Agriculture • Horticulture • Forestry • Environment • Amenity

LANDWARDS

Spring 2007

- Agro-industrial development
- Tractor pulling

HORTICULTURAL ROBOTICS

IAgrE JOURNAL Volume 62 No.1 www.iagre.org

Forestry Civil Engineering wins Environmental Construction Award

Innovative design gets round the Great Crested Newt, just one of the features at the Salcey Tree Top Walkway

Forestry Civil Engineering (FCE) has completed a great year by winning the award for the most environmental structure 2005-2006 from the British Construction Industry.

Forestry Engineering does not normally have the opportunity to compete with the major players in construction. The UK Construction Industry is a multi-million pound giant and here we have shown that, not only can we compete with the 'big boys' but we can win. We are now not only regarded as leaders in the field of rural architecture, creating harmony between structure and environment, but also as project leaders who can deliver on time and to budget – even with a crippling time schedule. We have introduced timber as a primary structural element to compete with steel and concrete.

The Salcey Tree Top Walk near Northampton was a great opportunity for FCE to show what it could do, and it did. End of year funds became available to construct something which had never been built before in the UK. It was to be erected on a Site of Special Scientific Interest (SSSI), housing numerous archaeological remains and home to the Great Crested Newt, an endangered species. This would require numerous consultations, reports from interested parties, detailed survey, civil, structural and architectural design, bills of quantity, contract documents and planning approval. It was also to require tendering within European guidelines, construction within health and safety law (with close supervision) and all in ten months – with a fixed, limited budget. Our experience has shown that this window of opportunity could only come with a severe budget and time restriction so, with eyes wide open, we took up the challenge, worked day and night and produced this successful structure. The design and supervision team never exceeded four people.

The £700,000 walkway is built from local timber – and steel, where necessary. It threads through the trees, any essential felling being kept to a minimum, and climbs to a height of 20 m. The walkway suits all abilities and provides a variety of visual and dynamic experiences. We have estimated that probably 30,000 visits have been made by the Public since it opened last Christmas.

One of the secrets of our success, besides good design, was having excellent contractors working with fair contract conditions. FCE prides itself on its ability to make these choices and manage them on-site.

CONTACT

Geoff Freedman.
Website: www.forestry.gov.uk

Volume 62 No 1, **2007**

LANDWARDS

The Professional Journal for Engineers, Scientists, and Technologists *in* Agriculture, Horticulture, Forestry, Environment and Amenity

Editor
Eur Ing Prof Brian D Witney
PhD CEng CEnv FIMechE HonFIAgrE MemASABE FFCS
LAND TECHNOLOGY LTD
33 South Barnton Ave,
Edinburgh, EH4 6AN
Tel/Fax: +44 (0)131 336 3129
E-mail: landwards@landtec.co.uk
Website: http://www.landtec.co.uk

Advertising
All enquiries to IAgrE
Tel: +44 (0)1525 861096
Fax: +44 (0)1525 861660

Origination: David King

Printing: Barr Printers Ltd

Publisher
Landwards is published quarterly by:
IAgrE,
Barton Road, Silsoe,
Bedford, MK45 4FH
Tel: +44 (0)1525 861096
Fax: +44(0)1525 861660
E-mail: secretary@iagre.org
Website: http://www.iagre.org

President
Professor Paul C H Miller
BSc PhD CEnv FIAgrE
Chief Executive & Secretary
Christopher R Whetnall
CEnv IEng FIAgrE MemASABE

CONTENTS

Feature Articles

2 AGRO-INDUSTRIAL DEVELOPMENT
Keynote Address: Agricultural Engineering for a better world
Gavin Wall

6 HORTICULTURAL ROBOTICS
Robots for greenhouses: challenges and opportunities
Gustavo Belforte, Paolo Gay and Davide Ricauda Aimonino

11 ALTERNATIVE FUEL
Biodiesel: reducing fossil fuel use – revitalising agriculture

15 VISION AWARD
Future of protected agriculture in arid regions: autonomous mobile robots
Alfredo Sánchez, José Luis Guzmán, Julián Sánchez-Hermosilla, Francisco Rodríguez and Manuel Berenguel

Membership Matters centrefold
Diary of IAgrE meetings and events

News and Comment

5 News scan
13 Recent research
20 Company and product information

Front cover: *Prototype robot in greenhouse operations (courtesy: Paolo Gay)*

The views and opinions expressed in individual contributions are not those necessarily of IAgrE or the Editor.
Landwards is compiled from information received by IAgrE but no responsibility can be accepted by the governing Council, the Publishers or the Editor in respect of any errors or omissions. The Editor reserves the right to edit any material sent to the journal.
Material from this publication may be quoted or reported on condition that full credit is given to *Landwards* and to the author, and that the date of publication and volume number are stated. In the interest of factual reporting, reference to trade names and proprietary products may be inevitable. No endorsement of the named products or manufacturers is intended and no adverse criticism is implied of similar products which are not mentioned.

© The Institution of Agricultural Engineers (IAgrE)
ISSN 1363-8300

KEYNOTE ADDRESS: AGRICULTURAL ENGINEERING FOR A BETTER WORLD

Gavin Wall

The following article is taken from the keynote address given to the International Commission of Agricultural Engineering (CIGR) World Congress in Bonn on the 3rd September 2006, by Gavin Wall, Chief of the Agricultural & Food Engineering Technologies Service, Food & Agriculture Organisation (FAO) of the United Nations.

Introduction

Addressing the opening session of the world congress in Bonn, Mr Wall stated that he was grateful for the chance for the FAO to be associated with the CIGR Congress whose focus on '*Agricultural Engineering for a better world*' is in close alignment with their own work.

Before reviewing some of the measures being taken by FAO to assist member countries to grow competitive agro-industries, he gave some background on FAO and the landscape in which our work takes place.

- When a family is without food, nothing is more important to that family than finding food.
- When nature's forces destroy crops and livestock, families and whole communities are vulnerable.
- When a farmer's livelihood is threatened by changes in demand for their produce, nothing is of greater concern to them than the market price.

This latter threat is a common bond for all farmers and rural communities in all countries.

Organisation goals

To face the challenges implicit in these statements, FAO has three overarching goals paraphrased as:

All people should have access at all times to nutritionally adequate and safe food.

Agriculture should contribute to economic and social progress.

Agriculture should contribute to the conservation, improvement and sustainable utilisation of natural resources.

FAO has provided the following core services to its member countries since 1945:

- knowledge networking – professional staff collect data, distill this into information on trends, and with our partners identify and disseminate 'best practices';
- consultancy – experience brought to member countries in response to their requests;
- neutrality – provide a neutral forum where member countries can meet as equals to discuss matters of common concern; and
- funding – mobilise and manage funds for projects utilising the know-how of the organisation.

FAO works for 190 member countries and relies on partnerships with government ministries, banks, international finance institutions, aid agencies, non governmental organizations (NGOs), and national and regional centres of excellence.

The environment in which the organisation works is replete with challenges, difficulties and uncertainties. At the World Economic Forum, Davos, this year it was observed that the global economy is beset with inefficiencies and imbalances that threaten to derail growth and halt efforts to bring prosperity to the world's poorest corners. The same inefficiencies and imbalances that economists say threaten trade and markets are hastening the depletion of natural resources and contributing to environmental destruction.

The rural poor feel these environmental and economic imbalances and uncertainties most acutely. For the rural poor, for the farmers we work for, uncertainty is frightening. Sugar growers in the USA share this uncertainty. It is shared by cotton farmers in West Africa and also by sheep farmers in Australia. For those entrepreneurs that have invested their savings in a food processing venture, any ambiguity is alarming.

Creating a better future?

'How can the FAO help to create a better, more certain future?' encompasses the question 'How can engineering contribute to a better world?' Three ideas can be highlighted here which are important to both of these questions.

Idea one

Constant innovation is the only guarantee of competitive advantage. This applies in all markets, whether at the village level or the global level and it applies as much to product portfolios as to new technologies and institutional structures.

Idea two

The rest of the world cannot solve the problems facing developing countries, but we do

BIO NOTE

Gavin Wall, Chief of Agricultural & Food Engineering Technologies Service, Food & Agriculture Organisation of the UN, Rome, Italy.
E-mail: Gavin.Wall@fao.org
Website: www.fao.org

need to stand alongside and work to help them to build their capacity to face their trials. It is not easily forgotten that the most fundamental imbalance has long been the disparity in wealth between developed and developing countries. Sometimes, the developed countries appear to tilt the playing field against the developing countries.

Although there has been notable success in some countries, there are still too many people living in poverty in too many countries. Eighty percent of these poor people live in rural areas and rely on agriculture.

Growing the productive capacity of agriculture and building value chains to link surplus production to local, national and international markets is critical to correcting this imbalance. The problems are substantial not only in terms of food supply, remembering that there are in excess of 800 million people who lack access to adequate food and nutrition but also in terms of the need to create employment for growing populations.

Egypt alone has to create 750,000 new jobs each year just to maintain current levels of unemployment. The FAO is proud to be working with Egypt, and many other member countries, in helping to create this employment.

Idea three

Local self-supplying models may challenge transcontinental large-scale food supply chains when all of the externalities are factored in. More change is on the way, only those with the capacity to adapt will be able to capture any opportunities that may emerge.

Capacity to adapt

The common theme in these three ideas is the need to build the capacity to adapt. The frameworks and assumptions upon which leaders in business and government have long depended to make decisions are no longer adequate. The economic and political context in which businesses and government institutions seek to compete or otherwise serve their constituents has fundamentally altered; new models, new leaders and new mindsets are necessary.

"The economic and political context in which businesses and government institutions seek to compete or otherwise serve their constituents has fundamentally altered."

As the world reacts to a new emerging architecture and creativity increasingly drives the economy, tomorrow's leading countries, companies and institutions will be those which have the courage and capability to adapt.

The key to ensuring that engineering contributes to a better world is to build technical and engineering capacity so that people can engineer their own destiny.

Specifically on agriculture

The most obvious recent change to agrifood systems has been the drive towards economic efficiency that has been enabled by globalisation. Until now, this has been about expanding trade, slashing labour costs through outsourcing to lower cost locations (e.g. cut flower production to Ethiopia) and maximising comparative advantage through the creation of global production chains employing sophisticated logistics and post-harvest technology.

These strategies have, however, had unequal impacts. For the rich, those with the capacity to adapt and to innovate, there have been numerous successes, but these have reached the point of diminishing returns. For the poor, those without these capacities, such strategies remain unobtainable. Such lack of capacity has resulted in loss of opportunities to add value, increase incomes and create employment. Our colleagues in the United Nations Industrial Development Organisation tell us that while high-income countries add US$180 of value by processing one tonne of agricultural products, developing countries generate only US$40 of value per tonne. Moreover, while 98% of agricultural production in high-income countries undergoes industrial processing, barely 30% is processed in developing countries. Yet, in developing countries, between 40% and 60% of manufacturing value added is generated by agro-processing industries where agro-industrial products are the major products exported from these countries, frequently accounting for up to half of all exports.

"The most obvious recent change to agrifood systems has been the drive towards economic efficiency enabled by globalisation."

For countries with some established agricultural value chains, we work with them to avoid them becoming trapped in either a zero-sum game where companies are competing fiercely for a fixed or declining market; or a race to the bottom which occurs when their internal costs go up and the progress of competitors demand further cost-efficiencies. In these cases, companies and societies alike need to create new products, develop new markets, and anticipate new market demands. We work with them to build their capacity to innovate. We do this primarily through the public sector, challenging governments to examine their policy framework, we work to search for means to build private sector capacity and we work towards effective linkages between the public sector research institutions and the private sector.

FAO expends considerable effort to build the capacity of the public sector to support agrifood processors, machinery suppliers, and enterprises throughout the supply chain to employ engineering systems and technology in profitable ways.

The current status of the Doha Development Round of the World Trade Organisation has highlighted the difficulty of rationalising the needs and expectations of developed and developing countries. Agriculture presents unique challenges because of its intimate connection with rural households and the rural environment. These rural concerns are also global concerns. All countries are concerned about their farmers, their farmland, their rural communities, and their agro-enterprises. If the intimate linkage of agriculture to society represents a constraint, then this is balanced by the enormous potential of the

"Agriculture presents unique challenges because of its intimate connection with rural households and the rural environment. These rural concerns are also global concerns."

range of products that can be created from biomass. One has to only reflect on the current levels of investment and political interest in bio-fuels to imagine what can happen when bio-plastics and other emerging bio-based products are mainstreamed.

The last idea, the risk of externalities to current global supply chain models, is raising a flag. It points out that global supply chains are optimised in the context of the individual jurisdictions that each enterprise operates, therefore, trans-national effects are largely ignored. For example, the 'carbon foot-print' of a global supply chain is not currently factored into the decision-making of supply chain managers. If and when such externalities are factored in, new opportunities will emerge. In some cases there will be technical fixes that can be employed, such as new post-harvest technology to enable sea transport instead of air transport. In other cases, new agrifood systems closer to the consumer may evolve, however this will inevitably demand new technology to counter some of the forces that originally favoured global supply chains. The effectiveness of the response will be conditioned by the capacity to innovate. Innovations will emerge quickly if the main players have the necessary capacities and are exposed to and aware of the market signals; policies designed to protect the status quo will hamper the process of change.

FAO has sponsored a workshop during this congress in which the challenges of creating machinery supply chains and using technology to add value to, and increase the quality of, agricultural products will be discussed. Why have we chosen these two themes? We think it is critical to add value if farmer incomes are to grow and if jobs are to be created. We know that small-scale and poor farmers need to mechanise to increase production; our analysis shows that the key impediments are the lack of efficient machinery supply chains and the lack of farm profit to afford to mechanise. Tractors and equipment of all sizes and degrees of sophistication exist. The challenge is to grow farmer income and create the private sector supply chains to get the equipment to farmers at an affordable price.

"It is important to adapt, enabling engineering to contribute to a better world."

Conclusion

FAO is committed to supporting the growth of competitive agro-industries because they can contribute to poverty reduction by raising the income of rural poor in low income countries and accelerating broader economic development in all countries. Engineering is essential in this endeavour and we look forward to continued collaboration with the members of the CIGR, in serving the needs of our member countries.

RASC RELOCATION

Commonwealth body re-locates to Edinburgh

The Royal Agricultural Society of the Commonwealth (RASC) is re-locating from London to Scotland and is to be based at the Royal Highland Centre at Ingliston. The administrative functions and secretariat of the Society will now be operated by the Royal Highland and Agricultural Society of Scotland which recently announced it is to host the 2010 RASC Conference.

The move follows a decision by the RASC's Board of Trustees to vacate its offices in London and to accept an offer from the RHASS to be based at Ingliston. The RASC, whose President is HRH The Duke of Edinburgh, will continue to be managed by the present Board of Trustees and will retain its Registered Office in London.

The recently appointed Honorary Secretary, Billy Yarr, former Chief Executive of the Royal Ulster Agricultural Society, said: "The costs involved in running the affairs of the Society from a London office were becoming prohibitive and after discussing a proposal from the RHASS, it made sense to re-locate. We will continue to have our main management meetings in London but the day to day running will be in the hands of RHASS staff."

Ray Jones, Chief Executive of the RHASS, added: "We are delighted to be involved with the running of the RASC. We have all the necessary administration skills and infrastructure here at Ingliston and we are sure this will prove to be a most cost effective and sensible move."

The RASC, a confederation of more than 40 leading national and regional agricultural show societies working in twenty Commonwealth countries, was founded in 1957. It is the only non-Governmental organisation representing agriculture across the Commonwealth with a mission to encourage the interchange of ideas and development of sustainable agriculture, forestry, fishing and the rural environment.

MORE INFORMATION

The RASC recently held its biennial conference in Calgary, Alberta, attended by 150 delegates from sixteen countries. The 2008 event will be held in New Zealand with Scotland the host nation in 2010. Website: www.rhass.org.uk

FOOD MILES

Sustainable distribution of food and drink

Evolving lifestyles and changes in standards of living are putting increased pressures on our transport system, particularly in the food and drinks sector where the cost of 'food miles' is becoming a major environmental issue. Against this background, the Department for Transport (DfT), has commissioned major surveys of the Food and Drink transport sectors stemming from the DfT strategy for Sustainable Distribution.

