Student project catalog

Biosystem Engineering

Fall 2008

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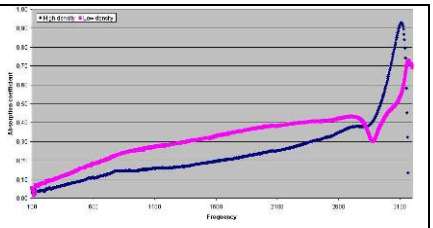
Ventilation, air motion in and emission from livestock buildings

Description	**Topics** Ventilation Air motion Emission **Background** The student will be involved in an ongoing research project at University of Aarhus, which focuses on the issues of reducing gas and odour emission in and from ventilated livestock buildings. **Resources** Possibility for tryouts in the ventilation laboratory at Research Center Bygholm.	 **Objective** • Modeling and control of indoor climate and environment. • Research on air motion and air quality in ventilated room spaces – scale model and full scale investigation. • Gas and odour diffusion and transport from floor and slurry surfaces in livestock buildings and in room – emission & boundary layers.
Further information:	Guoqiang Zhang, Guoqiang.Zhang@agrsci.dk	

Using building acoustic for biomass characterization

Description	**Topics** Data analysis and modeling **Background** Building acoustical measurements can be used for characterization biomasses used as sound insulation. **Resources** Possibility for tryouts using building acoustic measurements system.	 **Objective** • Measure sound absorption and reflectance different of biomasses.
Further information:	Ole Green, Ole.Green@agrsci.dk	

Design and Development of a multi-channel air velocity sensors

Description	**Topics** Design an air velocity sensor system with small and robust sensor head / probe that suitable for measurements in both small and large model/room air space. **Background** Airflow characteristics in a ventilated airspace are important for design and control of ventilation systems for the optimal indoor thermal environments and air quality. A proper air velocity measurement system is, therefore, crucial to achieve the necessary information on air velocity and velocity variations in different locations of the ventilated airspace. However, most commercial velocity anemometry instruments are either for single point measurement or with a sensor probes that are not suitable for small airspace such as in a scale model of a room.	**Resources** possible for tryout with a prototype system including calibration and test **Objective** • Design an air velocity sensor system with small and robust sensor probe. The system development includes two parts: • 1: sensor design and computer interfacing • 2: software design for sensing algorithm and data acquisition
Further information:	Guoqiang Zhang, Guoqiang.Zhang@agrsci.dk	

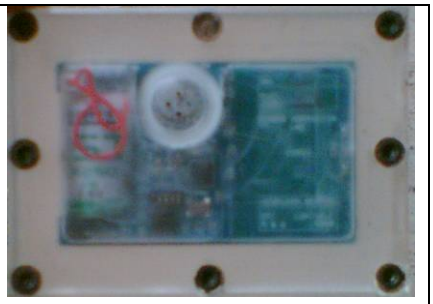
Algae biomass for biogas

Description	**Topics** Biogas Algae **Background** The student will be involved in an ongoing project at University of Aarhus, which focuses on using algae for biogas production **Resources** Possibility for pilot digestion of algae biomass at the biogas plant at Research Center Foulum.	 **Objective** • Assessment of the energy potential of using algae biomass for biogas. • Identification of inhibitors and ways to avoid inhibition
Further information:	Henrik B. Møller, henrikb.moller@agrsci.dk	

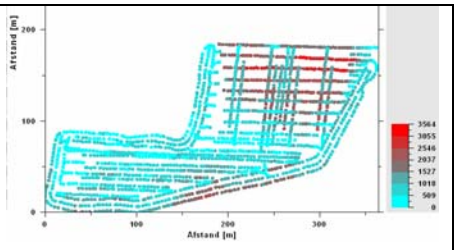
Development of a thermal manikin (T-Manikin)

Description	**Background** A large number of infectious diseases are believed to be airborne transmitted between people by large droplets. A ventilation system that can remove exhaled large droplets before they reach receivers is, therefore, considered to be an effective way to reduce airborne infection risks. Design and development of such ventilation systems requires detailed and precise knowledge and proper understanding about the movements of air and droplets, which are influenced by ventilation methods, thermal conditions, structural environment of the room and the persons in the room. Movements of the air and particles (droplets) around a human body are influenced by the thermal convection caused by the body heat and the obstructions due to the body. Studies on the effects of these parameters on airborne droplets transportations from a source to receivers are therefore desired. As the first step toward this, we need to develop T-Manikin that creates thermal convections and air flows around it that are similar to what occur around a human body.	**Objective** • The present project is aimed at developing a thermal manikin (T-Manikin) that creates thermal convections and air flows around it similar to what occur around a human body. The T-Manikin will be used for experimental studies to explore the movements of air and airborne particles around a human body. The studies will provide valuable information to understand the transport mechanism of infectious disease between people and to develop a ventilation system that can reduce airborne infection risks. Project plan 1: Visualisation and measurements of air movement around a human body in stagnant air and in the wind tunnel. 2: Measurements of heat distribution of a human body surface by using a thermo vision. 3: Development of T-Manikin and documentation of its similarity to a real human body concerning thermal convections and air flows.
Further information:	Hisamitsu Takai	

