look like ideally in 10, 20, or even 50 years from now?" The specific question for this program becomes, "how does ATRP begin to identify the existing technology and knowledge gaps that if successfully addressed will enable the poultry industry to achieve this vision of the future?" The answers to these questions provide the foundation and motivation for the research and outreach activities that are conducted within ATRP. So with this in mind, we have started what we hope will be a continuing conversation with several key academic, national association, and industry poultry experts regarding the future of poultry production.



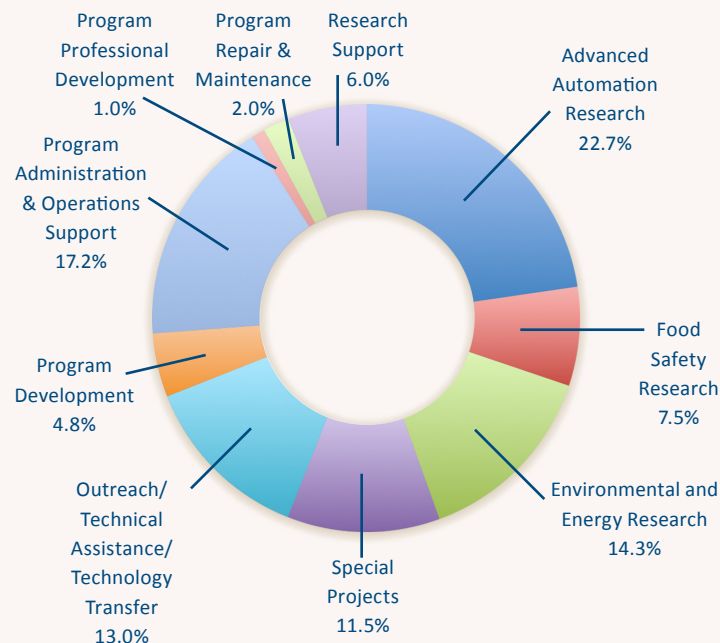
groups. One exciting new educational activity was the partnership between ATRP researchers and teachers from a local high school to support their Science, Technology, Engineering, and Math (STEM) initiative for students.

The troubling economic conditions of fiscal year 2010 continued to place pressure on ATRP's budget through further reductions in research, technical assistance, and outreach funds. However, the program continues to receive extraordinary support from industry and state stakeholders as well as the leadership within the Georgia Tech Research Institute. As a result of these commitments, ATRP has been able to continue serving the poultry and agribusiness industries in Georgia by focusing on core needs. Collaborations with our industrial partners and other academic institutions have grown appreciably over the past year, and as we look toward the future, we anticipate building on these relationships to pursue new opportunities together.

Doug Britton
ATRP Program Manager

ATRP continues to serve the state of Georgia and greater poultry community through education, outreach, technical assistance, and research in the fields of workplace safety, advanced fluid separations, adaptive robotic systems, novel audio and image signal processing, energy and water conservation, and food safety screening systems. These research activities generated more than 40 articles and technical presentations, 5 invention disclosures, and 8 research prototype systems in various stages of development. In addition to the research activities, the program provided 30 technical assists to industry members within Georgia, and it coordinated the annual National Safety Conference for the Poultry Industry, which experienced a slight increase in attendance for 2010. Outreach activities included coordinating the annual Poultry World exhibit at the Georgia National Fair in Perry, Georgia; producing a new format of the award-winning *PoultryTech* newsletter; and providing technology demonstrations to a variety of industry, government, and school

Fiscal Year 2010 Financial Summary
\$1,532,186



Intelligent Cutting and Deboning System

Researchers are developing a prototype system that uses 3D imaging and a robotic cutting arm to automatically adjust to natural size variations of product in order to perform precision cuts that optimize yield while eliminating the risk of bone fragments in finished product. During FY 2010, the team continued the development of the three key technology components of the Intelligent Cutting and Deboning System: tendon prediction system, bone detection algorithm, and force control to guide the blade around the bone. The team has been able to verify that the tendon prediction system is accurate to ± 3 mm. The image processing required for the tendon prediction is still being refined. The team has also been able to demonstrate a consistent bone detection algorithm for first contact of the blade with the bone as well as a simple force control algorithm to guide the blade around the bone. The force control will be optimized in the coming year. The system is now able to meet the testing goal of 1 bird every 3 minutes (the 3 minutes is taken up entirely by the setup of the bird in the system, which would not be required in a real system). For FY 2011, the team will begin to assemble the technology components into a prototype to allow for a yield test to be performed.