The DfT has commissioned SCALA Logistics Consulting to conduct these surveys exploring the efficiency of the transport of food and drink in England, whether carried by manufacturers, retailers or logistics companies. John Perry, Managing Director of SCALA, says "Our changed lifestyle means more goods are being delivered, often over much longer distances. We have also become accustomed to very high standards of product, in terms of variety, on-shelf availability, and quality. Within the food industry, quality, especially in fresh produce, often means travel from distant areas where produce is in season, and frequently means additional packaging to ensure unblemished condition".

Mr Perry added that these pressures, together with a growing and increasingly mobile population, make a safe, reliable and environmentally friendly transport system ever more difficult to achieve.

SCALA project manager for the DfT survey, Graham Stubs, told us that the overall aim of the Department for Transport is the creation of a sustainable transport system which is safe and reliable, and available for everyone. It should also be integrated and it should, indeed must, make as little impact on the environment as possible.

Mr Stubbs added "Some improvements in efficiency of vehicles and the way that they are used has helped to curtail the environmental impact of commercial vehicles, but there is still every reason to find further opportunity for improvement and to press for its achievement."

The DfT has conducted similar surveys in 1998 and 2002. These focused on five key performance indicators: vehicle fill, time utilisation, empty running, fuel consumption and deviation from schedule. Whilst wanting to build on this previous base of knowledge, industry workshops are planned to ensure that the information gathered in the new surveys is as relevant as possible to the industry and the participating companies.

"Our changed lifestyle means more goods are being delivered, often over much longer distances. We have also become accustomed to very high standards of product, in terms of variety, on-shelf availability, and quality."

The DfT and SCALA want a wide range of companies to actively participate. All companies, large and small, based or supplying delivery points in England, will have the opportunity to be involved including retailers, suppliers and manufacturers, together with the appropriate logistics and transport contractors.

There needs to be a commitment by each company to the survey, but there is no charge. In addition to helping to provide reliable quantified national data, all the participating companies will receive reports individually setting out their performance compared with the national performance.

The surveys will pool data from many different fleets to provide the industry with the range of achievements against key performance indicators (KPIs) and an indication of best practice performance. To enhance the value of the work, both to the participants and industry as a whole, there will be two surveys, in 2007 and 2009, providing a comprehensive indication of changes within the two sectors. Mr Perry pointed out that participation in the survey presents a unique opportunity for companies to benchmark their own operations against agreed, nationally recognised, criteria that have now been in place since 1998. A more detailed report on specific performance within each business will be available from SCALA Consulting on a totally confidential basis.

MORE INFORMATION

For further information contact SCALA Consulting. Tel: +44 (0)1484 422084. E-mail: survey@scalagroup.co.uk Website: www.scalagroup.co.uk/news_events Companies can also contact the SCALA project manager directly: Graham Stubbs +44 (0)7775 633775.

Copies of the 2002 Benchmarking Guide, Key Performance Indicators for the Food Supply Chain, can be ordered, free of charge, from the Freight Best Practice hotline on 0845 877 0 877, or can be downloaded from: www.freightbestpractice.org.uk

ROBOTS FOR GREENHOUSES: CHALLENGES AND OPPORTUNITIES

Gustavo Belforte, Paolo Gay and Davide Ricauda Aimonino

Since last century technology and science has increasingly affected all the sectors in which productive activities can be classified. The search for

- better product quality,
- higher productivity,
- unit cost reduction, and
- quality and production control

in an increasingly global market have steadily augmented the amount of advanced technologies employed by our productive system.

In this framework an important role has been covered by automation that, since the last decades of the 20th century, has completely changed the production methods in industry:

- reducing repetitive works to a minimum;
- increasing productivity (since robots are more precise and can work faster than human operators);
- ensuring constant product quality (since robots do not get tired and unfocused on their job); and
- improving safety standards (since robots are not affected by unhealthy working environment).

It is remarkable, however, that agriculture has been affected only marginally by this trend and has remained a mainly labour intensive activity even in the western world where labour costs are high and big efforts are constantly conducted to reduce them. Furthermore, the motivation for the minimal spread of automation in agriculture cannot be ascribed to a reduced interest for latest technology in this sector. Actually the use of up-to-the-minute genetic results for the production of hybrid flower plants is one of the many examples that illustrates how much the agricultural sector is exploiting the latest developments in science and technology to upgrade and improve its products and the production methods.

Indeed automation is not completely missing in agriculture. Some automation has been introduced, especially in intensive farming. The climate control in greenhouses is a decidedly clear example of automation and some dedicated machines, such as transplanters, can be regarded as robotic applications. Guidance systems based on (global positioning systems (GPS) or lasers for tractors and harvesters can also be included in the list. However, much more could be done with consistent advantages for the sector in terms of:

- productivity;
- cost reduction;
- quality enhancement;
- quality control;
- environment protection; and
- safety.

Why then is so little automation available in agriculture? Is it perhaps too difficult to use robotic and automated solutions in this field? Is it because of a lack of research effort? Is it down to the fact that, after all, automation can provide little improvement to agriculture?

Indeed the fact that the agricultural environment is less structured than the industrial one and therefore it is less friendly for automated solutions is a handicap but it cannot justify the minimal development of automation. Research activity has definitely carried on but, in the authors' opinion, consistent improvements could be achieved by redirecting it towards problems and solutions that take advantage of the specific features of the agricultural environment. A sharper focus on viable solutions for farmers should be sought, avoiding the mere transposition to the agricultural sector of solutions originally thought and designed for industry. Such solutions refrain from addressing complex problems which, although interesting from a research point of view, are of little

BIO NOTE

Gustavo Belforte is Associate Professor at the Dipartimento di Automatica e Informatica of the Politecnico di Torino, Italy. His research has focussed mainly on theoretical and applied problems related to modeling and identification of systems subject to bounded uncertainties. He has also investigated classification and signal processing problems. Professor Belforte was involved in the early stages of research into biomedical applications while in more recent years he has worked on mechanical and robotic systems. He is author/co-author of more than hundred papers published in international journals, books and conferences. E-mail: gustavo.belforte@polito.it

Paolo Gay is Associate Professor at the Dipartimento di Economia e Ingegneria Agraria Forestale e Ambientale of the Università degli Studi di Torino, Italy. He also holds collaborations with Politecnico di Torino, where he teaches several courses in Systems and Control Theory and Numerical Analysis, and with the institute IEIIT of the National Research Council (CNR) of Italy. His research interests include identification of uncertain systems, modelling and control of agricultural and environmental systems, robotics, logistics and food supply-chain optimisation. He is author or co-author of more than sixty papers published in international journals, books and conferences. E-mail: paolo.gay@unito.it

Davide Ricauda Aimonino is currently pursuing a PhD degree at the Dipartimento di Economia e Ingegneria Agraria Forestale e Ambientale of the Università degli Studi di Torino, Italy. His main research activities are thermal treatments for soil disinfestation, thermal processes in food industries and robotics and automation in agriculture. E-mail: davide.ricauda@unito.it

Fig. 1 The first prototype was designed to operate in a fixed position along a belt-conveyor displacement system. Its mechanical structure leads to a small encumber

practical impact in the short and medium period. In doing this, it is possible to provide a consistent contribution to the improvement of agriculture with significant advantages. However, for a clearer picture it is useful to review the research activities carried out so far, which take into account automation in currently utilised in agriculture.

Overview of research on automation in agriculture

For an ease of understanding and information presentation, it is better to group the available studies into two main classes, depending on whether they deal with applications in the field or in the greenhouse. A motivation for this grouping is related to the fact that, although several operations are common to both environments, some important differences characterise the two settings. In particular the available infrastructure and the expected productivity per unit surface (that sets constraints to acceptable investments) remarkably differentiate the two conditions, leading to different solutions.

Automation in greenhouses – the most important line of study – relates to specific cultural operations, to harvesting of different crops, and to guidance problems. An excellent overview can be found in Tillett (1993) concerning robotic applications in horticulture.

Transplanting and seeding are some of the cultural operations whose automation has been specifically studied, while automated harvesting of strawberries, cultivated mushrooms, lettuce and cucumbers has been considered for different proposed solutions (Reed *et al.,* 2001; and Van Henten *et al.,* 2002). In the context of automated guidance the case of robots in greenhouses has been specifically addressed (Sandini *et al.*, 1990).

Fig. 2 The second prototype has a Cartesian structure; this allowed to improve performances and operations accuracy

Research concerning applications out in the field has been largely directed toward automatic guidance problems. Automatic guidance systems for tractors and for other specific machines such as harvesters, transplanters, *etc.*, have been implemented based on different technological solutions such as artificial vision (that in some cases is stereoscopic), laser and ultrasonic sensing, or the global positioning systems (GPS) (Marchant *et al.*, 1997; Tai *et al.*, 1994). Other automated solutions have been studied for some specific operations like the automatic hoe control, inter-row raking and tilling for weed control in sugarbeet, precision spraying for weed control and crop treatment that has also been implemented with mechanical tools and electrical discharges (Tillett *et al.*, 2002; Blasco *et al.*, 2002). In addition, consistent attention has been devoted to robotic solutions for mapping yield and quality while harvesting.

It is remarkable that most studies deal with only one specific agricultural operation for which automated solutions are studied and presented. In most cases, the study comprises the design and testing of a dedicated machine, often even quite sophisticated, that can perform only one operation. The case of multipurpose robots suitable to carry out different tasks is an exception, although some studies in this category exists but are usually performed using robots designed and developed for industrial applications that are adapted with minor changes to the agricultural environment.

Fig. 3 Detailed view of the end-effector for precision fertilisation

What are the advantages of robotic and automated solution in agriculture?

To outline the directions in which research and technology development should be oriented in order to facilitate the use of robots in agriculture, a clear understanding of the opportunities that such solution can offer is very important.

Robots, if sufficiently dexterous and versatile, can replace human labour to a great extent, especially in repetitive operations which are very common in agriculture. This leads to several advantages.

Cost reductions

Reduction in required human power – robots can work 24 hours a day throughout the year with constant precision. This, however, opens new opportunities since robots can easily perform activities that are impossible for human operators. An example to clarify this point is given by the precision spraying of cyclamen (Belforte *et al*., 2006). This crop frequently needs treatment but, to be really useful, the spraying should occur within and under the leaf canopy since the pests to be targeted live under the leaves. To spray the cyclamens efficiently, they should be sprayed one by one, properly positioning the spraying nozzle. This indeed is practically impossible with human operators when the number of plants to be processed is large as is normally the case in dedicated enterprises. A robot, however, can do the task easily. They do not lose concentration during operations and can work indefinitely day and night.

Hazardous operations

The use of robots in hazardous operations, such as the spraying of chemicals, has advantages that are two-fold. Firstly, the advantage that dangerous operations are performed by machines (robots) and not by humans. This obviously makes the working environment safer for the workers of the sector and returns social benefits. Secondly, the fact that precision spraying (spraying on specific targets with pre-defined limited amount of chemicals) with robots is easy leads to a reduced usage of chemicals, with an immediate economic return (lower costs). It also has implications, long term, for the environment and social returns in terms of less pollution and consequently less impact on the health of population and workers.

Surveillance

Use of robots equipped with a vision system and other sensors enables constant monitoring and surveillance of crop growth and the ability to determine crop ripeness, detect disease or the presence of pests. This can in fact be carried out for each single plant, keeping track of it in a conventional database which can be used for further action and analysis.

Where should robotic solutions be adopted first?

In the first stages robotic solutions should be introduced and developed in horticultural and flower production in greenhouses, shifting the extension of their use into open fields to a second, future stage. The reasons for this are mainly technical, economic, and social/environmental.

Technical

The presence of some infrastructure, such as power supply, the presence of plinths to which the rails for the robot navigation can be hooked and the availability of moving benches to which the robot can be coupled for working in a fixed position, are all elements that reduce the installation costs. Further advantages derive from the regularity of the soil and in general from the fact that greenhouses are – at least partially – a structured environment, where the position of target plants is more or less known. Finally, some automation already exists in greenhouses, such as irrigation, light and temperature control, therefore the introduction of multipurpose robots represents a further step in automating those structures.

Economic

Greenhouses are already quite expensive facilities where highly remunerative crops are intensively grown. Therefore, new investments are more easily absorbed, especially in the light of important advantages in manpower reduction, increase in productivity, and in product quality. A point worth noting is that the introduction of robotic automation in greenhouses can make available operations and protocols that are not affordable using human operators. This is especially true if the robotic system is coupled with a database of the growing crop that allows precision agriculture applications, such as precision spraying, fertilising, monitoring and surveillance.

Social/environmental

The social and environmental advantage of introducing and developing robotic solutions initially into the greenhouse environment relate to reduction of pollution due to a safer and more controlled use of chemicals.

What are the characteristics of a viable robot for agriculture?

From what has been discussed so far, the obvious question is: Why have robotic automation and computer-controlled machines not yet been introduced into agriculture? The reasons are discussed by Kassler (2001) and can be summarised as: available solutions are insufficiently robust and costly; and they have limited working capabilities, while in general the available knowledge is

insufficient to create robots as dexterous and skilful as trained workers.

On top of this, currently available machines are usually able to perform a single agricultural task and therefore can be used only for a few times per year in connection with the seasonality of agricultural production. This indeed increases the length of time for investment return and discourages use. From this analysis it would appear that commercially available equipment does not fit with the needs of agriculture operators. However, in our opinion, technology is ripe to produce innovative machines which would be hugely useful and economically sound for the market. To do so the following guidelines should be carefully considered.

Robot accuracy

In agriculture, errors and uncertainties of some millimetres are usually acceptable. This implies that robots suited for this kind of application can have errors and uncertainties about 2 - 3 orders of magnitude greater than those required in robots designed for industrial applications. It is important to take advantage of this fact, designing specific robots that can be much lighter since rigidity of the structure is not a main issue and components need not be very precise.

Robustness and simplicity

The greenhouse environment – humid and dirty with possible chemical sprays – suggests simple and robust mechanical solutions based on standard components would be easiest to maintain. All this results in a considerable cost reduction that impacts greatly on the final price of the robot.

Structured environment

To facilitate the use of robotic operations it is advisable to set some requirements on the environment structure (for example imposing accurate positioning of plants and pots). In addition, avoiding autonomous navigation that is technically quite complex and has no real advantage. Rails or similar systems can work well, simplifying the navigation task and reducing costs.

Reduced bulk and weight

High costs of greenhouses means that surfaces required are used to the largest possible extent. Therefore, it is important that the robot demands little surface area so that space is not diverted from productive activity. Similarly, reduced weight can ease the installation of robots in existing structures, allowing possible hooking to existing plinths.

Scaling in size and operating volume

This should be pinpointed accurately in the design so that flexible adaptation to existing structures with different shapes and dimensions is possible.

Vision system

This is highly recommended. It can enable surveillance and crop monitoring actions to be exploited for increasing quality and productivity. Moreover, a vision system can also be used for obstacle detection and guidance in those cases in which the environment cannot be fully structured.

Versatility

The robot to be designed needs to be versatile and able to perform several different cultural operations with an easy conversion from one to another. In this way it could be possible to (almost) automate the entire production cycle of some cultivations.

Cost

Purchase price and installation charges should be kept as low as possible.

The features discussed so far clearly show fundamental differences between the characteristics required for robots to be used in agriculture and those required for robots to be used in manufacturing applications. The use of commercially available robots that at present are designed for manufacturing applications is therefore not advisable for applications in agriculture and new machines should be designed. To allow this to happen, specific robot prototypes should be built and tested in research activity. As research tools these robots do not need to satisfy all the constraints required for a commercial product (in terms of costs, simplicity, performances, *etc.*) since these topics can be delegated to a future engineering phase but they should allow testing of a great variety of applications.

