News from EurAgEng

Winter Issue - December 2012

Prof Giuseppe Pellizzi

On 21 August 2012 Prof. Dr. h.c. mult. Guiseppe Pellizzi, Professsor Emeritus at the University of Milan passed away. He was one of the most well known figures in the international agricultural engineering community.

His career was closely linked with the Agricultural Engineering Department at the University of Milan. In 1954 he became an assistant in this department, and received his PhD in Agricultural Machinery in 1958. From 1968 to 1987 he was full professor at the university.

His research was concentrated on the basics of agricultural machinery, renewable energy, testing of agricultural machinery and global mechanisation. Professor Pellizzi was a key player in the global agricultural engineering network. His outstanding contribution to EurAgEng was the organisation of the joint EurAgEng-CIGR congress in Milan in 1994. This was the first congress on behalf of both societies and contributed significantly to a better understanding between CIGR and EurAgEng which was at that time, still emerging as the European society.

Professor Pelizzi was the president of CIGR, the Club of Bologna and CIOSTA and he was a co-founder and life member of EurAgEng. As well as his organisational and professional abilities, his generosity, loyalty, trust, humour and father-like behaviour to younger colleagues were greatly appreciated. He will be sorely missed.

From the Secretary General

David Tinker

To back up the feeling that engineering for agriculture is beginning to rise to the surface I have found a few articles to show that this is indeed happening. These are mainly UK stories so please ask your publicity department to send news in any language to EurAgEng at secgen@eurageng.eu.

Good News 1 CIGR-AgEng2012 Valencia was a wonderful success. Very well attended (over 1000 from 63 countries) there was something technical in the ten topics and eight Special Parallel Conferences to suit all tastes whether an agricultural engineer, biosystems engineer or other discipline. There were EU project teams organising topic areas and having project meetings as well as the Agricultural Engineering and Technologies Technical Platform that choose CIGR-AgEng2012 for a workshop. Of course CIGR and EurAgEng had many organising and technical meetings and there was the Awards Ceremony. Congratulations to all winners of awards (see overleaf). Finally, from all of us who attended - a further vote of thanks to Florentino Juste for organising such a memorable event.

Good News 2 The public is being told about the work we do. The magazine *New Scientist* has produced an article on ***Farmerbots: a new industrial revolution*** - see page 4. *New Scientist* is the world's top science weekly, helping to keep its 900,000 readers up-to-date on technology, health and public policy – providing scientists with a view beyond their niche of expertise. It is excellent to see the work of EurAgEng members Simon Blackmore and Eldert van Henten featured.

Good News 3 A story (page 6) from France where Claas has opened the Tractor Testing and Validation Centre and that Claas has increased the number of R&D staff by 80%.

Good News 4 An ambitious, industrial-scale farming experimental facility has been opened in South West England for farm-scale agri-environmental activities. An aim is to attract researchers in sustainable agriculture and innovative ways of tackling old problems. Is it the site for your project?

Good News 5 Harper Adams University College, again in the UK, has now secured €3.75 million, equally split from UK Government and private sources, to develop a new engineering building to accommodate and support the ***National Centre for Precision Farming***. Harper Adams engineering graduates, with their applied skills and can-do attitude, are highly sought after by global engineering companies such as JCB, Claas, John Deere and Jaguar Land Rover.

Strange News – Georgia Tech Research Institute has produced an improved robot to automatically debone chickens (page 6). It's not actually so strange to those of us following mechanisation and robotics for the meat industry but it will keep your friends and family amused – but not while eating the Christmas turkey please!

At that point, on behalf of the President, Executive, Council and Secretariat may I wish all EurAgEng members a jolly Christmas and a particularly good New Year and prosperous 2013. There are still plenty of agriculture related problems to solve and perhaps the politicians have now realised that with some reasonable resources we can do it – well much of it!

PS If you found too many stories here from the UK then please remember us when you do something exciting; we will need some more interesting articles in May 2013. Don't forget!

Spotlight on EurAgEng 2012 prize winners

CIGR-AgEng2012 in Valencia was one of the highlights of the Agricultural Engineering calendar in 2012. Over 1000 people from around the world attended the conference or one of its special parallel sessions. There were over 1500 oral and poster presentations and delegates enjoyed the delights of Valencia and its sunny Mediterranean location. One of the highlights was the recognition of the work of the community through the Awards Ceremony.

Award of Merit

For the first time the EurAgEng Award of Merit was presented to an academic following the splitting of the prestigious award into two parts. The *Award of Merit - Scientific Understanding* will be awarded in the even years and The *Award of Merit - Innovation into Practice* in the odd years.

Professor Dr Ir Jos Metz from The Netherlands was the first recipient of the new award at CIGR-AgEng2012 in Valencia.