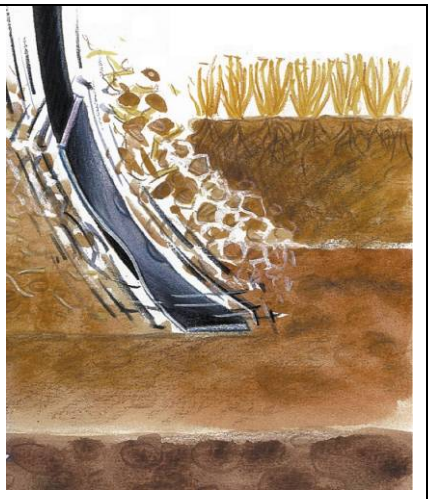
Cabinet design for Wireless Sensor

Description	**Topics** Mechanical design **Background** Wireless Sensors are being introduced into agriculture, but the extreme environment in agriculture set a lot of demands for the cabinet's protection the electronic. Often low pH and high moisture contents can kill the electronic while physical affects can break the sensor. This sets a lot of demands on the material selection and the design and dimensioning of the cabinet. **Challenges** Understanding the rough environment that different biomass surveys are, and combine this with the use and usability of the sensor. **Resources** Possibility for tryouts using rapid prototyping	 **Objective** • Designing a cabinet for wireless sensors used for biomass survey • Designing the tools for producing the cabinets For Global Business Engineer • Creating a business plan (relevant commercialization in US/Canada and Australia/New Zeeland)
Further information:	Ole Green, Ole.Green@agrsci.dk	

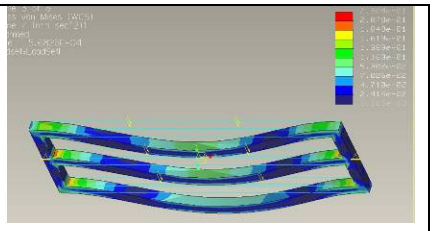
Precision fertilization with organic manure

Description:	**Topic** GIS **Background** GPS and yield monitoring can be used to verify the importance of site specific distribution of animal manure and straw. These materials are believed to increases the yield potential in cereal production. Data from 3 years are available, where manure has been applied site specific after the 2 years and the third year verifies the effect.	 **Objective** • Using yield maps to determine the effect of site specific distribution of animal manure.
Further information:	Ole Green, Ole.Green@agrsci.dk	

Design of energy low cost slurry injector tine

Description	**Topics** Mechanical design **Background** An increasing amount of slurry is being distributed by injection into the soil. The present designs of injector tines is not optimal in relation to crop damages and power consumption. **Challenges** The project allows the students the possibility to follow the product from initiate drawings, through the design face to the construction of a prototype slurry injector. **Resources** Possibility for tryouts of the developed tine using a test rig for field tryouts	 **Objective** • Develop energy low cost slurry injector tine
Further information:	Tavs Nyord, Tavs.Nyord@agrsci.dk	

FEM analysis of agricultural implements

Description	**Topics** Mechanical engineering **Background** As most of today's farming equipment is built by companies with a non-engineering background. This results in designs with a lot of optimizations potentials.	 **Objective** • Choose a specific agricultural implement and optimize the construction using FEM
Further information:	Ole Green, Ole.Green@agrsci.dk	

Method for evaluate slurry infiltration into soil

Description	**Topics** Bioprocess in soil Soil mechanics **Challenges** The project will give the student a possibility to combine the technical and biological knowledge **Resources** The student will be involved in an ongoing research project at University at Aarhus, which evaluating the biological processes in soil around slurry injection slit	 **Objective** • Develop a method for measuring slurry distribution in soil to evaluate different slurry injection techniques • Measuring nutrient transformation in soil with Bio-chemical online sensors and gas emissions from soil in static chambers.
Further information:	Tavs Nyord, Tavs.Nyord@agrsci.dk	