Ongoing research

With all the above considerations in mind, our research group developed a first prototype (Fig. 1) and described in Belforte *et al.*, 2006, with which some experimentation has been conducted in past years. Based on the experience gained with this experimentation, new robotic structures have been considered and a second prototype designed and constructed (Fig. 2) and described in Belforte *et al.*, 2004. Research is now ongoing with this robot and different agricultural operations such as precision spraying, precision fertilisation (Fig. 3), mechanical weed control and vision surveillance are under study and development.

References

Belforte, G; Deboli, R; Gay, P; Piccarolo, P; Ricauda Aimonino, D (2006). Robot design and testing for greenhouse applications. Biosystems Engineering, **95**(3), 309-321.

Belforte, G; Deboli, R; Gay, P; Giglio, A (2004). Robotic automation in greenhouses for productivity enhancement and pollution reduction. AgEng 2004 - Workshop on Intelligent Technology for Bioproduction Systems, Leuven, Belgium, 12-16 Sept., on CD ISBN 90-76019-258.

Blasco, J; Alexios, N; Roger, J M; Rabatel, G; Moltò, E (2002). Robotic weed control using machine vision. Biosystems Engineering, **83**(2), 149-157.

Kassler, M (2001). Agricultural automation in the new millennium. Computers and Electronics in Agriculture, **30**, 237-240.

Marchant, J A; Hague, T; Tillett, N D (1997). Row-following accuracy of an autonomous vision-guided agricultural vehicle. Computers and Electronics in Agriculture, **16**, 165-175

Reed, J N; Miles, S J; Butler, J; Baldwin, M; Noble, R (2001). Automatic mushroom harvester development. Journal of Agricultural Engineering Research, **78**(1), 15-23

Sandini, G; Buemi, F; Massa, M; Zucchini, M (1990). Visually guided operations in greenhouse. Proceedings of the IEEE International Workshop on intelligent Robots and Systems IROS '90, p279-285.

Tai, Y W; Ling, P P; Ting, K C (1994). Machine vision assisted robotic seedling transplanting. Transactions of the ASAE, **37**(2), 661-667

Tillett, N D (1993). Robot manipulators in horticulture: a review. Journal of Agricultural Engineering Research, **55**, 89-105.

Van Henten, E J; Hemming, J; Van Tuijl, B A J; Kornet, J G; Meuleman, J: Bontsema, J; Van Os, E A (2002). An autonomous robot for automated harvesting of vegetable fruit in greenhouses. Autonomous Robots, **13**, 241-258.

CONIFER RESEARCH

Edinburgh scientists boost hopes for endangered South American tree

Forestry scientists have helped to crack a secret that might help to conserve an important South American tree species that is at risk of extinction in the wild.

The Chilean plum yew (*Prumnopitys andina*) is an attractive conifer tree native to the Andean regions of southern Chile and Argentina. It is under threat from hydro-electric power station developments flooding its territory, and the conversion of its habitat to farmland and commercial forestry plantations. It is estimated that perhaps fewer than 10,000 plum yew trees now remain in the wild in their natural range.

And if all that were not bad enough, plum yew seeds do their species no favours in the battle for survival by being very reluctant to germinate. Previous research had indicated that germination occurs in only about 10 per cent of seeds, and this could take four years to occur. Although this rate of germination was probably enough to keep populations of the trees regenerating satisfactorily, once they are threatened by animals, flooding, fire or felling, the overall rate is too low to ensure a healthy future for the species.

Now, however, scientists in Farnham, England, working in collaboration with colleagues in Edinburgh, Scotland, have used their expertise in tree seed biology to treble the germination rate in just one year – holding out the hope that foresters will be able to boost the rate of regeneration and help the tree to flourish in healthy numbers once again.

Scientists from the Forestry Commission's Forest Research agency and the Royal Botanic Garden Edinburgh have been collaborating on the problem with colleagues at Chile's Austral de Chile University in Valdivia. Initiated through the Botanic Garden's International Conifer Conservation Programme (ICCP), funding has also been provided by the UK Government's Darwin Initiative for the Survival of Species. Dr Peter Gosling from Forest Research explained: "By integrating good collection methods, fruit handling, local storage conditions, careful transport and a unique combination of pulp removal, washing, moist pre-germination treatment, surgical dissection and embryo culture, we've achieved 34 per cent germination in just under one year.

"We started with 262 seeds and, by using these techniques, we succeeded in getting 89 seedlings established within a year. That's more than double the number of plum yews in some groups of the trees in their native area!"

The seedlings are being cared for at Forest Research's Alice Holt Lodge research station near Farnham in Surrey, and once they're big enough they'll be planted out in the Forestry Commission's National Pinetum at Bedgebury in Kent.

Dr Martin Gardner from the Royal Botanic Garden Edinburgh added, "We cannot afford to lose a single species from our planet, and definitely not a significant tree such as *Prumnopitys andina*, which is an important component of the Chilean rainforests.

"As technologies progress we are finding more and more important compounds that can be extracted from plants and used for medicinal treatments. Already it is known that this species has anti-fungal properties that could one day play an important role in the treatment of human diseases. So this is an exciting breakthrough. The technique is now assisting Chilean researchers in conservation programmes to restore degraded forest environments in Chile. "One restoration programme has already begun in partnership with a local landowner, who has fenced off a planting site to keep animals away from the young trees.

"We also hope that conservation programmes will generate employment opportunities in nurseries for poor local people, and help poorer landowners to make sustainable economic use of their forests, for example, by small-scale cultivation and sale of the native trees and plants growing on their land."

Paulina Hechenleitner, from Austral de Chile University, added, "We are very pleased to have been part of a collaborative initiative involving leading UK research institutes to help understand more about the propagation methods that can be used to assist the conservation of one of Chile's most important conifer species."

The techniques and treatments have been published in the Royal Botanic Garden Edinburgh's journal, *Sibbaldia*.

MORE INFORMATION

The Darwin Initiative for the Survival of Species is a grants programme that promotes conservation of biodiversity and sustainable use of resources around the world. Website: www.darwin.gov.uk

Forest Research is an agency of the Forestry Commission. Websites: www.forestresearch.gov.uk and www.forestry.gov.uk/research

The Royal Botanic Garden Edinburgh, also known as the National Botanic Gardens of Scotland, is a scientific institution dedicated to discovering and describing plants and their relationships, evolution, conservation and biology. Sites are in Edinburgh, Dawyck in the Scottish Borders, Benmore in Argyll and Logan in Dumfries & Galloway. Website: www.rbge.org.uk

BIODIESEL: REDUCING FOSSIL FUEL USE – REVATALISING AGRICULTURE

Those operating in the agricultural sector have a unique opportunity to benefit from the increased use of biodiesel. Not only can they reduce their dependency on fossil fuels and lower the emissions impact of operating machinery but, by growing the crops required for the increasing demand biodiesel, they can also access an important revenue stream for their businesses.

New Holland recognises the importance of biodiesel and the impact of its use throughout the farming sector. The brand was the first to embrace fully the potential of biodiesel in agricultural equipment with the announcement last year that it supports the use of biodiesel blends up to 20% (B20) throughout Europe on all current production equipment with CNH engines, including common rail engines.

"As increasingly tight emissions legislation is introduced, we want to make sure that we are in a position to offer our customers engines they can confidently run on biodiesel," stated Gianmaria Olivetti, Engineering Executive Director of Fiat PowerTrain which develops and builds CNH engines.

New Holland's commitment to biodiesel has been further extended recently following an intensive testing programme to evaluate the performance and reliability of all its engines with higher blends of biodiesel. Most of New Holland's machinery equipped with mechanical fuel injection diesel engines, and a number of electronic engines, are now approved to run on 100% pure biodiesel (B100), with the use of a simple adaptation kit and specific maintenance programme.

New Holland worked a standard 146 kW TM190 tractor non-stop for 500 hours using 100% biodiesel, to reproduce the work patterns of its most intensive-working customers, such as large-scale farmers and contractors

Christian González, New Holland Europe Marketing Director, understands the importance for the brand to make sure its customers have every advantage. "In keeping with our role as the 'clean energy leader', we have given our customers clear undertakings with regard to biodiesel and this announcement proves that we always keep our promises. In fact, by simply following our technical guidelines, New Holland customers can confidently use 100% pure biodiesel on no less than 70 models in our range, both tractors and harvesters."

The use of biodiesel in agricultural machinery brings with it special considerations. Biodiesel is a renewable fuel produced from crops such as rape seed and sunflower seed. It can be used as either B100, or blended with conventional diesel to produce a biodiesel blend, common blends being 2% (B2), 5% (B5) and 20% (B20). In every case, these fuels must meet specified industry standards for fuel quality (EN14214) to ensure optimum performance and durability of the engine. The hygroscopic nature of biodiesel means that it tends to absorb moisture, so that New Holland strongly recommend the use of approved fuels and to comply with strict handling, storage and maintenance requirements to maintain the integrity of the fuel.

For customers of New Holland, the use of B20 biodiesel in machinery with CNH engines is a straightforward process. There are no engine modifications required and the same service and maintenance programme can be used. Similarly, there are no temperature restrictions, as biodiesel can increase in viscosity as the temperature drops and the brand's warranty will continue to cover the machine with the use of B20, providing normal maintenance routines and the strict EN14214 fuel standards are respected.

Using 100% biodiesel

The use of 100% biodiesel (B100) represents a positive commitment from the manufacturers and the customers, greatly reducing emissions. Use of this fuel does bring with it storage and performance considerations.

Biodiesel will attract water vapours from the air, so fuel tanks should be kept as full as possible. Due to potential stability problems with biodiesel, the fuel should not be stored in the

vehicle or in on-site storage tanks for more than three months.

Higher cetane numbers mean that a tractor running on biodiesel will offer the operator a smoother drive and reduced noise. There is a small reduction in power and torque (about 2% for B20/B30 blends) and small impact on fuel consumption.

In May 2006, New Holland ran a 146 kW TM190 tractor for 500 hours continuously as part of an endurance exercise. The 22-day uninterrupted trial included ploughing and carrying out heavy cultivation work, as well as road transportation across five farms located in the Bordeaux region of France. A tough challenge for any machine but made all the more interesting as the entire trial was conducted on 100% biodiesel.

For the drivers taking part in the trial, the real-world performance of the tractor was unaltered. Mr Faucouneau, from Domaine du Preuil, completed a total of 30 hours at the wheel of the TM190, said: "The tractor has now been running for over 300 hours and it is performing impeccably. I didn't notice any loss of power at all, compared with a 146 kW tractor running on conventional diesel. I kept my eye on the engine temperature and it is not moving at all. The tractor performed to my complete satisfaction."

New Holland is continuously testing its machinery to maintain its leading position on biodiesel. The adaptation kit, which can include filters and gaskets, varies by model. However, on-going product development will see future biodiesel usage at higher blends become a standard feature.

The Eden Project in the UK chose the brand's range of tractors, due to the models' low noise levels, low emissions and low fuel consumption. New Holland has also made a unique commitment to running a joint 100% biodiesel test programme with the Eden Project and, together, they will develop a communication project to maximise this collaboration, supporting the promotion of biodiesel and sustainable development.

A bright future for biodiesel

"Biodiesel will open up new opportunities to us," said Mr Menara, a farmer from Le Clavier, who also took part in the trial. "It's a definite plus for today's agriculture and, more importantly, for the future. I am thinking, above all, about the young generation of farmers: for them biodiesel will add a new industrial outlet for their crops. I congratulate New Holland for organising this trial, it shows their commitment for the future!"

The European Union is the world's largest producer of biodiesel, both in terms of volume and capability, and its production level is still growing fast. Recognising biodiesel as an important element in meeting emission reduction targets, several member states have introduced tax incentives to encourage the use of biodiesel. This makes biodiesel a more cost-effective fuel than conventional diesel for New Holland's customers in many countries.

Under the current Common Agricultural Policy, crops for the production of biodiesel may be grown on set-aside land which, together with the increasing demand for these crops, opens the door to new opportunities for farmers.

The necessary technical advice and specific maintenance programmes are available through New Holland's expert dealer network. This is to ensure the biodiesel is handled properly and critical areas such as and fuel hoses and injectors receive further inspection. This means that customers can confidently work with EN14214-standard, B20 biodiesel blends without compromising the machine's performance or durability.

"Biodiesel is the future," says Christian González. "As the availability of fossil fuels becomes a greater problem, we need to look at alternatives. However, they must also be cleaner, environmentally sensitive alternatives. New Holland is renowned for its innovation and forward-thinking approach. We are committed to bringing our customers the latest technology and the benefits that comes along with that."

MORE INFORMATION

New Holland, John Hewett. Tel: +44(0)1268 292183 E-mail: john.hewett@cnh.com Website: www.newholland.com
New Holland's reputation is built on the success of our customers, cash crop producers, livestock farmers, contractors, vineyards, or groundscare professionals. They can count on the widest offering of innovative products and services: a full line of equipment, from tractors to harvesting, material handling equipment, complemented by tailored financial services from a specialist in agriculture.

EMPLOYMENT DIVERSITY

Why equality and diversity is a key issue in today's workplace

In just over seven years, only a fifth of the workforce will be white, able-bodied, male and under 45. This is the fact that has driven Acas, Britain's leading employment relations advisers, to develop its first free equality and diversity online learning tool.

"It must be an intolerable situation to know you are working in an environment where you feel your contributions are not valued. Unfortunately many can suffer – for years sometimes – without being able to overcome this problem, and even more worrying is that employers are not trained to be aware of the types of issues that can make people feel undervalued and ineffective," says Stephen Williams, Head of the Equality and Diversity Unit at Acas.

"This has been the main driver behind Acas devising a series of equality and diversity e-learning tools designed to help both employers and employees recognise relevant issues and be able to address them."

The e-learning tool, on sexual orientation and gender reassignment, provides a practical learning tool to assess an organisation's position and how any issues can be further identified and addressed. This new learning tool is provided alongside a free consultation from Acas.

MORE INFORMATION

Web: www.acas.org.uk/elearning

Quarterly SPRING 62(1)

MEMBERSHIP MATTERS

THE NEWSLETTER OF THE INSTITUTION OF AGRICULTURAL ENGINEERS

Tomorrow's Countryside?

The Past

There are times in history that have precipitated major changes in the look and purpose of the countryside. The introduction of the mouldboard plough lead to the introduction of the rectangular field pattern of the Celtic period. The Romans introduced a trading economy which made agriculture a wealth creating activity. The Anglo Saxons realigned the country into thin strips with an economy that was local and provided food, energy and a large proportion of raw materials. The Normans' commitment to the church gradually destroyed large areas of the Saxon farming system. One quarter of farmed land was dedicated to financing the religious establishment. Many village communities, their fields and common land were removed from the landscape to accommodate sheep. The dissolution of the Monasteries in the mid 1500's transferred vast areas of land to private individuals. Large areas of village land particularly in lowland Britain not already "enclosed" was rationalised and amalgamated into compact farms. The Enclosure Acts were still many years in the future and reflect a last ditch attempt to clarify ownership and rationalise farming.

The developments of the mid eighteenth century of shire horses and sophisticated rotations were the result of commercialisation of farming and lead to the early twentieth century countryside. Farming was dedicated to the production of food for the urban masses and fuel for some three million horses. By this time, manufacturing had largely moved out of the countryside.

The Present

The impact of the past is still seen in field layouts, hedgerows, location and configuration of farm buildings, areas of common land and of woodlands. This is long after their commercial rational has passed.

The present countryside is being shaped by two symbolic events that happened some seventy years ago. One is the start of production of Fordsons in the UK in 1933. The other, possibly a more important event, was the mass trespass at Kinder-Scout in 1932 and the related formation of the Ramblers Association in 1935.

"Farming was dedicated to the production of food for the urban masses and fuel for some three million horses. By this time, manufacturing had largely moved out of the countryside."