Prof Jos Metz holding the Award of Merit

Professor Metz has had a long and distinguished career in livestock housing. In the 70s and 80s he was actively involved at Wageningen University in the ethology of livestock related to different husbandry systems through the scientific analysis of problems and the scientific basis for design of new livestock housing systems. In 1989 Professor Metz joined the Agricultural and Environmental Engineering and Research Institute where he was responsible for the technical design of livestock buildings connected to the implementation of robotic milking, the control of emissions and waste management and the improvement of animal health and welfare. Between 2000 and 2007 he was professor of Agricultural and Biosystems Engineering at Wageningen University and introduced a new agenda for innovative livestock housing research which has inspired young engineers and the international community alike. Professor Metz is still involved in international projects and has been dubbed the founding father of Precision Livestock Farming.

Francis Sevila Award

Another first in Valencia was the presentation of the Francis Sevila Award, kindly sponsored by Pellenc and in memory of EurAgEng founding member Francis Sevila who passed away in 2010. This Award recognises the potential of younger European agricultural engineers who have demonstrated excellence in the early stage of their careers. This excellence is marked by a quality of leadership and/or technical and scientific attainment that is clearly seen to be outstanding by their employer and other organisations. They have shown outstanding flair in promoting agricultural engineering; for instance in education or leadership of regional initiatives or through extension work, or have published significant work that has attracted national or international attention evidenced by the technical press or other citation, or have shown outstanding productivity and creativity as demonstrated by patents or significant projects leading to successful equipment, operational systems or other designs.

The proud recipient of the award in 2012 was Francisco Javier Garcia Ramos, Professor of Agricultural Engineering and Rural Development at the University of Zaragoza, Huesca Campus in Spain. He demonstrated at an early age his passion and commitment for his subject and has been able to elevate the profession of agricultural engineering to a new level in Spain. He has developed new study plans and represents the School at a national level and has also gained international experience in California and the UK. As well as a dedicated teacher and administrator, he has conducted high level research, leading nine research contracts and co-authoring four patents specialising in the monitoring of fruit handling and spraying equipment. His original ideas and ability to convert research and new technology into industrial innovation are particular strengths.

EurAgEng President Robert Kaufmann (left) with Francisco Javier Garcia Ramos holding the Francis Sevila Award

Innovation and Development Award

A team from Germany won the Innovation and Development Award with their paper *First operating experiences with a prototype for automated attaching of the supporting strings that the hop vines grow on in high-trellis hop gardens*. Team members were Zoltán Gobor and Georg Fröhlich (Bavarian State Research Center for Agriculture, Institute for Agricultural Engineering and Animal Husbandry, Freising, Germany), Harald Soller (Soller Ltd, Geisenfeld, Germany) and Johann Portner (Bavarian State Research Center, Institute for Crop Science and Plant Breeding, Wolnzach, Germany). This award is given to the best paper presented at the conference from industry or with an industrial partner.

EurAgEng Recognition Award

Demetres Briassoulis, Ettore Gasparetto, Florentino Juste and Peter Pickel all received the EurAgEng Recognition Award for their commitment and hard work on behalf of the Society and agricultural engineering in Europe.

Demetres Briassoulis received this award for his work on developing a core curriculum for Agricultural Engineering at a European level recognized by FEANI. Between 2002 to 2010 he led three projects coordinating the work of 31 institutions from 27 European countries as well as four institutions from the USA through the ATLANTIS programme. They resulted in the emerging discipline of Biosystems Engineering.

Ettore Gasparetto has been a member of the EurAgEng council for many years and since 1994 a member of the Editorial Board of *Biosystems Engineering*. He was very active in the production of standards, including co-ordination and leading tasks, a member of several EU and ISO Commissions and OCSE Italian delegate within the Committee of Testing Codes for Tractors. He was Head of the Club of Bologna from 2005 to 2008 and is an active member of CIGR. He has promoted agricultural mechanisation in developing

countries, through several consultancies and aid in dozens of African nations, as well as in Asia and Latin America, mainly on behalf of the Italian Ministry of Foreign Affairs and other international bodies.

Florentino Juste played a key role in the creation of the European Society of Agricultural Engineering (EurAgEng) and to this day continues to provide leadership to the profession as Past President of this organisation. As a direct result of his work, EurAgEng represents the profession at important forums at a European and world level. In addition to all this, our good friend Florentino is the organiser of the 2012 CIGR/EurAgEng International Conference in Valencia, Spain.

