A Perfect Fit

Agricultural technology program observes a 30-year climb to the top.

by GARY GOETTLING

W hen the Georgia Poultry Federation first approached the Georgia Institute of Technology for help with a noise-abatement problem, no one anticipated the referral would evolve into an exceptionally productive long-term partnership.

That relationship — which observes its 30th anniversary this year — has resulted in substantial competitive benefits to the poultry industry and also fostered the Georgia Tech-based Agricultural Technology Research Program (ATRP) — ranked as one of the top programs of its kind in the country.

PHOTO BY GARY MEEK

"There is no finer example of a public-private partnership than the poultry and agricultural technology research program at Georgia Tech. It is a dramatic 30-year success story," says Abit Massey, executive director of the Georgia Poultry Federation and a key player in the establishment of ATRP. "The Federation is proud of its role in requesting the initial poultry project at Tech in the early 1970s, and then working closely with Tech and state officials and legislators in expanding it into a world-class program."

One measure of the ATRP's success is taking shape on the Georgia Tech campus. Scheduled to open in summer 2004, the $9.4 million Food Processing Technology Research Building will house the Georgia Tech Research Institute's (GTRI) Food Processing Technology Division, ATRP's organizational parent. The 35,000-square-foot Phase I structure opening in 2004 will contain office and laboratory space for ATRP work in automation technology, information technology and environmental systems. It will also accommodate research activities for FoodPAC, an industry-led partnership with the state serving Georgia's food processing industries (see sidebar). An 11,000-square-foot Phase II structure is also planned to house food safety, human factors and bioprocessing research.

A wireless handheld computer system under development at GTRI allows personnel to collect, retrieve and analyze a range of information from any location in a food processing plant, enabling closer control of production processes.

Funding for the buildings is being provided by the state of Georgia and corporate donors, particularly in the poultry industry.

"The new buildings will open doors that will strengthen Georgia Tech's partnerships with industry," says Craig Wyvill, chief of GTRI's Food Processing Technology Division. "That, in turn, may position the Institute as a research and development hub for the injection of technology into food processing equipment design."

Georgia's nation-leading poultry industry has been the catalyst, as well as chief beneficiary, of GTRI's application of technology to the agriculture business — efforts that include the establishment of ATRP in 1973.

It started with a bang — or more accurately, a lot of noise. Concerned with mitigating the high levels of equipment noise in poultry processing plants, the Georgia Poultry Federation turned to Georgia Tech for help. Researchers conducted one of the first definitive studies of the noise environment in a poultry plant. Teaming with NASA, researchers developed sound-absorbing fiberglass panels with a special, high-tech film coating capable of withstanding frequent washdowns, while also letting the noise penetrate to the soft, absorptive center. When installed on the ceiling of a plant, the panels reduced sound levels by two orders of magnitude. They were later marketed under the name Sanitary Acous-Tech Sound Panels.

Through the remainder of the energy-conscious '70s, the Poultry Federation frequently returned to Georgia Tech with concerns that resulted in several demonstration projects. Much of the research focused on energy efficiency and alternative fuel resources, including wood, solar energy and methane.

In the 1980s, ATRP's work shifted to systems-development projects dealing primarily with environmental compliance, electronic automation and plant-maintenance practices. ATRP research activities included:

● a thermally enhanced system to provide a faster, cheaper and more effective means for poultry producers to remove water from a valuable poultry byproduct called skimmings. Speeding up the separation process without adding chemicals was a major enhancement in the efficient recovery of skimmings.

● data entry terminals networked along the processing line, forming the basis for a tracking system created by ATRP scientists to automate post-mortem poultry inspection. The innovative information-management project enabled plant personnel, under a U.S. Department of Agriculture initiative, to assist with the inspection procedure.

The $9.4 million Food Processing Technology Research Building will house the Georgia Tech Research Institute's Food Processing Technology Division, the Agricultural Technology Research Program's organizational parent.
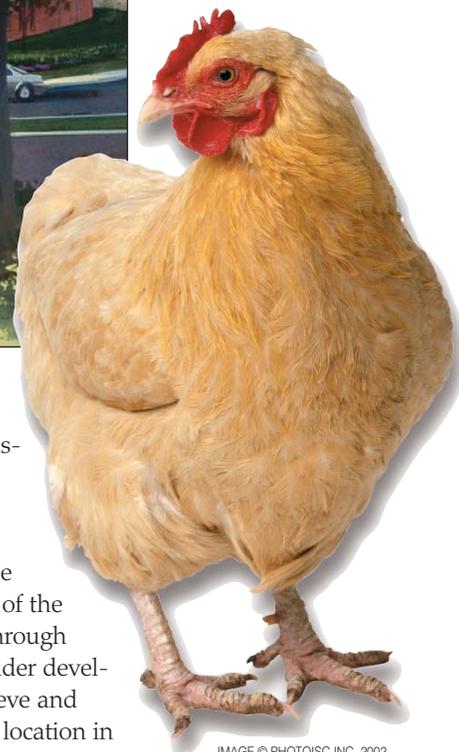
It evolved from a similar ATRP-created system for monitoring poultry quality.