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Monitoring Bird Status in Broiler Housing Using Audio and Video

It is well known that environmental conditions during broiler growout can affect the performance of the birds (usually measured as feed conversion ratio). The hypothesis for this research effort is that bird behaviors can be used as early predictors of flock health and performance. The goal of the research has been to monitor various video and audio characteristics of the birds to determine the correlation between the flocks' environmental or medical conditions and their audio and video time series data. Working with researchers at the University of Georgia's Poultry Science Department, the team developed a system to collect audio, video, temperature, and humidity data. The system was installed in a research growout house on the UGA campus, and data was collected over a six-week period. During this time, researchers collected data under normal and stressed (temperature increased 10 degrees above normal) growing conditions. An analysis of the data showed that it is possible to detect a change in the vocalizations of the birds due to a change in temperature. Two approaches were taken in this analysis: one was a filtering approach where an extraction technique was developed to remove the sounds being made by the birds (called vocalizations) from the background noises in the room (particularly the fans). The data showed that the number of vocalizations rose and fell commensurate with the change in temperature. An analysis technique using the time domain showed a similar result. Results from the video data, however, are not as conclusive. In FY 2011, researchers will further investigate and confirm the use of bird vocalizations as early indicators of other production and environmental conditions. If successful, this audio monitoring could be used to take preemptive or corrective actions to maintain the health and viability of the flock, which in turn could improve production efficiency and bird welfare.

Project Director: Wayne Daley
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Cone Line Bone Detection System

Researchers have demonstrated a new approach for the automatic screening of bone on the cone line by inspecting the frame (skeleton) after the meat has been removed. This not only assists in detecting bones that remain in the product, but also provides an opportunity to do real-time monitoring of production yield. The Missed Bone Screening System uses a special cone with internal illumination that backlights the frame giving the appearance of an x-ray image. The bones of interest are the clavicle and 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. Although the concept was demonstrated initially using a plastic cone, partner and stakeholder feedback has led to efforts focused on implementing the system using a steel cone. A laboratory prototype using the modified steel cone has been constructed, and FY 2011 plans include conducting field trials/demonstrations along with algorithmic and software support to evaluate the concept under production conditions.

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Novel Separation Technologies for Poultry Processing Liquid Streams

Researchers are working to improve liquid stream reuse or rendered oil quality (e.g., reduce physical, chemical, and microbiological contamination so as to prevent contamination or adulteration of product) via improved separations using dynamic filtration and adsorption chromatography systems. By targeting contaminant separations (e.g., fats, proteins, water-insoluble impurities), value-added byproduct recovery and more rapid, cost-effective, and accurate detection of chemical and/or biological agents (either accidentally or intentionally placed in the food supply) should also be accomplished. Preliminary work using a VersaFlash™ Flash Chromatography System with different media and an initial analysis of key parameters affecting membrane separations and filtration indicate that adsorption and novel dynamic filtration separation techniques can be applied to selected poultry processing liquid streams (i.e., polished oil, both red chiller and chiller waters). These efforts indicated that pre-treatment of chiller waters will most likely be required, especially for red water chillers. Additionally, literature reviews indicate that pH plays a significant role in adsorption; therefore, isotherms that vary in pH are needed to better assess the implications at lower concentrations. The media washing experiments indicated that value-added byproduct recovery may be viable for protein, but more work is needed for fats or free fatty acids. FY 2011 efforts will expand adsorption work to functionalized adsorbents and simulated moving bed technologies, while dynamic filtration research will examine methods to improve separations, especially when pre-treating liquid streams in advance of adsorption systems.