Peter Pickel received the EurAgEng recognition award for his extraordinary efforts to promote the agricultural engineering profession in the European community. He developed a strong connection to other production and manufacturing technologies and chairs the Agricultural Engineering and Technologies (AET) Working Group under the umbrella of the MANU*FUTURE* European Technology Platform. As spokesman for AET he gathers decision makers from the European industrial sector, from science and from the EU commission to define future research areas involving agricultural engineering. AET organised a workshop alongside the AgEng conference in Hanover last year and was part of CIGR-AgEng2012. A result of his efforts are the *Vision 2020* and the *AET Strategic Research Agenda* documents.

EurAgEng Outstanding Paper Awards

This award is given for outstanding papers published between 2010 and 2012 in the society's journal, *Biosystems Engineering*. The editorial board chose the winners from a shortlist of twelve papers.

D.D. Bochtis, C.G. Sørensen
The vehicle routing problem in field logistics: Part II
Biosystems Engineering, Volume 105, Issue 2, February 2010, Pages 180-188

P.J. Sonneveld, G.L.A.M. Swinkels, J. Campen, B.A.J. van Tuijl, H.J.J. Janssen, G.P.A. Bot
Performance results of a solar greenhouse combining electrical and thermal energy production
Biosystems Engineering, Volume 106, Issue 1, May 2010, Pages 48-57

S. Hong, I. Lee, H. Hwang, I. Seo, J. Bitog, K. Kwon, J. Song, O. Moon, K. Kim, H. Ko, S. Chung
CFD modelling of livestock odour dispersion over complex terrain, part II: Dispersion modelling
Biosystems Engineering, Volume 108, Issue 3, March 2011, Pages 265-279

B.H.E. Vanthoor, C. Stanghellini, E.J. van Henten, P.H.B. de Visser
A methodology for model-based greenhouse design: Part 1, a greenhouse climate model for a broad range of designs and climates
Biosystems Engineering, Volume 110, Issue 4, December 2011, Pages 363-377

Three of the Outstanding Paper Award winners with EurAgEng Past President Peter Schulze-Lammers on the left

EurAgEng Events

8-9 November 2013
Land.Technik AgEng 2013
Hannover, Germany
www.vdi.de/landtechnik-ageng

6-10 July 2014
AgEng2014 Engineering for Improving Resource Efficiency
Zurich, Switzerland
www.ageng2014.ch

26-29 June 2016
4th CIGR International-AgEng Conference 2016 - Robotics, Environment and Food Safety
Aarhus, Denmark

Sponsored Events

18-22 February 2013
48th Croatian and 8th International Symposium on Agriculture
Dubrovnik, Croatia

19-22 February 2013
41st International Symposium "Actual Tasks on Agricultural Engineering"
Grand Hotel Adriatic, Opatija
http://atae.agr.hr/

26-30 May 2013
FORTECHENVI Forest and Wood technology and the Environment
Brno, Czech Republic
http://fortechenvi.com/

5-7 June 2013
20th International Conference KRMIVA 2013
Opatia, Croatia
http://www.krmiva.hr/

25-28 June 2013
8th Int R&D Conf of Central & Eastern European Institutes of Agriculture
Puszczykowo near Poznan, Poland
www.belagromech.basnet.by/en

3-5 July 2013
CIOSTA XXXV From Effective to Intelligent Agriculture and Forestry
Legoland, Denmark
www.ciosta.org

27-29 August 2013
AgIng - Madrid'2013 Innovation and Production for the Future
VII Iberian Congress of Agricultural Engineering
Madrid, Spain
www.sechaging-madrid2013.org

Other Events

25-27 February 2013
First international Controlled Traffic Farming Conference
Toowoomba, Australia
http://ctfeurope.com/2012/ctf13/

19-20 June 2013
Four Decades of Progress in Monitoring and Modelling of Processes in the Soil-Plant-Atmosphere System:Applications and Challenges
Naples, Italy
http://www.diaat.unina.it/

7-11 July 2013
9th European Conference on Precision Agriculture (ECPA)
Lleida, Catalonia, Spain
http://www.ecpa2013.udl.cat/

19-20 September 2013
Engineering of Agricultural Technologies - 2013
Kaunas Lithuania

16-19 September 2014
The XVIII CIGR World Congress 2014
Agricultural & Biosystems Engineering - Upgrading Our Quality of Life
Beijing, China

Farmerbots: a new industrial revolution - James Mitchell Crow

Next time you stand at the supermarket checkout, spare a thought for the farmers who helped fill your shopping basket. They are finding life hard right now, and you can be sure this will mean higher food prices for you, and tougher times for the millions in the world for whom food shortages are a matter of life and death. Worse, studies suggest that the world will need twice as much food by 2050. Yet while farmers must squeeze more out of the land, they must also reduce their impact on the environment. All this means rethinking how agriculture is practised, and taking automation to a whole new level.