Building on the foundation set by its previous work, ATRP research from the 1990s to the present has focused on applied technology. Projects are divided into five areas: environmental sustainability, ergonomics and worker safety, food safety, factory automation and computer information systems.

"We're pushing the technology frontier and starting to deliver breakthroughs in low-cost imaging, robotics and sensor technologies," Wyvill says. "We're also involved with some really innovative digital signal-processing work and coming up with software that can discriminate scenes and images to make determinations on good and bad quality features, which is not easy."

Water consumption tops the list of environmental issues of concern to the poultry industry. ATRP researchers are studying water-saving approaches to the rinse cycle in poultry and meat processing, as well as ways to get "the most bang for the buck" with new technologies for wastewater treatment, Wyvill adds.

In information technology, ATRP engineers were among the first to recognize the benefits of mobile wireless computing in a food plant.

"Wearable and hand-held computers are going to have a huge impact on the efficiency of plant operations by allowing dynamic statistical process control," Wyvill explains.

Current ATRP projects include:

● machine vision and sophisticated image analysis to provide the basic technologies behind a prototype systemic screening system. Now undergoing field testing, the system automates the repetitive sizing, grading and quality-inspection tasks involved in poultry processing. System enhancements detect broken wings, bruising, improperly hung birds and empty shackles, in addition to monitoring line speed.

● optimal, real-time control over the poultry-processing line — the chief goal of the mobile computing research conducted through ATRP. The wireless hand-held system under development allows personnel to collect, retrieve and analyze a range of information from any location in the plant, enabling closer control of production processes.

● an intelligent-cutting system project, another step in the automation of poultry processing. Integrating 3-D machine vision with precision robotics, researchers are developing a flexible, sensor-based system that can debone a chicken breast with the same skill and accuracy as a human worker.

While poultry processing offers a tremendous and relatively untapped opportunity for the application of technology, it's not the only agribusiness with wide-open potential, Wyvill notes.

"As we keep pushing the development of key technologies like imaging, robotics, advanced sensors, integrated optical sensors and so forth, we're designing them for a certain application in poultry," he explains. "But at the same time, we're making these technologies more cost-effective and, therefore, available for other industry sectors."

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The Perfect Buns

Digital imaging system catches bad sandwich buns.

PHOTO COURTESY OF ATRP

An automated product-inspection prototype is under development by GTRI researchers working with Flowers Bakery in Villa Rica, Ga. Researchers are introducing continuous imaging technology to the large-scale production of sandwich buns for fast-food restaurants, which hold to exacting product specifications.

The perfect bun: That's one of the goals of an automated product-inspection prototype under development by Georgia Tech researchers working with Flowers Bakery in Villa Rica, Ga.

The first phase of the work is introducing continuous imaging technology to the large-scale production of sandwich buns for fast-food restaurants, which hold to exacting product specifications.

The fresh-baked buns are scanned by a digital camera as they move along Flowers' production line. Items not measuring up in terms of color, shape, seed distribution, size or other criteria are identified by the computerized eye's imaging software and eventually removed automatically from the conveyor.

The system concept is under development by engineers from the Georgia Tech Research Institute's (GTRI) Food Processing Technology Division in association with researchers from Georgia Tech's School of Electrical and Computer Engineering (ECE) and BakeTech, a baking equipment manufacturer in Tucker, Ga.

The project was made possible, in part, by funding from Georgia's Traditional Industries Program for Food Processing, a 10-year-old research and development program designed to improve the market competitiveness of Georgia's food processing industry — the state's second-largest employer. The Food Processing Advisory Council (FoodPAC) oversees such state-funded research grants.

The computerized imaging system in development will automate the inspection process at Flowers. Ultimately, the new approach will save money and time by increasing yield and reducing waste, says Doug Britton, a GTRI research engineer and co-principal investigator for the project.

"It should reduce the time between noticing a problem and fixing it," Britton explains. Also, the system will automatically record data, such as product count and the number of out-of-spec buns, to generate production reports. "Flowers will have all this data immediately for doing statistical process control so they can implement changes that reduce the number of poor-quality buns," he adds. "They'll get a better handle on what they are producing."

The second phase of the project will extend automation by providing in-line mechanisms to correct the vagaries leading to poor-quality products. Proofers and ovens — the heat- and humidity-controlled chambers where dough is sent to rise and bake — are subject to normal disturbances that can affect product quality. Automatically compensating for those disturbances reduces time spent correcting problems.

ECE researchers, working with the GTRI team, are using data from the screening and image-processing phase and from additional sensor inputs to build a supervisory control system. It will be able to make changes in the proofer and oven settings to fix problems as they are detected.

"Baking is both a science and an art," says Professor Bonnie Heck, Britton's colleague from ECE. "Good bakers know both and are able to react based on experience and feedback from the process. We're trying to enhance the ability of expert and novice bakers alike to make better quality-control adjustments, while also adding automation that can mimic some of those adjustments dynamically."

While the computerized quality-control and self-correcting production system holds great commercial promise for the baking industry, Britton says, generic aspects of the technology may be adapted to other food processing industries as well.

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