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Waste Heat Recovery for Energy Efficient Poultry Processing

Research focused on defining opportunities for waste heat recovery and utilization in the poultry industry. As with many other industrial processing sectors, poultry processing facilities reject an abundance of thermal energy as byproduct or “waste” heat. Recuperating this thermal energy has manifold benefits, including improved process efficiencies, reduced utilities expenses, and reduced emissions. Researchers identified thermally driven heat pumps as a prime opportunity area. Special consideration was given to adsorption heat pumps due to their greater amenability to low-quality waste heat supplies and maintenance durability. There is an anticipated opportunity for thermal designs that further position the heat pumps for poultry processing duty. Future work will focus on investigating the effective integration of thermally driven heat pumps within niche poultry industry opportunities such as alternative cooling systems for mobile and stationary bird welfare, as well as process water thermal management within poultry processing plants.

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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 Cutting and Deboning System

**Marel Stork Poultry Processing
Pilgrim's Pride Corporation
Tyson Foods, Inc.**

Monitoring Bird Status in Broiler Housing Using Audio and Video **University of Georgia**

Cone Line Bone Detection System **Cantrell Machines Mar-Jac Poultry, Inc.**

Novel Separation Technologies for Poultry Processing Liquid Streams **Claxton Poultry Farms Mar-Jac Poultry, Inc. Pilgrim's Pride Corporation**

Waste Heat Recovery for Energy Efficient Poultry Processing **Power Partners, Inc.**

Poultry Industry Analysis

Researchers participated in several fact-finding activities to determine how ATRP can leverage its wealth of poultry processing experience to bring the most value to the industry and do so with a large probability of success. The first activity was a one-day workshop at the University of Georgia (UGA), which provided an overview of the industry and touched upon possible areas for research projects. The workshop was followed by a presentation by an industry expert that outlined the industry's perspective regarding research and development activities. Next, researchers were given target lists of industry stakeholders to visit at the International Poultry Expo. These stakeholders represented first, second, and further processing; growout; and energy/environmental management. The final activity was a brainstorming session to generate ideas for future projects. As part of this effort, researchers also met with UGA and Auburn University researchers to discuss ways the universities could work together to enhance their effectiveness in delivering research solutions.

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Intelligent Sensing and Control for Poultry Processing Systems

Researchers explored the feasibility of using intelligent sensing and control to improve the processing accuracy of an eviscerator. In addition to gauging industry interest, statistical studies were carried out on the variability of bird sizes using several different sources of data. Researchers found there is little to no perceived interest in the industry to modify or redesign the evisceration process, with the general opinion being that the current designs are adequate for addressing the expected variability in the product.

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Optical Sensor for Chiller Characterization

Researchers investigated the possibility of using optical and visual data to characterize chiller water. Two different approaches were pursued: (1) an image analysis method, where images of the fluid surface in the chiller water were processed, and (2) a spectral absorption approach, where color fluid sample tests were studied to better understand the absorption changes at various color concentrations. Previously obtained image data of the fluid surface in a chiller (collected over a period of time) was analyzed using image processing techniques. Early indications show a strong correlation between the changes in the images and the water quality in the chiller. While the RGB color analysis showed some promise, the lack of a consistent image acquisition process (lighting, pose, and location) led to artifacts and noise that limited the analysis. The results of the color fluid and diluted chemical absorbance tests showed that there were correlations between the various concentrations and absorbance. However, the absorbance profiles measured using chiller water have so far been inconclusive, and more data is needed for further evaluation.

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Intelligent Oven Loading Monitoring System

Researchers have developed a prototype imaging system that monitors oven loading in fully cooked meat operations. Using 3D and IR cameras, the system can identify individual products and detect arrangement issues such as overlapping product. Thermal heat and mass transfer models along with the current oven cook profile are used to determine whether a product will reach the desired end point temperature. This enables an accurate prediction of the percentage of product that will be overcooked and identifies pieces of meat or arrangements of products that are likely to undercook. In the future, a producer might use this information to fine-tune the product arrangement before it reaches the oven.