On the new model farms, precision will be key. Why dose a whole field with chemicals if you can spray only where they are needed? Each plant could get exactly the right amount of everything, no more or less, an approach that could slash chemical use and improve yields in one move. But this is easier said than done; the largest farms in Europe and the US can cover thousands of hectares. And that is why automation is key to precision farming. Specifically, say agricultural engineers, precision farming needs robot farmers.

Soon, we might see fields with agribots that can identify individual seedlings and coax them along with tailored drops of fertiliser and measured sips of water. Other machines would distinguish weeds and dispatch them with a microdot of pesticide, a burst from a flame gun or a shot from a high-power laser. These machines will also be able to identify and harvest all kinds of ripe vegetables. Robots could bring major changes, too, in jobs and how we work, in the soil and its quality, and in how much energy, and thus carbon, goes into farming. They could reduce pollution and water use. The most visible change, though, for ordinary people, could be in how farmland looks. Crops could be planted in small, geometrically arranged fields, while fruit farms are filled with arrays of two-dimensional trees. Robofarmers might even influence the type of fruit and vegetables that reach our shelves.

More than a century of mechanisation has already turned farming into an industrial-scale activity in much of the world, with farms that grow cereals being among the most heavily automated. But a variety of other crops, including oranges and tomatoes that are destined for processed foods, are picked mechanically. On thousands of dairy farms cows are now milked by robots. These and other products arrive at your local store untouched by human hands.

Yet the next wave of autonomous farm machinery is already hard at work. You have probably seen it and not even noticed, for these robots are disguised as tractors. Many of today's tractors are self-steering, use GPS to cross a field, and can even "talk" to their implements - a plough or sprayer, for example. And the implements can talk back. "A mechanical weeding tool will tell the tractor 'you are going too fast', or 'move to the left'," says Simon Blackmore, who researches agricultural technology at Harper Adams University College in Shropshire, UK. Such systems are becoming the norm, he says.

Farm vehicles are also beginning to talk to each other. A John Deere system on sale this year allows a combine harvester, say, to call over a tractor-trailer so the driver can unload the grain. German firm Fendt has created paired tractors, one driven manually with the second self-steering and mimicking the first tractor's movements in an adjacent row. The system can effectively halve the time a farmer spends in the field - and this is just the start.

However, when fully autonomous systems take to the field, they will look nothing like tractors. With their enormous size and weight, today's farm machines have significant downsides: they compact the soil, reducing porosity and killing beneficial life, meaning crops don't grow so well. Compaction also increases erosion by rainwater run-off. "Why do we plough? Mainly to repair the damage that we have caused with big tractors" says Blackmore. "Up to 80 per cent of the energy going into cultivation is there to repair this damage. Surely there is an opportunity to do things in different ways."

Fleets of lightweight autonomous robots have the potential to solve this problem, Blackmore believes. Replacing brute force with precision is key, he says. "A seed only needs one cubic centimetre of soil to grow - if we cultivate just that we only put tiny amounts of energy in and the plants still grow nicely."

These lightweight robots could remove the need for ploughing altogether, significantly reducing the amount of energy, and thus carbon dioxide emissions, coming from farming. And with less compaction, the soil keeps its structure and beneficial organisms, and is able to absorb more water and stay fertile for longer.

Autonomous robots with these kinds of abilities are already showing their mettle in field trials. These agribots need to have three key abilities: to navigate, to interpret the scene in front of them, and to be able to help the farmer, by blasting a weed, applying a chemical or harvesting the crop.

Navigation systems are the simplest part of the equation, particularly with the emergence of a high-precision satnav technique called RTK-GPS, which enables machines to locate themselves to within 2 centimetres. Arno Ruckelshausen from the University of Applied Sciences in Osnabrück, Germany, is developing this for a modular robot farmer called BoniRob. This four-wheeled field rover uses spectral imaging cameras to pick out green plants against brown soil. It then records the location of individual plants and repeatedly returns to each one during the season to monitor its growth (Landtechnik, vol 67, p37).

Laser weed gun

Eliminating weeds is a particularly desirable aim, since they reduce yields in some crops by more than 50 per cent. So next, Ruckelshausen intends to fit this robot with a precision spraying system - based on an ink-jet printer - that can apply microdots of herbicide to the leaves of weeds. He calculates this could cut chemical use by up to 80 per cent. Even taking into account the initial investment in the robot, this would end up being cheaper than conventional weeding, Blackmore calculates. There are obvious benefits for biodiversity, too, by minimising the number of plants that are killed by herbicides. What's more, applying herbicide isn't the only way robots could kill weeds: prototypes have wielded flame guns and lasers to burn weeds, something that would be very useful for organic farming.