Though tractors, etc. had been available for some years, the mass production of cheap replacements for the horse released in excess of one and a half million hectares of ground from fuel production. Tractors gave land owners the power to establish and harvest crops at a higher rate with reduced manpower and opened up the possibility of easily reshaping the layout of the countryside. Before long, many farmers started to amalgamate fields into more economically viable blocks and replace old horse related farm infrastructure. With current machinery work rates and economic herd/flock sizes, one would expect the rural layout to be made from thirty hectare rectangular blocks. Farm buildings and other farm infrastructure should match current economic requirements. If farming is to compete at world prices then using farms designed for conditions in the late nineteenth century is no more valid than manufacturers of motor cars or

supermarkets working under similar constraints. How many factories have hedges and single oak trees within their production lines and how many supermarkets have ponds stocked with endangered newts in the aisles between the Canadian wild salmon and Peruvian strawberries?

There are areas of the country where, because of history and topography, farming has been progressive in its management of the landscape. With economies of scale and layout they are able to compete in the world market. Even here, there are some anomalies of field shape and ownership as well as hedges and woodland that would benefit from revision as happened with the Anglo Saxon field system. But who, even among farmers, wants to live in a northern French landscape?

The formation of the Ramblers Association was a signal that the purpose of the countryside had changed in people's minds. It was no longer there to produce food and raw materials or to provide employment for agriculturalist; it was there to provide recreation and relaxation for the urban masses. The urban majority's perception as to the purpose of the countryside and the increasing proportion of the rural population with no reliance or allegiance to farming has weakened the political demand to be self sufficient in any areas of agricultural. The farmer's acceptance of some three billion pounds of tax payer's money each year has locked them into economic fairyland. The 'beauty' of landscape has become more important than its economic worth. That beauty is based on artistic representations of a late nineteenth idyll. Politicians are willing to reinforce this representation as a reality by shifting where they spend tax payer's money in the rural economy to the landscape rather than agriculture.

"The farmer's acceptance of some three billion pounds of tax payer's money each year has locked them into economic fairyland. The 'beauty' of landscape has become more important than its economic worth."

However, there are pressures that work against this concept of a rural pleasure park. Urban masses expect the rural landscape to accommodate by-passes, motorways and airports. Training of helicopter pilots is not tolerated over urban landscapes nor are wind farms acceptable in town parks or along major city highways. These can be tolerated in the countryside; presumably the population is deaf and blind. Rural land owners are expected to modify their farming practices so that the water they collect and store on their land needs minimum processing before being pumped free to the water companies. They are expected to pump strangers' sewage on to the same land and pay for the privilege. This whole area is worthy of fuller investigation and analysis.

And Tomorrow

As usual it will have to wait till another day.

Geoffrey Wakeham

Academic Members

Askham Bryan College
Askham Bryan
York
YO23 3FR

Barony College
Parkgate
Dumfries
DG1 3NE

Bicton College
Budleigh
Budleigh Salterton
Devon
EX9 7BY

Coleg Sir Gar
Pibwrlwyd Campus
Pibwrlwyd
Carmarthen
SA31 2NH

Cranfield University Silsoe
Bedford
MK45 4DT

Greenmount Campus
CAFRE
22 Greenmount Road
Co Antrim
Northern Ireland
BT41 4PU

Harper Adams University College
Newport
Shropshire
TF10 8NB

Institute of Technology, Tralee
Clash
Tralee
Co Kerry
Ireland

Myerscough College
Myerscough Hall
Bilsborrow
Preston
Lancashire
PR7 0RY

Oatridge Agricultural College
Ecclesmachan
Broxburn
West Lothian
EH52 6NH

Pallaskenry Agricultural College
Co Limerick
Ireland

Pencoed College
Pencoed
Bridgend
CF35 5LG

Plumpton College
Ditchling Road
Lewes
East Sussex
BN73AE

Reaseheath College
Reaseheath
Nantwich
Cheshire
CW5 6DF

Royal Agricultural College
Cirencester
Gloucester
GL7 6JS

Scottish Agricultural College
SAC Ayr Campus
Auchincruive Estate
Ayr
KA6 5HW

Sparsholt College
Sparsholt
Winchester
Hampshire
SO21 2NF

Willowdene Training Ltd
Chorley
Bridgnorth
Shropshire
WV16 6PP

Wiltshire College - Lackham
Lacock
Chippenham
Wiltshire
SN15 2NY

Writtle College
Chelmsford
Essex
CM1 3RR

Weir Shield Competition

The Forestry Commission recently hosted the Institution of Agricultural Engineers Weir Shield Competition at their Inver Workshop near Dunkeld in Perthshire. The manager and mechanics at Inver Workshop did a tremendous job of setting up the tests and making arrangements for the competitors. Apprentices are chosen by their colleges to compete in the event, which is judged by independent assessors put forward by the IAgrE. The competition has been run since 1972, and was devised by Jim Weir, an Agricultural Engineer, working for the Electricity Board, who wanted to promote the spirit of competition amongst apprentices in Scotland. The event took place on Saturday 25th November 2006, there were 6 applicants, 2 each from Barony College in Dumfries, Oatridge College in West Lothian and Elmwood College in Fife. They had to complete the following tests to agreed standards and within specific times:

- Forwarder Operation – unload & load a forwarder
- Electrical – identify components on a Citroen Berlingo van
- Hydraulic – flow and pressure checks on a New Holland/Flail Tractor
- Honda Quad – inspection and identification of defects
- Welding/Fabrication – construct an exercise piece using gas cutting, hand tools, MIG and MMA (electrode) welding

The apprentices with the highest aggregate score determine which college is awarded the Weir Shield. Fraser Mills of Elmwood College won the competition and the Weir Shield also went to Elmwood. Fraser was presented with an engraved tankard at Elmwood College on 10th January 2007.

Jeff Livingston
Chairman, Scottish Branch

Left to Right: Ian Pearce, Head of Land and Environment at Elmwood, Jeffrey Livingston Chairman Scottish Branch, Fraser Mills, Winner of Weir Shield Competition and Nigel Ford Lecturer Land and Environment at Elmwood.

Long service certificates

Name	*Grade*	*Date of anniversary*
50 years		
Richard Basil **Evans**	AIAgrE	8 Jan 2007
John Kevin **Grundey**	MIAgrE	8 Jan 2007
Peter Stewart **Barton**	IEng FIAgrE	12 Mar 2007
Peter Cyril **Brimblecombe**	EngTech MIAgrE	12 Mar 2007
David Alastair **Jack**	MIAgrE	12 Mar 2007
John **Kilgour**	Eur Ing CEng FIAgrE	12 Mar 2007
35 years		
Malcolm George **Cluett**	AMIAgrE	26 Jan 2007
Dennis Chong Phoe **Khoo**	CEng MIAgrE	26 Jan 2007
Graham **Ovens**	MIAgrE	26 Jan 2007
Christopher John Edward **Adlard**	AIAgrE	26 Jan 2007
Richard Christopher Maurice **Smart**	AIAgrE	26 Jan 2007
Alan **Thorpe**	IEng MIAgrE	26 Jan 2007
Bernard Robert **Wynn**	AMIAgrE	26 Jan 2007
Jan Petr **Cermak**	CEng MIAgrE	26 Jan 2007
Brian Gilbert **Sims**	IEng MIAgrE	26 Jan 2007
Hugh Lempriere **Back**	CEng MIAgrE	26 Jan 2007
John Skidmore **Cooke**	IEng MIAgrE	26 Jan 2007
Andrew John **Landers**	CEng FIAgrE	26 Jan 2007
James Anthony **Sweetman**	IEng MIAgrE	26 Jan 2007
Robert Michael **Voss**	EngTech MIAgrE	26 Jan 2007
Hugh John **McIlvenna**	EngTech MIAgrE	10 Mar 2007
25 years		
Andrew **Earl**	IEng MIAgrE	13 Jan 2007
Ruth Diana **Metcalfe**	MIAgrE	13 Jan 2007
Richard **Bond**	MIAgrE	15 Jan 2007
Paul James **Stevens**	AMIAgrE	21 Jan 2007
Andrew Thomas **Blowey**	CEng MIAgrE	2 Mar 2007
Owen George Grant **O'Connell**	IEng MIAgrE	9 Mar 2007
Trevor Martin **Wells**	IEng MIAgrE	11 Mar 2007
Murdoch Alexander Macpherson **Gatward**	EngTech MIAgrE	11 Mar 2007
Maurice Christopher **Arnold**	IEng MIAgrE	11 Mar 2007

The world's most powerful motor sport

Tractor Pulling

Monday 6th November saw **Gareth Jones** of the Valtra UK Tractor Pulling Team deliver a presentation to the Wrekin branch of the IAgrE. A lot of interest was certainly generated in what is known as the World's Most Powerful Motorsport – Tractor Pulling!

The aim of this sport is to find out the best machine and driver at dragging a weight transfer sled the greatest distance along a 100 m clay track. The sled provides an increasing resistance the further it is pulled, with a weight box, driven by the rear wheels, pivoting the sled to apply increasing pressure to a large metal skid. The initial rolling weight is converted to a dead weight of up to 80 tonnes for the highest power vehicles.

Essentially, there are four main classes of Tractor Pulling in the UK.

Prostock Tractor Rough Justice (GB) driven by Ted Nicholson

Superstock Tractor Best Solution (D) driven by Marcus Kaiser

Mini modified tractor Little Dan (GB) driven by Rob Armistead

Modified Tractor Fox (DK) driven by Martin Larsen

The first is the **3.5 t Prostock class**, with each vehicle being weighed in before the start of competition. The Prostock class must maintain their original engine block, cylinder head casting, transmission casing and rear axle casing. They are restricted to an engine size of 8.3 litres, a single turbocharger and must use diesel fuel. The top tractors in this class are generating in the region of 1200 kW at 5500 rpm.

The **Superstock class** again must maintain the original engine block. However, they are given the option of unlimited engine size, up to four turbochargers, and are allowed to be converted to methanol fuel, enabling the generation of around 2250 kW from an original engine block.

Tractors in the **Mini Modified division** pull a smaller scale sled, and weigh in at 950 kg. However, when fitted with supercharged methanol V8s, small V12s or even radial engines, they can produce around 1150 kW.

The real high powered stuff, however, comes in the **Modified division**. Up to 5 x V8s, 3 x V12s, 4 x gas turbine engines are all regular sights on the European modified circuit, with the top machines putting out around 7500 kW from a 4.5 t vehicle.

However, the sport is far from pure engine power alone. Skill in setting up tyre pressures, balance and 'reading' the track, as well as driving skill, form an essential part of success.

Tractor Pulling in the UK is growing all the time, we now have around 6 events per year, two of which are held at Great Eccleston in Lancashire, and the rest held in the South West. If you are interested in more information of the sport, feel free to visit the British Tractor Pullers Association website **www.tractorpulling.co.uk** or alternatively send me an e-mail to **roughjustice3688@aol.com**

Ted Nicholson
Rough Justice Tractor Pulling Team
Harper Adams University College

Dunsfold Collection Open Weekend event

The IAgrE Pioneering Technology Specialist Interest Group (PTSG) had a stand at the Dunsfold Collection open weekend on Saturday 10th September.

This was the group's second appearance at the Dunsfold show and, yet again, we were given one of the prime locations on the show ground – adjacent to the beer tent!!

For details of the Dunsfold Collection please see: **http://www.dunsfoldcollection.co.uk/**

In spite of membership-wide publicity for the event, including a 'flier' in the summer edition of *Landwards*, there were no advance notifications of attendance. Nevertheless, we had a small number of enthusiastic members attend on the day.

At about midday, we organised a private tour round the Dunsfold Collection of Land Rovers. The collection contains many of the wild and wonderful creations of the Land Rover brand and many representing the specialist conversions which have been created using the Land Rover vehicles as a starting point. The vehicles on show included a recently acquired 1955 86 inch wheelbase Land Rover Series 1 with a front mounted straight snow plough blade made by Howie, a Turner front mounted hydraulic winch and a rear mounted 3 point linkage believed to have been made by Adrolic. All these adaptations may well have been on the vehicle from new. In spite of its 50 year life, this vehicle has still only covered 19,000 miles from new! (The above details about the vehicle taken from *Blade Runner* by James Taylor published in Land Rover Enthusiast Magazine, September 2006.)

For those members who had not seen it before, we were able to arrange a private viewing of the John Parker collection of model Land Rovers. This amazing collection was donated to Dunsfold by the family after John's death and is now available for private viewing only.

A 1955 86 inch wheelbase Land Rover Series 1 with a front mounted straight snow plough blade made by Howie [Photo: Stuart Martin]

In addition to providing a meeting point for members, the PTSG stand served to publicise the Agricultural Engineering industry and was able to offer advice to both young enthusiasts and teachers visiting the show. Drinks and biscuits were also provided as a service to visiting members.

It is hoped that the next PTSG outing will be to Combe Mill in Oxfordshire. For more information see website: **http://www.combemill.org/index.html**

Details to be announced.

Stuart Martin

The same vehicle with a rear mounted 3 point linkage displayed on the Dunsfold Collection stand at the Land Rover Marque event, Heritage Motor Centre, Gaydon, in May 2006 (see http://www.heritage-motor-centre.co.uk/) [Photo:Stuart Martin]

Membership Changes

Admissions

A warm welcome to the following new members

Fellow

C Tacon (Cheshire)

Member

M G Cann (Norfolk)
S J Curtis (Norfolk)
P H Fairhead (Norfolk)
J P Gooderson (Norfolk)
R O Goss (Devon)
S J Hall (Suffolk)
P E Harvey (Norfolk)
T G Hinchley (Norfolk)
C A Llewellyn (Bedfordshire)
H J H Pullen (West Sussex)
J W Warne (Warwickshire)

Associate Member

R Best (Dorset)
T Gee (West Yorkshire)
D Kent (Nottinghamshire
D Pengelly (Cornwall)
T Schroeder (Hertfordshire)

Associate

A J Becvar (East Sussex)
J Mathieu (USA)

Student

Brooksby College:
J Baker
A Barber
C Barrott
T M Bence
L Bowditch
F D Brown
S T Day
D J Evans
R French
L J Gould
D C Jeffrey
P Joy
S Mudd
K W Oliphant
J Owen
R Pitcher
J Plummer
T Purser
L M Shepherd
K Simpson
P Strickson
T E Thomson
M Watters
S Wedderburn
M Welbourne

Coleg Sir Gar:
A M Dufty
D R James
T C J Phillips
J Smith
E W Stone
A J G Thomas
R G Williams

Myerscough College:
S C L Biddle
J Birkett
J Booth
A Bradshaw
J Cowgill
T J Dewhurst
J J Gerrard
R Haddow
S Hodge
A S Hodkinson
T Holt
B I Jones
J Morrison
J Ormiston
M Patz
D Saul
T Wallbank
T E Webster

Reaseheath College:
M Anderton
S M Attwell
L J Barber
J Battye
J A Bennett
J Brocklehurst
O Charlesworth
B Clark
C D Coombs
C Coppenhall
S Cox
J Daniels
J Day
W Dummer
J Elliott
B Fleetwood
R Fowler
D Foy
C J Gardner
M Hansford
B Hart
N H Heggie
J G Henderson
J Holland
M Honour
J Jones
E J Kingsholt
J Larder
D Lea
S P Littlechild
G McCombie
J McDermott
C D Milligan
L Morgado
T J Morley
R Oldfield
A Petrie
D Petrie
A Podlinski
G I Ritchie
S Rouse
J Rutter
P Scorgie
P Shaw
T D Speakman
F Thomson
R J Twinn
B Unsworth
L J Wakefield
D T Williams

Readmissions

Member

L R Bright (Norfolk)
T J Cooper (Suffolk)
R W Hudson (Suffolk)

Transfers

Congratulations to members achieving a further phase of their professional development

Member

E M Davies (Berkshire)
J S Garner (Buckinghamshire)

Associate Member

C J Frost (Suffolk)
S K Morgan (Gloucester)

Deaths

J P Low (Cornwall)
T R Shewell (Wiltshire)

Engineering Council

Registrations

Congratulations to the following members who have qualified as Engineering Technician, entitling them to use the designatory letters Eng Tech after their names

EngTech

M Bentley (Ayrshire)
R Best (Dorset)
S Brayshaw (West Yorkshire)
T Collins (Lincolnshire)
T Gee (West Yorkshire)
R Guy (Hampshire)
A Hazledine (Nottingham)
A Leisk (Berkshire)
D Pengelly (Cornwall)
S Reed (Somerset)
D Roberston(Fife)
O Rumsey (Norfolk)
T Schroeder (Hertfordshire)
B Sharp (York)
J Smith (Norfolk)
A Terry (Lincolnshire)

Commercial Members

Autoguide Equipment Ltd
Stockley Road
Heddington
Calne
Wiltshire
SN11 0PS

Douglas Bomford Trust
Springhill House
Salters Lane
Lower Moor
Pershore
Worcestershire
WR10 2PE

Bomford Turner Limited
Salford Priors
Evesham
Worcestershire
WR11 5SW

John Deere Ltd
Harby Road
Langar
Nottinghamshire
NG13 9HT
FEC Services

NAC
Stoneleigh Park
Kenilworth
Warwickshire
CV8 2LS

G C Professional Services for land-based and related industries
Highdown Cottage
Compton Down
Winchester
Hampshire
SO21 2AP

Law-Denis Engineering Ltd
Millstream Works
Station Road
Wickwar
Wotton-under-Edge
Gloucestershire
GL12 8NB

David Ritchie (Implements) Ltd
Carseview Road
Suttieside
Forfar
Angus
DD8 3EE

Shelbourne Reynolds
Shepherds Grove Industrial Estate
Stanton
Bury St Edmunds
Suffolk
IP31 2AR

White Horse Contractors Ltd
Lodge Hill
Abingdon
Oxfordshire
OX14 2JD

Membership Matters

In response to the honour of being awarded a 50 year Long Service Certificate, ***Alan Chadborn*** *is still proud to tell people that he is an Agricultural Engineer, although few people in Inner London – where he still teaches blacksmithing for Newham Borough – know what that is! He and his wife are also involved with the City Farms there, but it is quite a contrast the important contribution they made earlier in life as he explains.*

A ripper planter and a wheelbarrow 4-row sprayer constructed by the Chadborns

I thank God for a most interesting life, including 19 years in rural Africa, with my long-suffering wife, the last 11 years living in grass thatched village huts and cooking on an open wood fire!