Project Director: John Stewart
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Sanitation Automation and SCADA Field Studies

Researchers explored the conceptual design of machines to be used for sanitation in various food processing industries, and the implementation of SCADA or Supervisory Control and Data Acquisition in a food processing environment. A study was generated on food recalls and illnesses that helped researchers become more aware of areas requiring better sanitation and stimulate ideas for the design of automated sanitation systems. As a result, researchers developed a conceptual design of two robots: an overhead gantry drive mechanism was compared to a mobile robot platform to highlight the challenges faced by various methods of locomotion in a food processing facility. The design exercise resulted in a number of invention disclosures that can be pursued in future attempts to automate cleaning in food processing. Researchers also evaluated the current and future state of SCADA in the context of food processing. A sub-component of this research was to generate a functioning demonstration using multiple SCADA software packages in an effort to compare the usability and utility of a number of interfaces for food processing plants. Three software packages (Cimplicity, Citect, and VTSCADA) were successfully implemented and tested during the duration of the project. Barriers preventing a wider acceptance in the industry are related to reliability, safety, and the need for more advanced and networked equipment. Researchers believe that as these barriers are overcome and newer equipment finds its way into plants the desire for SCADA-like networking will become universal in fresh meat processing industries.

Project Director: Jonathan Holmes
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Chiller Design Investigations

Researchers investigated automated methods to perform the rehang task after the chiller that can be retrofitted into existing poultry processing lines. The major technical challenge associated with automating the rehang process is the ability to uniformly orient and distribute the birds as they exit the chiller. Researchers surveyed several plants and identified technical, space, and economic factors that affect the implementation of an automated system. They proposed two systems that maintain or track the known orientation of the birds before they drop to the chiller. One of the proposed systems uses shackles or a guiding line through the chilling process. The second proposed option uses a tracking system to uniformly orient and distribute the birds as they exit the chiller. A key challenge to successful implementation of either concept is its adaptability to processing lines with varying configurations.

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Worker Safety Related to Back Injuries in the Poultry Industry

Researchers began a pilot study to investigate an intervention tool to help the poultry industry assess risk factors associated with injuries to the lower back. The work is being carried out in conjunction with the Georgia Tech Campus Recreation Center (CRC) and compares the Wii-Fit game to traditional methods of strengthening hip flexor muscles as an intervention to reduce the risk of lower back injuries during lifting. This pilot study is currently ongoing, with the pre-intervention testing and data gathering phase almost completed. The participants in the study are in the process of following their respective intervention strategies. Preliminary analysis of this data will be started in FY 2011, along with the final analysis and publication of results. Based on the results of the pilot study, submission of a proposal to OSHA to do further analysis is proposed for FY 2011. If the pilot study with human-based intervention is effective, the hope is that similar projects can be conducted at various

plants where researchers assist in defining what the risky tasks are and address those in a cost-effective manner. In addition to the pilot study, researchers also conducted an extensive literature review to find out what research has been done to address back injury problems in the poultry industry and in other similar or related industries. They found that many studies on proper lifting techniques have been conducted, but few have focused on the biomechanics of lifting in the poultry plant environment, and to their knowledge, none have considered the interventions that this project proposes.

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Raman Detection and Identification of Biofilms

Researchers explored the feasibility of building a non-contact, portable device to detect biofilms containing common foodborne pathogens. The project primarily focused on a literature search to identify Raman or other remote sensing technologies that could be used to implement stand-off methods for determining if a food processing area has been successfully cleaned and sanitized. Researchers believe it may be possible to scan processing surfaces in either the visible or ultraviolet range to determine if unwanted organic materials are still present after cleaning. At the low concentrations likely to exist after sanitation, remotely classifying these materials as a specific biofilm type will be significantly more difficult and expensive. Researchers also discovered that there are a number of hand-held Raman systems commercially available that are marketed for drug identification for law enforcement and for counterfeit drug detection in pharmaceuticals. These devices are not sensitive or selective enough to detect very low levels of pathogens, although they might see levels in the biofilms reported in fluorescence detection. These devices may also have utility for ingredient screening on the plant floor.

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Lateral Flow Biosensor

Researchers explored the development of a lateral flow biosensor for pathogen detection. Lateral flow-based diagnostics have been used for detecting pathogens, drugs, hormones, and metabolites in biomedical, veterinary, food, and environmental settings. They are designed for single-use at point-of-care or non-laboratory environments. However, their lack of detection sensitivity and quantification capability has limited their use in many applications. For this project, researchers employed low-cost and sensitive transducers including microelectrodes, a grating coupler, and surface-enhanced Raman scattering with lateral flow technology to develop a disposable, sensitive, quantitative disease diagnostic platform. Microelectrode sensors were constructed and treated to attach to specific bacteria, in this case *E. coli*. The microelectrodes were then stimulated with different frequencies, and the impedance of the device was measured. Tests indicated that there was a noticeable change in the impedance that could be used to detect the presence or absence of bacteria. When the device was allowed to react with bacteria that it was not programmed to detect (in this case *Listeria*), researchers did not see the magnitude of response that was seen with the target bacteria. The evaluation with the Raman response did not go as smoothly either, mainly because researchers were not able to obtain time on a working Raman detector. However, the technique shows promise in detecting bacteria. More experiments need to be conducted in order to verify these findings, and researchers maintain it is also necessary to test the lateral flow concept as a delivery mechanism to the sensor. The Raman tests would also be a technique to verify the operational principle.