Similar savings are possible with fertiliser: field trials have shown that by using sensors to assess an individual wheat plant's nitrogen levels, a robot can tailor the amount of fertiliser it gives and reduce the overall amount used by more than 80 per cent, with no loss in yield (Soil Science Society of America Journal, vol 73, p1566). The decrease in fertiliser use, combined with reduced

Hortibot *created by Rasmus Jørgensen and a team at Aarhus University in Denmark in 2007, Hortibot is a prototype agricultural robot that uses autonomous navigation, cameras and tools to carry out repetitive tasks in the fields. (Image: Aarhus University)*

***SprayCell** uses cameras and image analysis software to identify and locate crops and weeds. A row of spray nozzles then gives the weeds alone a dose of herbicide, which could halve the amount of weedkiller used on farms. (Image: Aarhus University)*

water run-off from less compacted soil could mean healthier rivers and waterways. Not to mention the fact that industrial production of fertiliser is a huge contributor to carbon emissions.

The next challenge is how to distinguish weed from crop. Researchers are developing machine vision systems that use the shape of the leaves to distinguish between, say, weeds and sugar cane. Progress is slow, though, says Salah Sukkarieh, a robotics researcher at the Australian Centre for Field Robotics in Sydney, because of a lack of funding. "If I had the money for agricultural robots that I have from mining and defence projects, I'd solve it. But there's just not enough money in farming. We have to learn from other industries, it's a trickle-down effect," he says. Still, machine vision should be ready in around three years, he predicts.

Blackmore, too, sees no technological reason why agricultural robots can't go commercial. Tests of robots with machine vision such as the Danish HortiBot have shown they can identify weeds in a field and spray them with precise amounts of pesticide. Other tests have shown that robotic irrigation systems can cut water use by up to half. "It's just a question of finding the investment. The technologies have all been developed" he says.

In Japan, the government has taken the matter into its own hands. The country currently grows 40 per cent of its own food, making it more reliant on imports than any other nation, but the government aims to increase this to 50 per cent within the next decade. And with an ageing population shrinking the pool of potential farm workers, the country is turning to robots.

Noboru Noguchi at Hokkaido University is leading a five-year, $8 million project funded by Japan's Ministry of Agriculture, Forestry and Fisheries to bring agribots to market. The project aims to automate everything from planting through to harvest, and will focus on Japan's three staple crops: rice, wheat and soya beans. By 2014, the team plans to be pilot testing its agribots on farms. "Five years from now, we want to be selling them" Noguchi says.

One big concern for Noguchi is the risk that a robot might hit hikers or stray cattle. So he is working with German engineering company Bosch to develop robots equipped with lasers and ultrasonic sensors that monitor their surroundings and jam on the brakes if a collision is imminent. As a back-up, touch-sensitive bumpers stop the robot should it strike anything.

After Japan, the next places to feel the pinch of farm labour shortage - and where robot farmers are likely to appear the soonest - are North America and western Europe. And it is a similar story in rapidly developing nations such as China. "Work in agriculture is not interesting, prestigious or usually very well paid. It is physically demanding and dirty - people prefer to go to the cities and work in factories or in office jobs" says Eldert van Henten, a robotics researcher at Wageningen University in the Netherlands. "While the population is growing and needs to be fed, a rapidly shrinking number of people are willing to work in agriculture."

Linda Calvin, an economist at the US Department of Agriculture, and Philip Martin at the University of California, Davis, have studied trends in mechanisation to predict how US farms might fare as the labour force shrinks. So far, migrant workers mainly from Mexico have kept the numbers high, but the flow of immigrants is slowing and many in the US are returning home. The US Department of Labor's National Agricultural Workers Survey has interviewed more than 50,000 farm workers during the past 25 years. More than half of respondents to recent surveys were illegal immigrants, yet even amongst this group, where legal status, education and language act as barriers to other employment, most give up farm work after less than a decade for less physically demanding jobs.

Rising employment costs have driven the adoption of labour-saving farm technology in the past, Calvin and Martin say, citing the raisin industry as an example. In 2000, a bumper harvest crashed prices and, with profits squeezed, farmers looked for savings. With labour one of their biggest costs - 42 per cent of production expenses on US farms, on average - they started using a mechanical harvester adapted from a machine used by wine makers. By 2007, almost half of California's raisins were mechanically harvested and a labour force once numbering 50,000 had shrunk to 30,000.

Agribots may not be good news for labourers who depend on the land for their living, but what about farmers themselves? While studies suggest that robotic milking makes little impact on overall profits, the machines save dairy farmers the chore of daily milking. But calculations by Blackmore suggest that agribots could bring significant financial benefit, reducing weeding costs by about 20 per cent per hectare in cereal or sugar beet fields. Gains should be larger for organic farmers since labour makes up more than 50 per cent of their total costs. A study of organic farming in Denmark suggests agribots could halve the cost of weeding, once machinery and maintenance costs are taken into account.