From early years at Writtle, I took up the 'Small is beautiful' theme and tried to encourage rural industry around improved farming. Civil war, etc., reduced much of the outcome in Nigeria and Uganda, but I have to have some excuses.

An ATNESA conference at Jinja alerted me to Conservation Farming (where I met Barney Muckle) also we made a range of implements including ripper-planters, knife rollers and wheelbarrow 4-row sprayers.

Since arc or gas welding is expensive out of town, we used the earlier techniques of coal-forging steel bar and riveting. The forge was carved from an ant-hill and under a shady tree. Riveting requires drilling many holes. Manual pillar drills did well, but began to wear with much work in the open, with sand blowing in the dry season. So this year, I designed and built a prototype in London, took it to Uganda and we made a production model from materials sourced in Uganda. It is pedalled, transmission is of bike parts, and feed is by adjustable weight. So it is sustainable, and can drill 16 mm holes in 10 mm thick steel.

We built a shed, for tools and steel, of murram walls and catenary-arch roof made of sun-dried bricks after the manner of ancient Egypt, but we had more rain than Egypt so it didn't last more than 2 years. My composting toilets were more successful and provided 9 barrows of good compost each year.

We trained donkeys for work, people to handle them, and others to make harness from sisal rope. Carts to carry 350 kg were made from light poles with wheels of double bike rims and 80 spokes.

Our best form of transport in rural Katakwi was a trials motorbike and sidecar. This carried farm implements to customers or planks from town. But the two of us looked like Wallace and Grommit! This was fine, because as an old friend said: 'Half the purpose of Brits in Africa is to provide amusement'!

I have enjoyed making designs to suit local needs, with locally available material and using skills which my young men could learn. On my visit this year, I was pleasantly surprised to find these chaps earning from their production to feed their families. Not yet revolutionising farming, but ready when farmers are open to change.

I hope these few words convey something of my life in Agricultural Engineering, which has also included teaching in Ag. Colleges in Zambia and Suffolk.

Branch Meetings and Events

APRIL 2007
Tuesday 3 April 19.30 h
South East Midlands Branch
JCB Diesel Max Land Speed Record Attempt
Speaker: Dr Tim Leverton – Group Engineering Director, JCB
Venue: Stumble Inn, Cranfield University at Silsoe.
This will be the story of JCB's successful attempt to break the presently held 236 mph record for a diesel powered vehicle set in 1973. JCB's vehicle contains two 750 bhp JCB444 diesel engines. Their goal of >300 mph was achieved on the Bonneville Salt Flats on August 22nd with a speed of >326 mph with a further record breaking run on the 23rd of over 350 mph. Given the outcome this should be a dynamic meeting!
Dr Tim Leverton is responsible for all JCB engineering activities worldwide, and has board level responsibility for the JCB Power Systems business unit that manufactures the new JCBM444 engine.
Prior to joining JCB he worked for 25 years in the automobile industry, holding senior engineering positions at Rover Group and Land Rover, and latterly at BMW in Munich where he was Chief Engineer for the Rolls-Royce Phantom launched in January 2003.
This is a joint meeting with IMechE.
Contact: John Stafford – tel: 01525 402229 e-mail: **john.stafford@silsoe-solutions.co.uk**

Wednesday 11 April 19.30 h
Yorkshire Branch
The Halley Project in Antarctica
Speaker: Martin Bell
Martin is the engineer in charge of the Halley Project and will have just returned from Antarctica.
Venue: Buckles Inn, Askham Richard, York
Contact: Gordon Williamson – e-mail: **gordon.williamson@ntlworld.com**

Wednesday 18 April 19.30 h
East Midlands Branch
Globalisation. Where is it going to be made next? Does it matter?
Two very different companies, two different approaches.
Speakers: Mike Alsop – Vaderstad and
Philip Wright - Simba
Venue: Vaderstad, Grantham
Contact: David Wilkinson – tel: 01205 362667 or e-mail: **DebbieWilkinson60@btinternet.com**

Tuesday 24 April 19.30 h
West Midlands Branch
Alvan Blanch – The Company and its latest projects
David Abbott will review the progress and developments of this long established company which has survived by developing niche markets and providing a professional service to farmers and growers.
Venue: Friends Meeting House, Stratford upon Avon
Contact: **westmids@iagre.biz**

Monday 30 April 19.30 h
Wrekin Branch
Social Evening
Venue: Reaseheath College
Contact: Graham Higginson – e-mail: **wrekin@iagre.biz** or tel: 01270 613230.

MAY 2007
Thursday 3 May
IAgrE Annual Conference 2007
"Achieving Traceability across the Food Chain"
Venue: East of England Showground, Peterborough
See: Outside Back Cover of *Landwards*

Monday 14 May 19.30 h
South East Midlands Branch
Sustainable Farming and the Role of Natural Biotic Systems
Speaker: Martin Wolfe – Research Director, Elm Farm Arable Research (ERFC)
Venue: Stumble Inn, Cranfield University at Silsoe
Martin will describe his unique project that turns away from the consensus that monoculture systems give the best yields. His philosophy is to bring as many species together as possible and demonstrates that by so doing, yields are more robust and diseases and pests are better held at bay. Interactions operate at all levels and between all species and their associated micro-organisms and mychorrhizae. After a distinguished career as a plant pathologist with the Plant Breeding Institute and as Professor of Plant Pathology at the Swiss Federal Institute of Technology, Martin Wolfe moved to Wakelyns Farm, Suffolk to conduct experiments in organic agro-forestry. Wakelyns became one of EFRC's three experimental sites. Since 1997 he's been putting into practice previously theoretical ideas and seeing some exciting results for organic arable production
Contact: John Stafford – tel: 01525 402229 e-mail: **john.stafford@silsoe-solutions.co.uk**

JUNE 2007
Tuesday 5 June 19.30 h
East Midlands Branch
The Environmental Challenges towards the Sustainable Development of a large Lincolnshire Estate
Running a business alongside environmental considerations.
Speakers: Graham Harding and Sandy Donald
Venue: Blankney Estate, Nr Sleaford
Contact for further details and/or if you wish to attend: Sandy Donald – tel: 01522 810265 or e-mail: **sandytd2000@tiscali.co.uk**

Saturday 9 June
West Midlands Branch
Visit to Bygones Museum at Claydon, nr Banbury
This is a private collection of tools and equipment built up over the past 30 years and will be a time to relax and enjoy this lovely site in North Oxfordshire. An afternoon cream tea will be provided.
Contact for further details and/or if you wish to attend: **westmids@iagre.biz**

Produced by: Land Technology Ltd, Edinburgh Printed by: Barr Printers, Glenrothes

Biosystems Engineering

The contents of the latest three months of published research

(&, second author; et al., other authors)

Volume 96 Issue 1

PA – Precision Agriculture

Yield Monitoring of Sugar Cane
P S G Magalhaes & 1

PM – Power and Machinery

Soil Influences on the Mechanical Actions of a Flexible Spring Tine during Selective Weed Harrowing
A M Mouazen *et al.* 7

An Investigation of Roll-off Cleanliness for Hydraulic Systems and its Application to a Tractor
Jae-Cheon Lee *et al.* 19

Test Method for Boom Suspension Influence on Spray Distribution, Part I: Experimental Study of Pesticide Application under a Moving Boom
Y Lardoux *et al.* 29

PH – Postharvest Technology

Some Physical and Morphological Properties of Wild Sunflower Seeds
E E Perez *et al.* 41

Moderate Electric Field Treatment of Sugarbeet Tissues
N I Lebovka *et al.* 47

Moisture Dependent Physical Properties of Tef Seed
A D Zewdu & 57

SE – Structures and Environment

Surface Irrigation of Dairy Farm Effluent, Part II: System Design and Operation
I Ali *et al.* 65

Analysis of the Stress State at the Cogging Joint in Timber Structures
J R Villar *et al.* 79

AP – Animal Production Technology

Observation of Cow Behaviour in an Automatic Milking System using Web-based Video Recording Technology
J Kaihilahti *et al.* 91

SW – Soil and Water

On-farm Sprinkler Irrigation Performance as affected by the Distribution System
N Lamaddalena *et al.* 99

Development of Parabolic Weirs for Simplified Discharge Measurement
C Igathinathane *et al.* 111

Improving Irrigation Performance in Hose-drawn Traveller Sprinkler systems
L L Silva *et al.* 121

RD – Rural Development

Carbon Dioxide Mitigation using Thermophilic Cyanobacteria
E Ono & 129

RESEARCH NOTE

SW – Soil and Water

Resevoir Level Forecasting using Neural Networks: Lake Naivasha
S Ondimu & 135

Volume 96 Issue 2

AE – Automation and Emerging Technologies

Development of an Autonomous Navigation System using a Two-dimensional Laser Scanner in an Orchard Application
Oscar C Barawid *et al.* 139

PA – Precision Agriculture

Map Quality and Zone Delineation as affected by Width of Parallel Swaths of Mobile Agricultural Sensors
H J Farahani & 151

PM – Power and Machinery

Test Method for Boom Suspension Influence on Spray Distribution, Part II: Validation and Use of a Spray Distribution Model
Y Lardoux *et al.* 161

A Mathematical Model of the Kinematics of a Rotating Disc for Inter- and Intra-row Hoeing
M J O'Docherty *et al.* 169

Design Calculations on Roll-over Protective Structures for Agricultural Tractors
J Mangado *et al.* 181

Simulated and Experimental Analyses of a Toothed Rolling Coulter for cutting Crop Residues
P S G Magalhaes *et al.* 193

PH – Postharvest Technology

Effect of Disinfection, Packaging, and Storage Environment on the Shelf Life of Mango
A Tefera *et al.* 201

Diffusion Coefficient Relationships during Drying of Soya Bean Cultivars
M C Gely &

Development and Performance Evaluation of a Medium-scale System for Processing Bitter Leaf
J K Tangka & 223

Stem-end/Calyx Identification on Apples using Contour Analysis in Multispectral Images
J Xing *et al.* 231

Mechanical Damage to Apples during Transport in Wooden Crates
T Acican *et al.* 239

SE – Structures and Environment

Sensitivity of the Tomgro Model to Solar Radiation Intensity, Air Temperature and Carbon Dioxide Concentration
A Cooman & 249

AP – Animal Production Technology

Real-time Control of Pig Growth through an Integrated Management System
D J Parsons *et al.* 257

Logistics Chain of Animal Transport and Abattoir Operations
D Ljungberg *et al.* 267

SW – Soil and Water

Modelling the Transport of Metalaxyl in Gerbera Plants grown in a Closed-loop Hydroponic System
G Karras *et al.* 279

Comparison of Ultraviolet, Visible and Near Infrared Sensing for Soil Phosphorus
I Bogrekci & 293

Volume 96 Issue 3

AE – Automation and Emerging Technologies

Correction of low Altitude Thermal Images applied to estimating Soil Water Status
R Suguira *et al.* 301

Application Accuracy of a Machine Vision Controlled Robotic Micro Dosing System
H T Sogaard & 313

continued overleaf

Contaminant Classification of Poultry Hyperspectral Imagery using a Spectral Angle Mapping Algorithm
B PARK *ET AL.* 323
PH – Postharvest Technology
Modelling and Simulation of Paddy Grain (Rice) Drying in a Simple Pneumatic Dryer
P BUNYAWANICHAKUL *ET AL.* 333
Modelling Three Dimensional Air Temperature Distributions in Porous Media
V T THANH *ET AL.* 345
Electrical Conductivity for Quality Evaluation of Popcorn Kernels subjected to Mechanical Damage
A L D GONELI *ET AL.* 361
SE – Structures and Environment
Evaluation of Suitability of Some Local Pad Materials as Cooling Pads
T GUNHAN *ET AL.* 369
Influence of pH and Biological Metabolism on Dissolved Phosphorus during Biological Treatment of Piggery Waste
M L DAUMER *ET AL.* 379
Factor Analysis of Downwind Odours from Livestock Farms
L PAN *ET AL.* 389
AP – Animal Production Technology
Evaluation of Instrumentation for Cow Positioning and Tracking Indoors
A HUHTALA *ET AL.* 401
Determination of Thermal Diffusivity of Freshwater Fish during Ice Storage by using a One-dimensional Fourier Cylindrical Equation
D JAIN *ET AL.* 409
SW – Soil and Water
Improvement of Soil-affected Soils, Part 3: Specific Heat of Salt-affected Soils
G GUO *ET AL.*
Adaptation of an Automatic Irrigation-control Tray System for Outdoor Nurseries
R CANCERES *ET AL.* 421

RESEARCH NOTE
IT – Information Technology and the Human Interface
Multiplicative Scatter Correction during On-line Measurement with Near Infrared Spectroscopy
M R MALEKI *ET AL.* 429

Professor B D Witney
Editor

FARM DIVERSIFICATION

Adding value to farm woodlands in Breadalbane

Three farmers encouraging farm diversification have become the first to receive a cash boost from Forestry Commission Scotland as part of its 'Adding Value to Farm Woodlands' pilot grant scheme.

Neil Black (farmer) at the Palax firewood processor with John Kinnaird (President NFUS).

The £100,000 project helps farmers find new ways to make the most of their woodlands and woodland products by encouraging woodland management and diversification of farm businesses. The grant supports farmers for up to 40 per cent of agreed costs, with a maximum of £30,000 per applicant. The scheme is being piloted in the Breadalbane area, Perthshire, over a two year period and is being promoted through the Breadalbane Initiative for Farm Forestry (BIFF).