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Technology Transfer

ATRP continued an active Technology Transfer Program in FY 2010. Three issues of the program's newsletter *PoultryTech* were published (Environmental-Summer 2009/Safety-Fall 2009/Spring 2010), with several articles reprinted in the trade press. A new format was introduced with the Spring 2010 issue. Instead of focusing exclusively on Automation research, the new format included a combination of articles to provide more timely and relevant information of interest to a broader cross-section of readers, as well as researcher spotlights and short news and information updates.

A cover story on "Automation to the Rescue?," highlighting the program's robotic breast deboning system and its potential to maximize yield without generating bone chips or fragments, appeared in the December 2009 issue of *WATT PoultryUSA* magazine.

Research staff also generated more than 40 articles and technical presentations and filed 5 invention disclosures. The FY 2009 Annual Report was published, and the ATRP website was updated. In addition, the program received the Georgia Tech Gold Tower Award for Best Newsletter for the Spring 2009 Automation issue of *PoultryTech*. Georgia Tech Communications and Marketing presented the inaugural Gold Tower Awards on November 12, 2009. The Gold Tower Awards program provides a way to recognize the best work of Georgia Tech communicators on an annual basis.

Outreach Activities

ATRP once again participated in the International Poultry Expo, the Georgia Poultry Federation Spring Meeting, and the Night of Knights, preparing exhibits for all three.

Poultry World continued to be a major draw at the Georgia National Fairgrounds in Perry, Georgia. Working with the Georgia Poultry Federation, Georgia Tech helped coordinate the more than 150 volunteers who staffed the exhibit.



In conjunction with the Georgia Poultry Federation, the National Chicken Council, and the National Turkey Federation, ATRP hosted the 2010 National Safety Conference for the Poultry Industry in Ponte Vedra Beach, Florida, attracting 76 safety professionals and vendors representing 39 companies and organizations from 17 states.

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 165 students, representing groups from area elementary, middle, and high schools, as well as numerous industry and government groups.

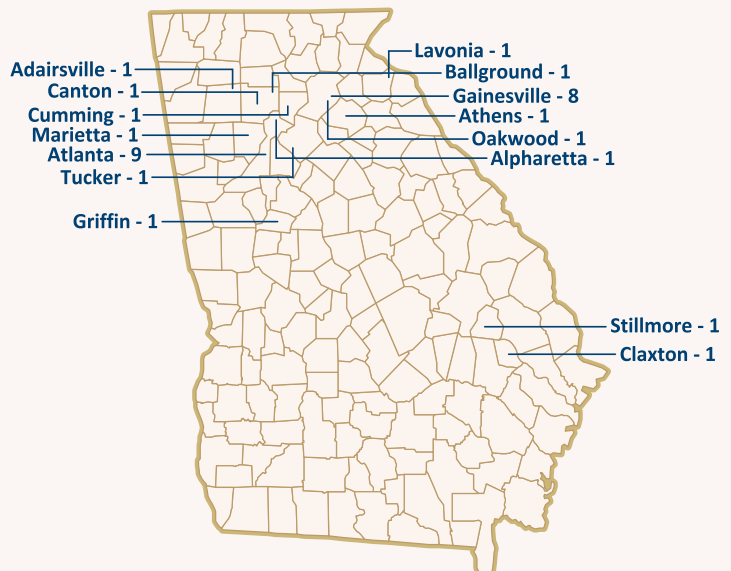
Project Director: Angela Colar
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Technical Assistance

Thirty 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.