Bot-friendly farms

Josh Stride from the UK's Soil Association - which backs organic farming - is excited by the prospect of technology that can reduce chemical use. But, he warns, we also need to appreciate the risks. "The introduction of any new technology should be contingent on its ability to provide demonstrable benefits."

Can agribots reduce the price of groceries, say? Perhaps, says Blackmore. So many forces control the price of food, from the weather to supermarket price wars, that it is hard to tell whether automation will make fruit and veg any cheaper in the long run, he says. Yet making farming less energy-intensive should give us a chance to keep prices down. However, the widespread adoption of agribots might bring other changes at the supermarket. Lewis Holloway, who studies agriculture at the University of Hull, UK, says that robotic milking is likely to influence the genetics of dairy herds as farmers opt for "robot-friendly" cows, with udder shape, and even attitudes, suited to automated milking (Journal of Rural Studies, in press). Similarly, he says, it is conceivable that agribots could influence what fruit or veg varieties get to the shops, since farmers may prefer to grow those with, say, leaf shapes that are easier for their robots to discriminate from weeds.

Almost inevitably, these machines will eventually alter the landscape, too. The real tipping point for robot agriculture will come when farms are being designed with agribots in mind, says Sukkarieh. This could mean a return to smaller fields, with crops planted in grids rather than rows and fruit trees pruned into two-dimensional shapes to make harvesting easier. This alien, geometrical farmscape tended by robots is still a while away, says Sukkarieh, "but it will happen." Van Henten agrees. "When we started on robotics in the mid-90s, growers were laughing and sceptical" he recalls. "But when we demonstrated a cucumber harvester, they asked if they could buy it tomorrow."

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Robot Uses 3-D Imaging and Sensor-based Cutting Technology to Debone Poultry

www.gtri.gatech.edu/casestudy/robot-3d-imaging-sensor-based-debone-poultry

Researchers at the Georgia Tech Research Institute (GTRI) have developed a prototype system that uses advanced imaging technology and a robotic cutting arm to automatically debone chicken and other poultry products. The Intelligent Cutting and Deboning System employs a 3-D vision system that determines where to cut a particular bird. The device automatically performs precision cuts that optimise yield, while also greatly reducing the risk of bone fragments in the finished product.

"Each bird is unique in its size and shape," said Gary McMurray, chief of GTRI's Food Processing Technology Division. "So we have developed the sensing and actuation needed to allow an automated deboning system to adapt to the individual bird, as opposed to forcing the bird to conform to the machine."

Poultry is Georgia's top agricultural product, with an estimated annual economic impact of nearly $20 billion statewide. Helping the poultry industry maximise its return on every flock can translate to important dividends. The research is funded by the state of Georgia through the Agricultural Technology Research Program at GTRI.

Under the Intelligent Cutting and Deboning System, a bird is positioned in front of the vision system prior to making a cut, explained GTRI research engineer Michael Matthews. The vision system works by making 3-D measurements of various location points on the outside of the bird. Then, using these points as inputs, custom algorithms define a proper cut by estimating the positions of internal structures such as bones and ligaments.

A robotic system used in the Intelligent Cutting and Deboning project prepares to slice through the shoulder joint of a chicken. (GT Photo: Gary Meek)

"Our statistics research shows that our external measurements correlate very well to the internal structure of the birds, and therefore will transition to ideal cutting paths," Matthews said. "In our prototype device, everything is registered to calibrated reference frames, allowing us to handle all cut geometries and to precisely align the bird and the cutting robot. Being able to test all possible cut geometries should enable us to design a smaller and more simplified final system."

The prototype uses a fixed two-degree-of-freedom cutting robot for making simple planar cuts. The bird is mounted on a six-degree-of-freedom robot arm that allows alignment of the bird and cutting robot to any desired position. The robot arm places the bird under the vision system, and then it moves the bird with respect to the cutting robot. The system employs a force-feedback algorithm that can detect the transition from meat to bone" said research engineer Ai-Ping Hu. That detection capability allows the cutting knife to move along the surface of the bone while maintaining a constant force.

Since ligaments are attached to bone, maintaining contact with the bone allows the knife to cut all the ligaments around the shoulder joint without cutting into the bone itself. A similar approach can be used for other parts of the bird where meat must be separated from bone.

Hu explained that the force-feedback algorithm uses a force sensor affixed to the knife handle. During a cutting operation, the sensor enables the robot to detect imminent contact with a bone. Then, instead of cutting straight through the bone, the system directs the cutting tool to take an appropriate detour around it. "Fine tuning is needed to adjust the force thresholds, to be able to tell the difference between meat, tendon, ligaments and bone, each of which have different material properties," Hu said.