Announcing the three successful applicants, Scottish Forestry Minister Rhona Brankin, said:

"The pilot grant scheme is helping to improve the economic value of farm woodlands and encourage woodland management in the BIFF area by promoting the development and supply of forest products. Developing woodland products that meet market needs is a priority action of the Scottish Forestry Strategy. The strategy also recognises the value of small scale processing of timber for providing local opportunities for employment, income generation, development of a broader skills base and creating a base for farm diversification.

"I am delighted to announce the first three successful applicants who have been awarded assistance towards equipment such as mobile saws and a firewood processor. I hope that grant scheme will be the start of diversifying the farming business in a way that contributes to sustaining healthy rural communities."

The three farmers who have been offered funding through the scheme are:

- Neil Black from Gatehouse was awarded £12,835.00 towards a Palax firewood processor and mega deck. This equipment will be used to expand his current firewood supply business.
- Andrew Barbour of Fincastle was awarded £5,084.00 towards a Lumbermate saw, Minimax smartplaner and thicknesser and an Arrowsmith kiln. This will allow Andrew to produce timber from the woodlands on his property.
- Athel Price of Bolfracks was awarded £4,000.00 towards a Woodmiser portable sawmill. This will allow Athel to utilise the thinned materials from his woodlands.

John Kinnaird, NFU Scotland President, said: "Making the most of Scotland's diverse farm forestry and enlivening entrepreneurship through training is essential for the industry's well-being. This project encourages on-farm diversification and local business collaboration, and news of this grant will be very welcome for the recipients. NFU Scotland is fully behind farmers wishing to diversify in this ever-changing environment. Financial support for farmers who develop or enhance an already successful business will in turn be re-introduced into the local community. This means the wider rural population will also gain from the project."

FUTURE OF PROTECTED AGRICULTURE

IN ARID REGIONS: AUTONOMOUS MOBILE ROBOTS

A. Sánchez, J.L. Guzmán, J. Sánchez-Hermosilla, F. Rodríguez and M. Berenguel

Introduction

Focusing on the topic of the UNACOMA Vision Event, the question to be answered must be: *what is the vision of agricultural and biological systems engineering in the future?* From the authors' point of view, the idea of future agriculture lies in the efficient used of technology to improve agricultural tasks and avoid the health and safety issues of manual tedious or dangerous tasks. At the same time, the environment and the economic profitability must also be taken into account.

On the other hand, the current competitiveness between companies and the market demands are being widely reflected in the agricultural field. There are large-scale production requirements for everything these days, with the need for good quality produce but in a very short turnaround time.

Technology is ever more present in agricultural engineering now due to the need to fulfill such requirements. However, great care must be taken to ensure that these technological advances avoid harmful effects for both the environment and health.

The future of robotics is a continuous field of growth. Several studies conclude that nanotechnology and robotics will alter the world in the future, where Robots will make producing goods and services more efficient for society.

Robots of the future would become closer and closer to the decision-making ability of humans and also more independent (Dueñas, 2003). Agriculture in the future could be supported by multiple robotic systems, tele-operated or autonomous, considering the previous aspects and performing typical agricultural tasks (such as spraying, fertilisation, harvesting, or pruning). An example of the use of technology in the agricultural environment can be found in greenhouses. Currently, it is very common to find greenhouses completely automated, where climate is controlled in an autonomous way. Most of the current greenhouses are equipped with automatic vents, shade screens, fans and heating systems, in order to keep the climatic variables within specific ranges. During the last few years, greenhouse automation has

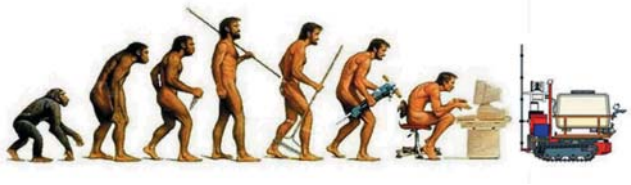


Fig. 1 The autonomous mobile robot evolution (adapted from Anon., 2000).

BIO NOTE

Alfredo Sánchez, Manuel Berenguel, Julián Sánchez-Hermosilla, José Luis Guzmán and Francisco Rodríguez are all members of the Automatic, Electronics and Robotics Research Group, University of Almería, Ctra. Sacramento s/n 04120, Almería, Spain. E-mail: joguzman@ual.es

This paper was selected as the winner of the UNACOMA Vision Award 2006 and presented at the AgEng 06 Conference held in Bonn, Germany, in September 2006. The Vision event was sponsored by the Italian Machinery Manufacturers' Association (UNACOMA) and the prize to the winning team was presented by Professor Ettore Gasparetto on behalf of the sponsors.

Fig. 2 Possible applications to replace by automation in the future: (a) spraying tasks by hand (top left); (b) harvesting in greenhouses by hand (top right); and (c) other manual agricultural tasks (bottom)

been confirmed to improve the profitability and crop quality (Rodríguez, 2002; Rodríguez *et al.*, 2003]. However, there are numerous agricultural tasks in greenhouses that are currently performed manually and require to be improved, such as spraying, fertilisation, harvesting or pruning tasks.

This project consists of the study of the possibility of enabling technological and autonomous systems to perform typical greenhouse tasks. Robotics seems to be the ideal solution for this purpose. Agricultural Robotics is the logical proliferation of automation technology into biosystems such as agriculture, forestry, fisheries, etc. Robots have the advantage of being small, light weight and autonomous (Guzmán *et al.*, 2004).

State of the art

In the last decades of the century, numerous autonomous systems for agricultural purposes have been developed without proceeding to commercialisation (Mandow *et al.*, 1996; Kassler 2001). In the post millennium agriculture some barriers have been identified and studied in order to develop new systems overcoming the world's agricultural reality (Kassler, 2001) . This problem also presents itself in the protected agriculture for arid regions, where this work tries to surmount all of these barriers.

As presented in the introduction, the human urge to automate our world seems unstoppable. Robotics is a good example of these technological advances enabling numerous developments, such as autonomous robots to perform both routine and complex activities in place of humans. However, the use of robotic systems in protected agriculture is slower mainly due to the equipment size relative to the surface of cultivation (considerably lower for open air crops) and the narrow corridors in the typical greenhouse structure where

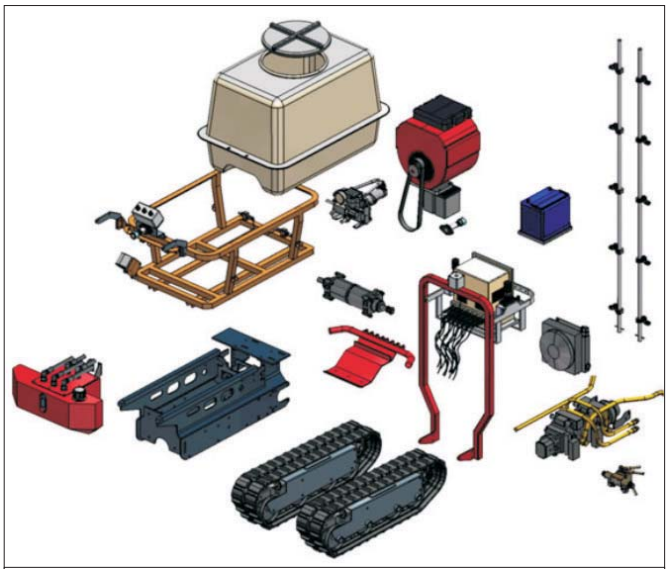


Fig. 3 Digital assembly of the autonomous robot designed

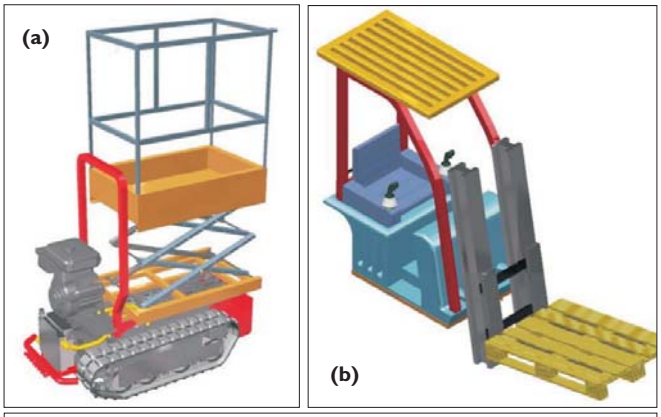


Fig. 4 Two features designed by CAD-CAE engineering: (a) lifting platform (left); and (b) forklift (right)

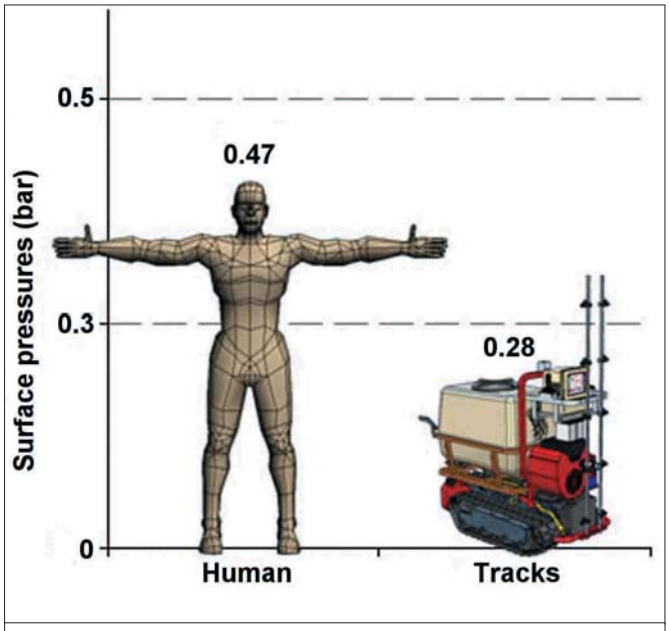


Fig. 5 Surface pressures (in bar) of the rubber tracked system compared to human foot traffic

Fig. 6 Autonomous mobile robot including the spraying system layer

the robot must manoeuvre.

The common greenhouses in the arid regions are light structures of galvanized steel and tensioned wire mesh holding a plastic surface used for cover and for the lateral walls. These kinds of structures allow the plants to grow in a characteristic environment with high temperatures, high relative humidity and a reduced air renovation, so increasing the crop performance and faster crop cycles. However, the main drawback of this environment is that the presence of plant diseases and insect infestations increase and the fact that it is also a hostile environment for workers.

The current mechanisms for controlling disease and insect infestation in protected agriculture in arid regions describe perfectly the obvious problems. Most of the phytosanitary applications in greenhouses in Almería (South-East Spain) are performed using traditional methods nowadays: a worker carries on a spray gun joined to a tank containing the chemical products that have to be applied to the crop, usually producing a non homogenous deposition on both surfaces of the leaves (Fig. 2a). Furthermore, the worker's exposure to these products is endangers health. This technique is very environmentally unfriendly and currently presents a health risk.

So, the newer automation and robotics techniques and technologies may help to improve and optimise the effectiveness of the phytosanitary applications. In the same way, this kind of new technological systems could allow the replacement of other tedious and dangerous tasks for workers such as fertilisation, harvesting, prune tasks, cleaning of the vents and shade screen, etc., (Fig. 2b and 2c).

Objectives of paper

The objective of this project is the development of a mobile robotic system which would be expected to perform the agricultural protected tasks in an autonomous way, moving inside of a greenhouse by means of intelligent navigation and avoiding the health risks currently incurred by humans. Furthermore, it is a more effective system from both technical and agronomic viewpoints, since it allows reduced crop costs and environmentally unfriendly activities.

Versatility is one of the key features required, enabling the performance of agricultural tasks inside the greenhouses but also developing to enable work on outdoor crops.

The robot design is composed by a layer-based architecture, where the lowest layer is devoted to work with actuators and sensors and the highest defines the final task to perform. In this way, multiple applications such as spraying, fertilisation, harvesting or pruning tasks, can be performed by the robot alone, thus exchanging the highest architecture layer and connecting the different final elements (related to the task) to the autonomous navigation platform.

The system has been developed with strong consideration to the main barriers presented in previous technological agricultural developments (Kassler, 2001). Therefore, the most important characteristics, taken into account in the design of the vehicle which determines its configuration, are:
mobile platform with appropriate dimensions for movement through crop lines inside greenhouses;
mobility and reduction of compaction of the loose sandy mix used in lanes of most greenhouses;
robustness and stability;
efficient spraying;
reduction of pesticide losses and application volumes to below that of traditional systems;
automation to avoid exposure of operator to pesticide;
economically feasible with comparison to most common greenhouse spraying systems in arid regions; and
inclusion of a layer-based architecture in order to perform most common agricultural applications.

Design/implementation of the future

The emergence of computer aided design (CAD) and rapid prototyping technologies has had a major impact on draughting, design and manufacturing, thereby reducing design effort, testing and prototype work . This has resulted in significantly reduced costs and improved productivity (Choi & Larson, 2002).

The CAD-CAE technology was used to design the mechanics of the vehicle, adapting previously established morphology and minimizing volumes and weights (taking into account the manufacturing materials), and optimising the disposition of the elements in its interior. Besides the static analysis by finite elements (FEA) of the chassis and the digital design, the assembly of the prototype has been developed (Fig. 3).

Also, by CAD-CAE engineering and considering the layer-based architecture, two implements were designed for the prototype: a

Table 1 Treatment applied

Sprayers	Nozzle type	Nº of nozzles	Pressure, bar	Travel speed, m/s	Application rate, l/ha
Spray boom	Flat fan	3	15	0.87	750
Spray-gun	Hollow cone	1	38	0.50	2000

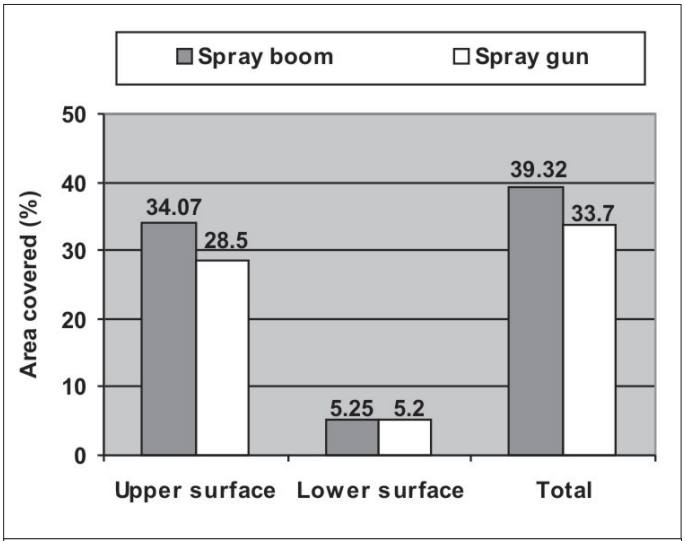
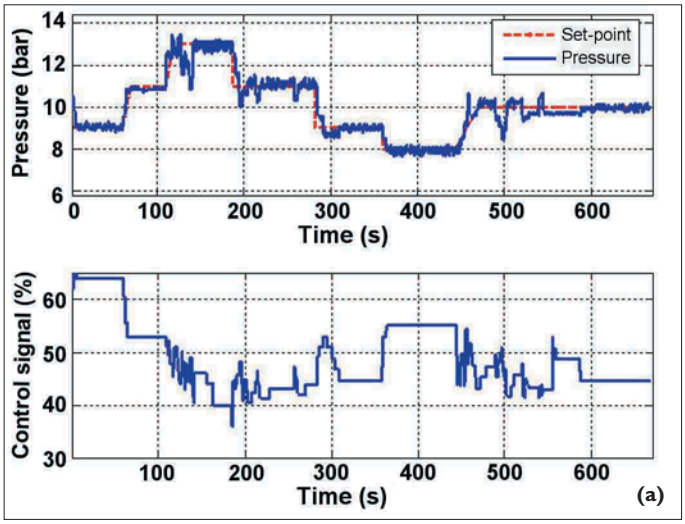


Fig. 7 Area covered (upper, lower and total) in the spraying tests



lifting platform (Fig. 4a) to reach high zones to perform tasks (staking, cleaning leaves, harvesting, manual pollination, etc.) and a forklift (Fig. 4b) to transport and raise heavy materials

In addition, with the aim of corroborating the suitability of the rubber tracked system selected, a theoretic study was made on the pressure on the soil surface of the greenhouse lanes exerted by the prototype, considering the autonomous robot of 756 kg in comparison with the pressure exerted by humans. As a reference, a man of medium weight exerts a pressure on the soil of between 0.47 and 0.5 bar (Ellenrieder, 1996), and thus the action of the rubber tracked system studied reduced the soil-compaction pressure by almost half due to the greater support area, compared to human foot traffic (0.28 bar of rubber tracks versus 0.47 bar of human) (Fig. 5).