Activity Leader: Doug Britton
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Categories:
Energy: 9
Environmental: 16
Safety: 3
Other: 2



Trade Publications

Harley, L. Fall 2009. The applicability of using the NIOSH lifting equation in a poultry processing plant. *PoultryTech*. 21(3):3, 8.

Harley, L. Spring 2010. What is the best way to lift? *PoultryTech*. 22(1):4, 8.

Haynes, C. Summer 2009. New combined heat and power (CHP) opportunities: just the right fit for food and beverage processors. *PoultryTech*. 21(2):6-7.

Holmes, J. and A. Colar. August 31, 2009. Washdown-ready robot undergoes testing. *Poultry Times*. 56(18):7.

McMurray, G. August 31, 2009. Designing food safety into processing equipment. *Poultry Times*. 56(18):4, 10.

McMurray, G. and A. Colar. August 31, 2009. Cutting controls tested on automatic deboner. *Poultry Times*. 56(18):8.

McMurray, G. and D. Britton. December 2009. Automation to the rescue? *WATT PoultryUSA*. 10(13):18, 20, 22-23.

McMurray, G. December 2009. New methods, similar goals. *The National Provisioner*. 223(12):40-43.

Pierson, J. Summer 2009. A closer look at water/energy conservation in food processing operations. *PoultryTech*. 21(2):3, 8.

Pierson, J. February 2010. The challenge of stormwater. *The National Provisioner*. 224(2):51-52, 54.

Thomas, S. and J. Pierson. Spring 2010. Functional testing of silver nanoparticles on food processing surfaces. *PoultryTech*. 22(1):3.

Usher, C. and W. Daley. Spring 2010. Modeling the chicken. *PoultryTech*. 22(1):5.

Vogel, A. Summer 2009. Adding value: researchers turn poultry processing byproducts into fuel. *PoultryTech*. 21(2):5.

Vogel, A. Summer/Fall 2009. Relaying information to food processing technicians. *Research Horizons*. 26(3):43.

Vogel, A. December 2009-January 2010. Researchers turn processing byproducts into fuel. *Poultry*. 16(6):8.

Vogel, A. Spring 2010. Ready-to-eat: imaging system monitors oven loading in fully cooked meat operations to ensure quality. *PoultryTech*. 22(1):1-2.

Zhou, D. and G. McMurray. March 2010. Modeling of blade sharpness and compression cut of biomaterials. *Robotica*. 28(2):311-319.

Conference Proceedings

Zhou, D., W. Daley, and G. McMurray. 2009. Kinematics and verification of a deboning device. Proceedings of the IEEE International Conference on Mechatronics and Automation, Changchun, Jilin, China, August 9-12. ON CD-ROM.

Book Chapters

Holmes, J.F., J.K. Allen, and G. Russell. 2010. SCADA and related systems: an introduction. In: *Robotics and automation in the food industry: current and future technologies*. (D. Caldwell, ed.). (Submitted for publication).

Lectures and Presentations

Britton, D. and G. McMurray. 2009. Poultry research activities at the Georgia Tech Research Institute. Georgia Poultry Federation Summer Poultry Leadership Conference, Ponte Vedra Beach, FL, July 22-25.

Britton, D. and G. McMurray. 2009. 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 7.

Britton, D. 2009. Poultry research activities at the Georgia Tech Research Institute. Visit by the Poultry Federations for Mississippi and Virginia, Atlanta, GA, August 10.

Britton, D., W. Daley, G. McMurray, and J. Pierson. 2009. An overview of GTRI's Food Processing Technology Division and its commercial successes. Visit by staff assistants to Congressman Phil Gingrey, Atlanta, GA, August 26.

Britton, D., W. Daley, and G. McMurray. 2009. An overview of GTRI's Food Processing Technology Division and its commercial successes. Visit by Donnie Smith-Director of Georgia's Center of Innovation for Agribusiness, Atlanta, GA, August 27.

Britton, D. and W. Daley. 2010. Overview of GTRI's Food Processing Technology Division with application to poultry. Visit by Nandini Mendu-Director of Biodevice R&D with Pfizer Poultry Health/Embrex, Atlanta, GA, January 29.

Britton, D. and W. Daley. 2010. Food processing technology research activities at the Georgia Tech Research Institute. Visit by the Honorable Larry Walker-Member of the University System of Georgia Board of Regents, Atlanta, GA, March 30.