McMurray said he expects the Intelligent Deboning System to match or exceed the efficiency of the manual process. Testing of the deboning prototype system, including cutting experiments, has confirmed the system's ability to recognise bone during a cut and to avoid bone chips – thus demonstrating the validity of GTRI's approach.

"There are some very major factors in play in this project," McMurray said. "Our automated deboning technology can promote food safety, since bone chips are a hazard in boneless breast fillets. But it can also increase yield, which is significant because every 1% loss of breast meat represents about $2.5 million to each of Georgia's 20 poultry processing plants."

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What's New in Farming
Claas Tractor test centre opened

The Claas Group has opened a new Tractor Testing and Validation Centre at Trangé, near Le Mans. Close to the Claas tractor assembly plant at Le Mans, the facility will encourage important synergies, the sharing of skills and cooperation between Claas Tractor's product development, industrialisation and after-sales departments.

A CLAAS AXION 900 with the new testing and validation centre in the background

Although the site is private, it is still very much outward-facing, and partnerships have been forged with the Université du Maine, the acoustics laboratory, the agricultural colleges, the college of surveyors and the automotive institute. This will enable Claas Tractors to continue to play an important role in energising industry in the Sarthe region.

The centre has a testing zone that can deal with up to 80 tractors at any one time, larger prototype development workshops, and soon it will have more efficient test rigs. The new Testing and Validation Centre represents a new era in the development of Claas tractors. It will provide a further step on the road to excellence and an essential stage in the company's international development strategy – already 70 per cent of the tractors produced at Le Mans are exported.

The number of permanent employees in the R&D and projects departments at Claas has risen by 80 per cent and teams based there are currently involved in a product development excellence programme designed to enable them to provide efficient support as part of the company's tractor strategy.

Multi-million pound *North Wyke Farm Platform* to compare agricultural methods at an epic scale

www.bbsrc.ac.uk/news/food-security/2012/120918-f-big-questions-bigger-experiments.aspx

Imagine a study comparing the productivity of entire farms in a grassland ecosystem, recording the chemical constituents of water running from each field, detailing every input that goes onto the ground before finally measuring animal production. Now multiply that complexity by three contrasting farming systems and you're close to the scale and ambition of the North Wyke Farm Platform.

Set in the UK countryside at North Wyke and part of the Rothamsted Research institute, the North Wyke Farm Platform (NWFP) is one of the largest experiments underway in the UK and a unique project designed to compare different approaches to sheep and beef farming on forage yield, water and air and soil quality.

"The North Wyke Farm Platform is a facility that allows researchers to better understand aspects of the productivity and sustainability of grassland science and farming systems," says Head of Site at North Wyke, Dr Phil Murray.

Growing more food using fewer inputs, such as fossil fuel-based fertilisers, is a major challenge in ensuring food security whilst reducing the negative impact that agriculture can have on the environment. The NWFP is now set to begin collating data which, Murray says, will ultimately provide a background and evidence for agricultural policymakers and policy development in the UK.

The NWFP covers 67 hectares and specifically looks at the agri-environmental footprint of beef and sheep farming. The area has been sub-divided into three farmlets. The first serves as a control where conventional livestock practices will continue, such as using inorganic fertilisers to optimise grass growth for the yearling beef cattle and sheep, to feed on. The second farmlet will largely replace fertilisers with nitrogen-fixing legume crops, such as red and white clover which can transfer plant growth-boosting nitrogen from the atmosphere to the soil via symbiotic bacteria living in their roots. "We'll be able to compare optimal use of nitrogen fertilisers against biological fixation from legumes and see the impact that has on production," says Murray.

The third farmlet will test innovative species and varieties of plants, especially those being developed by the Institute of Biological, Environmental and Rural Sciences (IBERS). Examples include high-sugar grasses and deep-rooted plant varieties to lock carbon away in the soil and provide a controlled release of soil water in grasslands. This treatment will allow a greater degree of intervention and finer adjustment, allowing for precision farming techniques to be measured for example.

"The overall aim is to improve grassland productivity by optimising production from the three systems," says Murray. "Because we have the three contrasting systems, farmers will be able to see how they might use the outputs from the research to improve their own productivity." The research aims to be as relevant and applicable to livestock farmers as possible, down to the last detail. For instance, at the farm platform, cattle and sheep will be housed separately during the winter, bedded on straw, and the farmyard manure produced will be returned to each respective farmlet.

The North Wyke Farm Platform is split into three experimental farmlets across 67 hectares. Image: BING/ESRI

French drains at North Wyke use perforated pipes to capture and funnel water to special flumes. Image: North Wyke

Murray adds that they have established a group of farmers who will act as a 'sounding-board' for how they are managing the farmlets and who will ultimately champion the work to their peers.