As a first application for the autonomous layer-based system, it has been developed an automatic control system aimed at regulating the output pressure of a spraying system mounted on the mobile robot in spite of changes in the vehicle velocity. Figure 6 shows different views of the system.

To evaluate the effectiveness of the spraying operation of the equipment, a test was made comparing a manual system with a hydraulically operated spray-gun. The study was made in a typical Mediterranean greenhouse situated at the research centre 'Las Palmerillas, CAJAMAR' in Almería, Spain, the spray being applied to a tomato crop (leaf area index of 3.25) using tartrazine a 1000 g/ha as a tracer, with collectors of paper filter placed on the upper and lower leaf surface. The working conditions of each of the treatments are summarized in Table 1.

in the tests

The tests showed that using the prototype, equipped with a vertical boom sprayer at a pressure of 2.5 times lower and distributing a volume of 750 l/ha, dispositions proved superior to the use of the hydraulic spray gun (2000 l/ha). This represents a 2.6 fold saving in the application volume, in addition to the energy savings in using lower working pressures (Fig. 7).

In relation to the pressure control system, the valve position-pressure model of

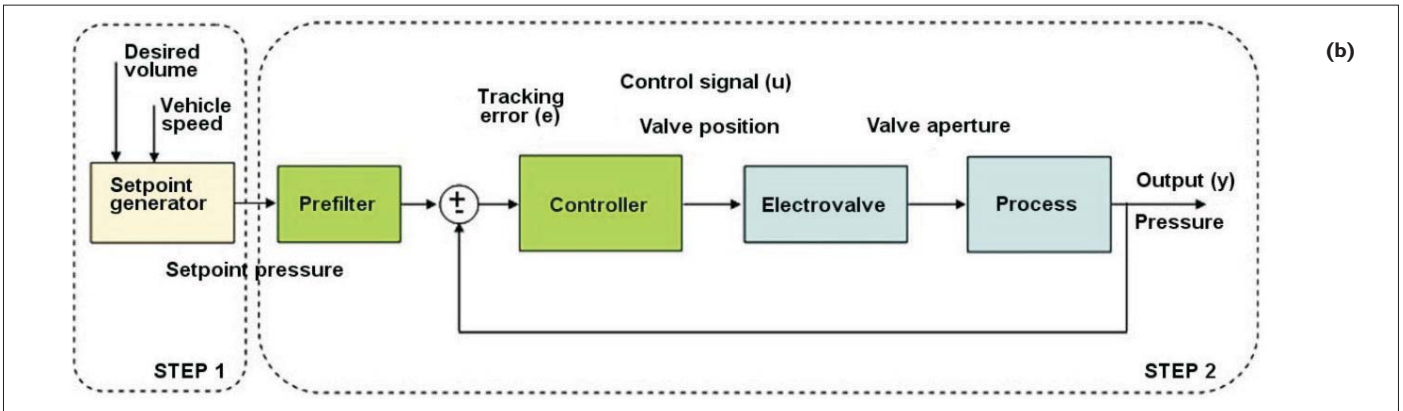


Fig. 8 The final control system and typical set point profile: (a) results of a real test where the gain scheduling control has been implemented; and (b) full spraying control system taking into account the velocity and volume

the system has been obtained detecting several non-linear characteristics. Different control strategies were studied aimed at achieving desired pressure tracking performance, where a gain scheduling control approach was finally selected to account for the non-linear characteristics of the system. This last strategy has been tested (see Fig. 8), introducing typical references depending on the robot speed and the total volume to spray (Guzmán *et al.*, 2004).

Conclusions

In conclusion, the authors' opinion is that an important factor in the future of agriculture is the integration of the technological evolution. However, the efficient use of this technology must be always borne in mind, with respect mainly to human health and the environment.

To this end, an example has been described in this article with a view to contributing towards the future of agricultural advances. A layer-based autonomous mobile robot for agricultural tasks (spraying, harvesting or pruning), in arid regions, has been described in detail, in order to remove health and safety issues of work which are tedious and dangerous to human health. This autonomous suggestion also respects both the environment and economic profitability.

Acknowledgments

This work was supported by the Spanish CICYT funds under grants AGL2002-00982 and AGL2005-00848, FIAPA and CAJAMAR. The authors would like to thank Dr Julián Sánchez-Hermosilla López, Dr Francisco Rodríguez Díaz, Prof. Manuel Berenguel Soria and Dr Constantino Valero Ubierna for their suggestions and help.

References

Anon. (2000). Evolución, Hombre, Máquinas. Website: http://www.dialogica.com.ar

Choi, C Y; Larson, D L (2002). Innovative CAD education for engineering students. ASAE Paper No. 701P0301. World Congress of Computers in Agriculture and Natural Resources, Iguacu Falls, Brazil, p13-15.

Dueñas, F A (2003). La Robótica. Website: http://www.monografias.com/trabajos6/larobo/larobo.shtml

Ellenrieder, K (1996). Design of an autonomous agricultural vehicle. MPhil. Thesis, Silsoe College, Cranfield University, UK.

Guzmán, J L; Medina, R; Sánchez-Hermosilla, J; Rodríguez, F; Berenguel, M (2004). Pressure control of a mobile spraying system. Spanish Journal of Agricultural Research, **2**(2),181-190.

Kassler, M (2001). Agricultural automation in the new millenium. Computers and Electronics in Agriculture, **30,** 237-240.

Mandow, A; Gómez-de-Gabriel, J M; Martínez, J L; Muñoz, V F; Ollero, A; García-Cerezo, A (1996). The autonomous mobile robot AURORA for greenhouse operation. IEEE Robotics & Automation' **3**(4), 18-28.

Rodríguez, F (2002). Modelling and hierarchical control of greenhouses crop growing. PhD Thesis, University of Almería, Spain.

Rodríguez, F; Berenguel, M; Arahal, M R (2003). A hierarchical control system for maximizing profit in greenhouse crops. European Conference Control, Cambridge, UK.

Allow for climate change when investing, farmers warned

Farmers and growers should account for climate change in their long-term business outlook, or else run the risk of making the wrong investment decisions.

The warning from Alvan Blanch, one of the UK's specialist agricultural engineering companies, follows the publication of the Stern Report outlining the economic consequences of climate change. It painted a grim picture of rising temperatures and economic decline if immediate steps to address carbon emissions are not taken.

"Stern's report described climate change as the 'greatest and widest-ranging market failure ever seen'," says Andrew Blanch, the company's managing director. "He also acknowledged that climate change is already happening, and that even drastic and immediate action will have little effect on the next 40 or 50 years.

"Climate change could have a dramatic effect on UK agriculture, particularly in the arable sector," Mr Blanch explains. "A rise in average temperatures of just one or two degrees will not only push up crop yields, but also widen the range of crops that are viable on UK farms.

"This prospect was highlighted at this year's Royal Show by Junior Environment Minister Ian Pearson, who specifically cited sunflower and soya beans as crops which could become viable," Mr Blanch adds.

Some farmers are already thinking about the options for new crops, with the current interest in grain maize reflected in the Maize Growers' Association's decision to host a Grain Maize Demonstration Day at Elveden Farms, Thetford, where growers heard about the opportunities – and difficulties – involved with switching to the novel crop.

"If, in ten to fifteen years' time we're able to grow, with little difficulty, sunflowers, hemp and grain maize in the UK, it's equally likely that the southern Mediterranean countries will have considerable difficulty. So not only would we have new crops, but new export markets too."

Yet grain drying and storage systems in the UK are configured to deal with traditional grain crops, points out Mr Blanch. "Many current on-floor systems struggle to cope even with grain maize – in the UK, it comes off the field at between 32 and 37% moisture – even though they will adequately handle wheat and barley. As an industry, we're only just realising that flexible systems should be order of the day.

"But that needn't mean over specification. When buying a tractor, you might opt for extra power to cope with future expansion. But if you don't, it's not too much of a problem to upgrade it to a more powerful model – it has a relatively short operating life.

"Static equipment such as grain systems, on the other hand, has a much longer operational lifetime," Mr Blanch stresses. "Our research suggests that the average age of a UK on-farm grain drier, for example, is 25 years. Installed new today, it will be drying crops long after climate change starts to affect UK agriculture.

"It's wise for today's farmers to consider what they, or their successor, might be growing in 10, 20 or even 30 years' time before buying a grain system. Failure to keep an open mind could be a costly mistake."

CONTACT

Andrew Blanch, Alvan Blanch Ltd. Tel: +44 (0)1666 577333. Website: andrew.blanch@alvan-blanch.co.uk

RENEWABLE ENERGY

21st century waterwheel key to sustainable energy

The Beck Mickle water wheel which can provide electricity to over 50,000 UK homes and potentially millions more worldwide

An innovative new waterwheel that can operate in small rivers and streams has been proven to convert water power into electricity at a commercially viable rate. As a result, the company that developed it is now planning to sell them to the public in late 2007.

The waterwheel that could provide electricity to over 50,000 UK homes and potentially millions more worldwide is also suitable for industrial use. The 'plug and go' machine is the first off-the-shelf water wheel system that can run in rivers and streams with a water head of as little as 20 cm.

The device harnesses the energy of shallow gradient (low head) streams, producing 1 to 2 kW of power and generating a minimum of 24 kWh of sustainable green energy in a day (an average household consumes daily around 28 kWh including heating).

The device's ability to generate electricity whilst producing zero carbon emissions could assist to realise Chancellor Gordon Brown's announcement in his pre-budget report last week that "within ten years, every new home will be a zero-carbon home".

The Beck Mickle 'low head' micro hydro generator was funded by the Lake District National Park sustainability fund and has been tested at St Catherine's, a National Trust site near Windermere, opening up previously untapped energy from low head sources.

Inventor Ian Gilmartin who developed the device in conjunction with Bob Cattley says: "A conventional waterwheel allows the water to escape prematurely as the wheel rotates, but the Beck Mickle Hydro generator contains the water for the full drop of the device, converting around 70% of the energy into usable electricity. "While we cannot say this provides free electricity, because of the initial cost of buying the machine, it is expected to pay for itself within two years and thereafter greatly reduce the owner's electricity bills."

Beck Mickle Hydro is now refining the device, which is built predominantly of recycled materials and is preparing it for mass production with plans to start retailing it in late 2007.

Beck Mickle Hydro has received assistance from Lancaster University and is currently supported by Life-IC Ltd, the energy technology incubator (www.life-ic.com) which specialises in the commercialisation of low carbon technologies.

CONTACT

Beck Mickle Hydro Limited, 28 Northumberland Street, Morecambe, Lancashire, LA4 4AY.

WATER TREATMENT

Low cost waste water treatment

Micromac Filtration Managing Director, Len Harris, viewing the quality of water treated by one the company's new effluent treatment systems

Devon-based industrial filtration specialist, Micromac Filtration, is targeting the small-scale industrial user market with a new low-cost Batch Dissolved Air Flotation (DAF) waste water treatment system. Addressing a broad range of industrial applications from bakeries and dairies through to breweries and fuel producers, Micromac's new batch DAF unit offers significant operational cost savings whilst adhering to the most stringent effluent discharge quality regulations.

Priced from £15,000, the Micromac Batch DAF unit provides small-scale users with market leading effluent treatment facilities at low cost levels, which have been previously unobtainable using this technology. Incorporating many of the advanced features and functions of Micromac's larger capacity continuous flow DAF system, this new model processes batches of 1 m^3 or greater whenever required.

The new batch unit works by collecting the effluent in an integral tank then running the dissolved air flotation system when a preset volume is reached. Taking around one hour to process each 1 m^3 batch, this approach combines high quality water treatment with optimal levels of operational flexibility and cost minimisation for businesses with effluent discharges from 5 m^3/day.

With a footprint of just 2.5 m^2 and a unique low-profile design, the Micromac Batch DAF unit offers outstanding integration versatility. The unit fits into confined spaces and comes skid mounted for easy positioning on site. Installation is so simple that the user can establish and commission the unit themselves.

"Increasingly stringent environment protection legislation puts onerous demands on many industries, and can present real problems to smaller scale business operations with many options being prohibitively expensive," commented Len Harris, managing director of Micromac Filtration.

"Our Batch DAF unit offers new levels of cost-effective and reliable waste water treatment for small and medium sized enterprises."

CONTACT

Richard Milton at Micromac Filtration Limited. Tel: +44 (0)7816 842781 E-mail: Richard@firefly.ltd.uk

HOUR METER

Vibration activated hour meter aids planning of machinery maintenance

Staffordshire engineering firm, Turfmech Machinery, has launched a vibration-activated hour meter that will help machinery owners, operators and managers ensure that regular servicing schedules are carried out on time and in accordance with the manufacturer's recommendations.

The instrument, known as Viba-Timer, is ideal also as a retro-fit addition to all equipment that has never previously had a regular servicing schedule, enabling such a schedule to be quickly and easily set up for the machine by its manufacturer, supplying dealer, manager or user.

Suitable for attaching to any machine with no in-built means of recording operating hours, Turfmech's Viba-Timer hour meter uses a highly-sensitive vibration detection system to capture every movement of the machine to which it is fitted. The movement is recorded and displayed in hours and tenths of an hour on a clear quartz crystal display, which has a guaranteed accuracy of + or – 0.01%.

An important feature of the Viba-Timer is that it requires no external power source and no wiring. All of the power needed is supplied by an internal battery with a working life of up to eight years.

Fitted quickly, easily and requiring no wiring or external power source, Turfmech's Viba-Timer vibration-activated digital hour meter is suitable for fitting to any machine

Turfmech's customer service manager, Leigh Bowers, explained that the Viba-Timer hour meter had been developed initially to complement Turfmech's Service Plus scheduled maintenance scheme for turf and grounds care equipment.

"Many of the machines we accept onto the Service Plus scheme have no means of recording how many hours the machine has actually worked," he pointed out. "Unless the user keeps a record, it is very difficult for an owner, manager or operator to know with any degree of accuracy when the next service is due.

"By displaying the actual working hours of the machine to which it is fitted, Viba-Timer enables regular servicing and maintenance to be carried out as recommended and on schedule, ensuring that the machine continues to perform at peak performance with optimum safety, while also fulfilling all of the servicing requirements laid down within the warranty conditions."

Typical applications for the Viba-Timer include trailed and mounted mowers, top dressers, sprayers, aerators, scarifiers, debris blowers and collectors, cultivations equipment, fertiliser spreaders and many other horticultural, agricultural and industrial machines without an hour meter.

CONTACT

Austin Jarrett, Managing Director or Leigh Bowers, Customer Service Manager, Turfmech Machinery Ltd, Hangar 5, New Road, Hixon, Staffordshire, ST18 0PJ. Tel: +44 (0)1889 271503 E-mail: sales@turfmech.co.uk Website: www.turfmech.co.uk

MERCHANDISE

Introducing the 2007-8 Valtra collection

This year sees the introduction of the complete, 2007 Valtra Collection, consisting of over 80 items it ranges from working gear and leisure clothing through to toys and gifts.

Divided into six groups, the 'Farmer' category includes practical work clothes for both summer and winter. The 'Children' category includes bright children's clothing, toys and games. The 'Freestyle' category features casual clothing with restrained colours and red highlights. Last but by no means least, 'Accessories and Gifts' includes items such as belts, umbrellas, pens, mugs and books.

A brand new category this year is 'Tractor Pulling', which features sporty clothing with big prints and strong colours. This is the first time that Valtra's tractor pulling items will be widely available; the first items were introduced this autumn and have been highly successful.