Britton, D. 2010. Food Processing Technology Building and facilities at Georgia Tech. Visiting delegation from the University of South Florida Polytechnic, Atlanta, GA, April 20.

Britton, D. 2010. Emerging processing technology: research and development. U.S. Poultry & Egg Association Poultry Processor Workshop, Atlanta, GA, May 12-13.

Harbert, S.D. 2009. Emerging technology. U.S. Poultry & Egg Association Information Systems Seminar, Destin, FL, July 20-22.

Hu, A.-P., S. Grullon, D. Zhou, J. Holmes, W. Holcombe, W. Daley, and G. McMurray. 2009. Intelligent cutting of the bird shoulder joint. Georgia Poultry Conference, Athens, GA, September 29-30.

McMurray, G. 2009. An overview of GTRI's Food Processing Technology Division. Visit by Dr. James Browne-President of the National University of Ireland-Galway, Atlanta, GA, July 15.

McMurray, G. 2009. An overview of GTRI's Food Processing Technology Division and food safety research initiatives. Visit by the head of the Food Industry Division of the Mongolian Ministry of Food and Agriculture, Atlanta, GA, September 11.

McMurray, G. 2010. An overview of GTRI's Food Processing Technology Division and food safety research initiatives. Visit by the Georgia Association for Food Protection, Atlanta, GA, March 11.

McMurray, G. and D. Britton. 2010. Food processing technology research activities at the Georgia Tech Research Institute. Visit by spouses of members of the Georgia General Assembly, Atlanta, GA, March 9.

McMurray, G., D. Britton, and S. Harbert. 2010. An overview of GTRI's Food Processing Technology Division and biosensors research initiatives. Visit by Indonesian Public Health Officials, Atlanta, GA, March 19.

McMurray, G. 2010. An overview of GTRI's Food Processing Technology Division and food safety research initiatives. Visit by public officials from Central Asia, Atlanta, GA, April 12.

McMurray, G. 2010. ATRP's and GTRI's role in commercializing technology. Testimony before U.S. House Committee on Agriculture Public Hearing, Morrow, GA, May 14.

McMurray, G. 2010. An overview of GTRI's Food Processing Technology Division. Visit by staff assistants to Georgia Tech President G.P. "Bud" Peterson, Atlanta, GA, May 19.

McMurray, G. 2010. An overview of GTRI's Food Processing Technology Division. Visit by Dr. Marita Cantwell, University of California-Davis, Atlanta, GA, May 25.

Peterson, G.P., S. Cross, and G. McMurray. 2010. Industry collaboration model with the food processing industry at GTRI. Visit by the Honorable Michael Collins-Irish Ambassador to the United States, Atlanta, GA, February 9.

Pierson, J., R. Wallace, C. Haynes, D. Britton, and G. McMurray. 2009. An overview of food processing technology research at Georgia Tech. Visit by high school students participating in Georgia Tech's LEAD Summer Engineering Institute, Atlanta, GA, July 7.

Pierson, J. 2010. Stormwater issues. U.S. Poultry & Egg Association Environmental Management Seminar, New Orleans, LA, March 17-18.

Thomas, S., D. Britton, W. Daley, and J. Pierson. 2010. Food processing technology research activities at the Georgia Tech Research Institute. 7th Annual National Agricultural Week in Georgia Kick-Off Celebration, Atlanta, GA, March 16.

Invention Disclosures

Holmes, J.F. and D. Bleth. Gantry based installation for sanitation robot in food processing.

Holmes, J.F. Mobile sanitation robot—specifically for food processing applications.

Holmes, J.F. False ceiling for food facilities—improvement to reduce utility usage.

Holmes, J.F. Robot learning modes—specifically for teaching robotic motions in food processing sanitation operations.

Holmes, J.F. Motion capture system for use in training robotic systems.

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	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.
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Ken Long	Pilgrim's Pride Corporation
John Naes	Pilgrim's Pride Corporation
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David Austin	Tip Top Poultry, Inc.
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Lisa Guilmet	Tyson Foods, Inc.
Andy McLeod	Tyson Foods, Inc.
Matt Brass	Victory Foods
Tom Frost	Wayne Farms LLC

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