The big idea of the farm platform is to record inputs and outputs that go into, and come off each farmlet. But measuring what comes off each farm is a more complex issue than just weighing the animals reared to get a measure of productivity – many nutrients are washed away by rain for example.

This is where the design, layout and uniqueness of the site come into play. Most of the site is set against a natural slope with water-impermeable clay underneath, meaning that all the water falling onto and flowing off the site can be captured by simple structures called French drains. These stone-filled trenches contain a perforated pipe into which the water flows. The drains lead to 15 flumes where water-measuring instrumentation records the physical and chemical characteristics of the water that passes through.

At each of the 15 flumes, a data-reading station sends the water quality information and more than 200 instruments are deployed across the NWFP including those measuring rainfall, soil moisture and soil temperature. These are all reporting back to a central server every 15 minutes and the system can be monitored, controlled and adjusted from anywhere on the World Wide Web.

The researchers have spent much of the past year testing and validating the site in readiness for the next phase when the new treatments begin. During the 2011-12 baseline period the team has been monitoring the site to understand more about the soil's nutrient content and structure. To this end, they've overlaid a grid over the farm platform with an intersection every 25 metres where they've taken a soil sample. This data is mapped using Geographical Information Systems (GIS) which are used as visualisations and to integrate information on local geography with statistics and analyses for all the NWFP data.

The NWFP is certainly an ambitious project built on an industrial scale so that the results can be applied to real farming systems that operate at similar scales. Construction of the infrastructure cost around €4.4 million. The farm platform at North Wyke provides a unique farm-scale 'research hotel' for agri-environmental activities to attract researchers from different communities and disciplines to promote new ideas, better address key issues in sustainable agriculture, or to tackle old problems in innovative ways.

Visit www.rothamsted.ac.uk/northwyke/FarmPlatform.php
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71st International Conference on Agricultural Engineering LAND.TECHNIK – AgEng2013

8-9 November 2013 Hanover, Germany

Presentation proposals are welcome until 7 March 2013

The 71st International Conference on Agricultural Engineering, LAND.TECHNIK – AgEng2013 will be held in Hanover, Germany on 8-9 November as the prelude event to AGRITECHNICA, the most important fair for agricultural machinery, which starts on 10 November with the preview days.

This year´s theme *Components and Systems for Better Solutions* underlines the importance of suppliers in the machine development and manufacturing process as well as in the extensive after sales services. Pursuing the ultimate ambition to increase productivity and efficiency with less energy input and to improve the complex process chains of agricultural economies, a well structured network between suppliers and manufacturers is necessary. Therefore the conference will give an excellent platform to discuss new and better solutions concerning components, systems, machines and processes.

The conference is organised in cooperation with the VDI Department Max Eyth Society for Agricultural Engineering (VDI-MEG) and the European Society of Agricultural Engineers (EurAgEng). During recent years, the number of participants has grown to a new record of 850 participants in 2011, when visitors from 31 nations were registered. Thus the conference is one of the most important meeting points for the international community of agricultural engineers.

The topics include all important working fields of agricultural engineering:

- Tractors, motor, machine management, chassis & use, test & evaluation
- Power train, electric drives and mobile hydraulics
- Agricultural information technology, precision farming, software engineering and data handling
- Automation, electronic components and sensors, locating, tracking and navigation
- Soil protection, tillage and sowing
- Harvesting technology
- Sustainable energy
- Industrial product development and market service

The programme committee invites representatives of industry, universities and research institutes as well as of practical farming to present their current technical solutions from research and product development. Young engineers particularly are welcome to use this opportunity to present their skills. Papers may be submitted via the internet at www.vdi.de/landtechnik-ageng by 7 March 2013. The language of the conference will be English.

For more information on the conference please visit www.vdi.de/landtechnik-ageng
Current information on AGRITCHNICA Exhibition is available at www.agritechnica.com

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Happy delegates at LAND.TECHNIK - AgEng2011

Don't miss it!

The email messages sent every month by David Tinker are now the main method of communication with members. Unfortunately, some messages do not get through because they are being sent to incorrect addresses or are being rejected by email systems.

It is very simple to update contact details with EurAgEng to make sure your email address is correct. Go to www.eurageng.eu click on Members' Login and enter your username and password. Instructions are on the login page but if you need any help, contact David Tinker on secgen@eurageng.eu.

Once you have logged in, click on Update Your Membership Details and enter any new details in the boxes. When you press the Submit button, the new information will be sent to the secretariat.

Also, it often helps if you include secgen@eurageng.eu in your address book. However, if you do not wish to receive the updates, please send a message to secgen@eurageng.eu with Unsubscribe to Updates as the subject heading.

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