The 2007 Valtra Collection has been designed to meet customer requirements; functionality, safety, visibility and quality. Created in co-operation with students from the respected Institute of Design at Lahti, the Valtra Collection focussed on new, fresh designs through out the development stage. This unique range of clothing will be available through Valtra tractor dealers.

Valtra Inc. develops, manufactures, markets and services Valtra tractors. They are the leading tractor manufacturer in the Nordic countries and the second most popular brand in Latin America.

CONTACT

Paul Lay, Manager, Public Relations & Communications, AGCO Limited, Abbey Park, Stoneleigh, Kenilworth, Warwickshire, CV8 2TQ. Tel: +44 (0)2476 851209. Fax: +44 (0)2476 851182 Website: www.agcocorp.com

AWARDS

Second service award for Scottish dealer

John Deere's Technician of the Year for 2006 is Robert Duncan of Scottish dealer T M Simpson at Hillend, Dunfermline in Fife.

This is the second time the trophy has been won by a Simpsons service technician, with the 2001 award going to Andy Wall of the dealership's Ceres branch, also in Fife.

Senior service technician Robert, known to all as 'Rab', has worked at Simpsons in Hillend for 23 years, virtually since the branch opened, having joined about a year after he left school. In his spare time he restores vintage and classic tractors and is currently working on a 1968 1020 model.

"It really didn't cross my mind that I might have won – I was out doing a service job on a farm when I was told," he says. "At the final at Langar I just worked my way through all the tasks, and did the best I could. I don't remember feeling as if I'd done anything special, so it was a great surprise to hear I was the overall winner."

Currently one of three service staff at the branch, Rab has seen many changes in the technician's role and considers the job to be possibly harder now than ever.

"There are just far more machines to handle," he says. "When I started we sold maybe five or six tractors a year, now its more like 50 to 60, and there are far more products in the range too. The biggest change has been in the reliability of the engines – we've moved away from problems with clutches and gearboxes, and these days you need to know a lot more about electronics."

Rab was presented with his award in front of customers at John Deere's JDX2 new products show, which is welcoming over 4500 UK and Irish farmers and contractors to the company's Langar headquarters during November and early December. "The new 30 Series tractors are definitely the best we've seen so far, they've got a lot more power and the way they perform is very impressive," he adds.

T M Simpson dealer principal Joe Petrie accompanied Rab and a group of 55 dealer staff and customers to the award presentation at JDX2, where a total of 27 new John Deere machines were on display. "We were over the moon when we heard about the award, especially as it's our second in five years across the two dealerships," he says. "Ours is a small but busy branch, with a great team of people, and it's really a credit to everyone on the staff – it's given us all a great lift. If you talk to Rab's customers, they all say he's the best anyway!"

ROSE stands for Recognition Of Service Excellence, with the top award going to the best all round service technician from John Deere dealerships all over the UK and Ireland. John Deere provides upwards of 5000 training days each year to dealer personnel, on more than 40 different subjects, including around 3500 days for service technicians. Each technician undergoing training during the eight month season is automatically competing for the ROSE Awards - and those who achieve the highest standards become area finalists.

Winner of the Silver Award for 2006 as runner-up was Richard Pearce of Masons, Chudleigh in Devon. The other eight finalists who won Bronze Awards were: Craig Blakeley from E A Clayton Ltd, Stockton-on-Tees, Cleveland;

John Deere ROSE Award winner Robert Duncan with his gold framed certificate and the ROSE Bowl trophy

Mark Cann, Ben Burgess & Co, Norwich, Norfolk; Mark Christmas, Bell Agricultural Ltd, Romney Marsh, Kent; Paul Hamer, Rea Valley Tractors Ltd, Pontesbury, Shropshire; Paul Hutchinson, Louth Tractors Ltd, Louth, Lincolnshire; John Lawlor, Comerford's Garage Ltd, Kilkenny, Co Kilkenny, Ireland; Paul Lawson, The Burdens Group Ltd, Sutterton, Lincolnshire; and Gary Ryan, Lyons & Burton Ltd, Kilcock, Co Kildare, Ireland.

CONTACT

Peter Leech. Tel:+44 (0)1949 860491 Website: www.johndeere.co.uk

DATE LOGGERS

Tinytag Talk 2 – improved performance at no extra cost

Gemini Data Loggers has launched its best ever Tinytalk – the Tinytag Talk 2, an improved version of the successful Tinytalk range of temperature, humidity and voltage data loggers, in reaction to an increasingly demanding market place.

Tinytag Talk 2 increases overall accuracy by incorporating improved measurement electronics and increasing the resolution from 8 bits up to an impressive 16 bits. This gives much smoother graph readouts from the Tinytag Explorer software. Reading capacity is also increased from 2,000 to 16,000 readings, enabling longer logger deployment or faster logging intervals.

Tinytag Talk 2 is compact, lightweight and

Tinytag Talk 2: improved version of Gemini's impressive range of temperature, humidity and voltage data loggers

competitively priced. Like the original Tinytalk from the early 90s, Tinytag Talk 2 is housed in the popular 35 mm film canister, providing dust and spray water protection (IP54). A new 0 – 20 mA logger is also added to the range.

In addition, more robust firmware monitors battery condition and provides improved data integrity.

All these benefits are now available at no additional cost, so why not take advantage of the new and improved benefits of the Tinytag Talk 2 from Gemini Data Loggers.

CONTACT

Gemini Data Loggers. E-mail: marketing@tinytag.info Website: www.tinytag.info and www.geminidataloggers.com

GENERATORS

Froment reveal Magnate updates

Froment has re-designed the three-point linkage chassis for Portable Power Pack models within its Magnate range of pto generators and introduced additional product features.

Finished in hot dipped galvanizing the chassis combines strength and rigidity at the forefront of its design with new, sleek lines that give an aesthetically pleasing appearance. Constructed from 3 mm mild steel, strengthened channels give optimum resistance to torque-based twisting whilst the generator is under full load.

The chassis has been designed for use with both category 1 and 2 tractors, whilst still adhering to the stringent guidelines of ISO2332.

The optional low power panel box for the generator has now been incorporated into the standard Portable Power Pack specification giving the user the benefit of two additional 16 A single-phase sockets at no extra cost.

Re-design and additional features: three-point linkage chassis for Magnate's Portable Power Pack generators

All Froment Magnate units feature brushless alternators and are continuously rated at maximum output with a powerful surge for motor starting and precise voltage regulation over a wide range of powers and speeds. Capacities range from 20 kVA to 80 kVA to meet various individual needs.

The renowned Froment gearbox, standard across the Magnate range, features premium quality hardened and ground helical gears to ensure quiet running, high reliability and extra long life.

All Froment Magnate generators feature a market-leading three year warranty.

CONTACT

N J Froment & Company Limited, Easton-on-the-Hill, Stamford, PE9 3NP. Tel: +44 (0)1780 480033. Fax: +44 (0)1780 480044. E-mail: knf@froment.co.uk
Website: www.froment.co.uk
Contact: Keith Fowler

WATER TREATMENT SYSTEMS

Contaminant removal from food processing waste water

A new technology which removes 100% of contaminants from food processing waste water could soon be accepted best practice in the food and drinks industry. The technology has many industrial applications and also has the potential to treat and recycle process-water enabling major cost savings to be made. Amongst its other applications is that of water-source treatment in developing countries or remote locations where access to fresh water supplies is scarce.

UVPS Environmental Solutions Ltd, a spin out of The Robert Gordon University (RGU) in Aberdeen, has developed the new 'Sapphire' ™ range of water treatment systems which is the culmination of extensive research carried out by Professor Peter Robertson at RGU's Centre for Research in Energy and the Environment (CREE). This research was supported by Scottish Enterprise through the Proof of Concept Fund.

The proven, patented technology can provide solutions for the destruction of contaminants such as herbicides, pesticides, dissolved oils, dyes, micro-organisms and bacterial tainting. Kourosh Bassiti, Chairman and CEO of UVPS said "The technology has already been used on waste water from oil rigs. Existing technologies remove approximately 92% of contaminants from waste water. The UVPS system is 100% effective and has applications in many industries, including the oil and gas, food and drinks, water treatment as well as healthcare. As a result we harbour high expectations that the technology will become accepted best practice for contaminant removal throughout the industrial fields."

The technology uses an activated catalyst in the presence of ultraviolet light to remove and destroy a wide range of dissolved chemicals, pesticides, micro-organisms and other toxins, which have so far been difficult or prohibitively expensive to treat.

Changes in EC legislation will eventually result in some purification treatments being phased out (e.g. chlorination) and other commonly used technologies unable to meet new legislation for specific contaminant discharge consents. The technology developed by UVPS offers an extremely cost-effective solution to many issues faced by companies in the oil, chemical, food and drink, health and water sectors. The 'Sapphire' ™ modules can also be fitted with a range of sensor packages to ensure the purity of the treated water.

MORE INFORMATION

Neil Foster. Tel: +44 (0)1224 262693.
Web: www.uvps.co.uk

BALERS

New Holland's US production line rolls off 200,000th round baler

Customers, dealers and staff were among those joining the special celebrations at New Holland's Pennsylvania plant as its 200,000th round baler rolled off the production line in November 2006.
Abram Zimmerman started the New Holland Machine Works at this plant in October 1895, repairing agricultural equipment and developing his own portable corn mill. After 79 years, in 1974 New Holland's first round baler was launched in Europe: the Model 850 produced bales 1.7 m wide and up to 1.7 m in diameter, making a hay bale weighing 700 kg. To form the bale, the 850 had a heavy steel apron chain with lugged floor chains and twine tying that was applied by manually turning a handle from the operator's seat.

Since the model 850, New Holland has led baler design, utilising the latest technology to meet modern production requirements. 1977 saw the first commercially endorsed, round-bale silage baler. The ability to produce silage without large investment in clamps has seen round balers grow rapidly in popularity with more than 13,000 units currently sold each year in Europe. Now European round baler production is moving to Plock, Poland. New Holland will develop these models close to its customer base.

The continuous development of innovative features, such as endless belts, unique duckbill net application and electronic control, is designed to make farmers more productive and more profitable. Today, New Holland's industry-leading machines, including the BR750A, are in widespread use around the world. In 2005, the brand's global market share for round balers was almost 20%.

'Since the model 850, New Holland has led baler design, utilising the latest technology to meet modern production requirements'

Their facility in Pennsylvania is the world's largest single-plant producer of round balers, square balers and pull-type forage harvesters and the brand is also a global leader in hay and forage equipment, with a tradition of innovation dating back to the introduction of the first commercially successful automatic pick-up square baler in 1940.

Commenting on the milestone of the 200,000th round baler, Product Marketing Manager Derek Gardner from New Holland said "With over 1.2 million balers of different types and pull-type forage harvesters manufactured since we first began production back in the 1940s and the widest baler offering in the industry, New Holland's pedigree and track record speak for themselves.

"On this important milestone, we'd like to register our deep thanks both to our staff and to our dealers and customers around the world. Their continued commitment and support has inspired us so far and we look forward to continuing to work in partnership with them to develop our product range still further in the years ahead."

CONTACT

John Hewett, New Holland.
Tel: +44 (0)1268 292183.
E-mail:
john.hewett@cnh.com

Powermix Pro Series diet feeders

Shelbourne Reynolds has announced the introduction of the new Powermix Pro Series diet feeders. The result of 12 years intensive testing throughout the UK, these new machines have been developed specifically for operation in UK conditions.

Notable features of the Pro Series include:

- all new gearbox drive system using high quality Comer gearboxes;
- lower power, faster mixing and chopping auger design;
- webbing style conveyor belt system.

In addition, twin auger Powermixers are now available with high speed sprung, steering axles.

Heralding a new breed of Powermix Pro Series diet feeders incorporating new: drive system; auger; and webbing conveyor

New drive system

The chassis of the machines have now been significantly simplified using Comer gearboxes. This more compact drive system provides space to fit sprung steering axles.

New auger

In the mixing compartment the auger flighting has been modified from a 270° wrap to a 720° wrap which decreases the angle of the flighting and, as a result, reduces power requirement.

A reduced flight angle also allows the auger to run faster and produce a livelier mix. Independent tests have revealed that higher operating speeds and shorter mix times produce a looser fluffier mix and lessen the risk of over processing. The Pro series auger speed runs at 25 rpm – 25% faster than previous models.

The auger flight has also been slightly tapered towards the top of the auger to allow extra space for bales to drop further down into the mixing chamber when they first enter the tub. This coupled with the faster auger speed reduces chopping time significantly.

New webbing conveyor

Shelbourne Reynolds has developed a totally new webbing conveyor system for its Powermix range of vertical diet feeders. This unique system, which can be described as a cross between a rubber belt and a chain and slat system, enables the machine to elevate feed up-to 1.5 m to the left and right of the feeder.

The conveyor mounting module can be hydraulically shuttled to both sides as well as aligning it centrally within the overall width of the machine for transport.

In developing the new conveyor webbing, Shelbourne Reynolds recognised that conventional rubber belts have high maintenance requirements and that traditional chain and slat systems, while being more positive, are noisy and have a tendency to carry feed round rather than deliver it. The new system offers the benefits of extreme durability, smooth quiet operation and the ability to cleanly throw the feed in an even arc off the end of the conveyor.

The new Powermix Pro Series is available in six sizes: 9, 11 and 13 m^3 with single auger and 16, 19 and 22 m^3 with twin augers.

CONTACT

Neil Smith, Shelbourne Reynolds Engineering. Tel: +44 (0)1359 250415 Mobile: +44 (0)7739 332196

LANDWARDS 2007

Traceability across the food chain

LANDWARDS 2007 Conference — May 3rd

Venue: East of England Showground - Peterborough

The Conference provides a unique forum involving senior representatives from each of the key sectors in the food chain. The aim is to uncover some of the issues arising from the implementation of traceability systems and to identify where technology can make a contribution with particular emphasis on agricultural inputs.

The morning session, to be chaired by IAgrE President - Professor Paul Miller – will feature prominent speakers including:

- **Christine Tacon, who will set the scene from her position as General Manager of Farmcare, the UK's largest farmer with strong retail connections.**
- **Peter Kendall, President of the NFU, presenting the benefits (and pitfalls) to the producer.**
- **Teresa Wickham, independent retail consultant, who will relate traceability to the 'changing consumer'.**
- **David Heather, consultant to the Agricultural Industries confederation, will identify the issues surrounding the traceability of agricultural inputs.**
- **Jane James, Agricultural Policy Manager of the Environment Agency, who will set out how traceability can contribute to environmental compliance.**
- **Brigitta Wolf, International Relations Manager, QS Qualität und Sicherheit GmbH, summarising experiences with traceability in Germany**

The afternoon session – chaired by Professor Dick Godwin - will take the form of brief presentations leading to a discussion on developments in technology for acquiring and handling information to support traceability and assurance down the chain.
Speakers will include:

- **Sven Peets and Carla Gasparin, Cranfield University, PhD studies.**
- **Nyle Wollenhaupt, Manager, Agronomy & Software Support, AGCO Global Technologies**
- **Peter Henley, Managing Director, Farmade Management Systems.**
- **Peter Nelson, Engineering Director, RDS Technology Ltd.**
- **Stephen Leese, John Deere & Co**

Conference organised by

IAgrE In association with TAG

and sponsored by

AGCO and JOHN DEERE

For further information, please contact:
IAgrE Secretariat:
conferences@iagre.org

IAgrE
Barton Road
Silsoe
Bedford
MK45 4FH
t: 01525 861096
f: 01525 861660

The professional body for engineers, scientists, technologists and managers in agricultural and allied industries including food, forestry and biological systems

IAgrE is a licensed body of the Engineering Council[UK] and a founding constituent body of the Society for the Environment

Innovation, science and technology in **Ag**riculture and the **R**ural **E**nvironment

AGRICULTURE **FORESTRY** **ENVIRONMENT** **AMENITY** **HORTICULTURE**

www.iagre.org