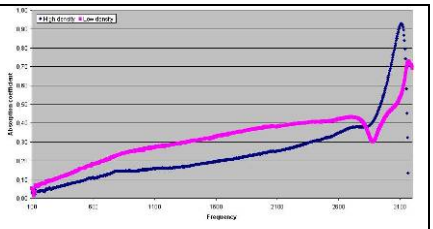
Organic weeding in cereal production

Description:	**Topic** Mechanical engineering **Background** Weeds in organic cereal production can have a negative effect on the yield but no known methods can be used to reduce the number effect of weeds, when the crop is at a certain development stage. When the crop is to big it is not possible to use a harrow to kill the weeds, but at this stage a new system to cut the top of the weeds, to reduce their germination for next season can be introduced.	 **Objective** • Developing a method and a system to cut of and collect the weeds growing in cereal production.
Further information:	Ole Green, Ole.Green@agrsci.dk	

Development of a mechanical cough-sneeze imitator

Description	**Topics** Mechanical design **Background** A large number of infectious diseases are believed to be airborne transmitted by large droplets. A ventilation system that can remove exhaled large droplets before they reach receivers is, therefore, considered to be an effective way to reduce airborne infection risks. Design and development of such ventilation systems requires detailed and precise knowledge and proper understanding about the movements of air and droplets, which are influenced by ventilation methods, thermal conditions, structural environment of the room and the persons in the room. As the first step toward this, the behaviour of airborne solid particles blown out by a MCSI in a ventilated room desired to be explored.	**Objective** • Developing a mechanical cough-sneeze imitator (MCSI) that blows particles and CO2 gas out in such ways that are similar to animal and human expirations regarding to velocity, volume and direction. • Used for experimental studies to explore the underlying mechanism behind airborne transmission of infectious disease and to develop a ventilation system that can reduce airborne infection risks.
Further information:	Hisamitsu Takai	

Frequency analysis and model development

Description	**Topics** Data analysis and modeling **Background** A new measurement system is being developed based on acoustic frequency spectra. To increase the information value these data needs to be analyzed using different methods. Frequency analysis can be used to analyze the data and used to generate a model for this prototype measurement system.	 **Objective** • Developing a model based on acoustic frequency spectra
Further information:	Ole Green, Ole.Green@agrsci.dk	

Pre-treatment of biomass for enhanced biogas production

Description	**Topics** Biogas Biomass Pre-treatment **Background** The student will be involved in an ongoing project at University of Aarhus, which focuses on finding ways to improve biogas production from biomass by using pre-treatment. Only 50-60% of the energy potential of manure can be exploited to day, thus offering huge potentials for better degradation. The pre-treatment might differ from simple maceration to advanced thermo-chemical treatments and enzymes. **Resources** Possibility for pilot digestion of algae biomass at the biogas plant at Research Center Foulum.	 **Objective** • Assessment of the effect of different pre-treatments. • Optimization of pre-treatment methods • Economical evaluation of the methods
Further information:	Henrik B. Møller, henrikb.moller@agrsci.dk	

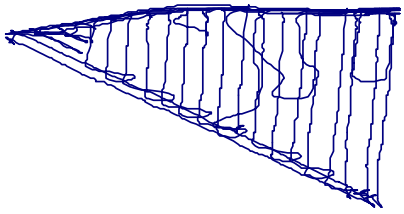
Auto steering tractors with pre-programmed route planes

Description	**Topics:** Software **Background** AutoFarm AutoSteering is a commercial autosteering system for tractors based on RTK-GPS positioning system. It allows the tractor to steer around on the field after pre-set lines or after a recorded route plan. The route plan is normally created by driving a specific path and then the autosteering computer the routeplan a multiple of times thereby covering an entire field.	 **Objective** • Create software that allows the user to pre-program the autosteering computer with the route-plans for a field.
Further information:	Ole Green, Ole.Green@agrsci.dk	

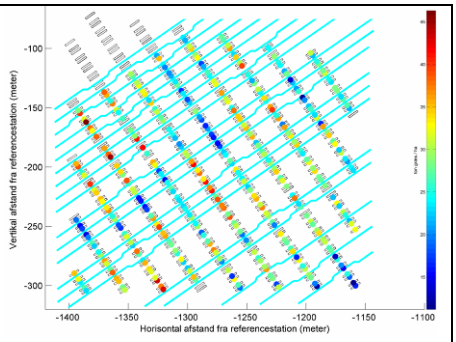
Control algorithm for optimizing of light/contrast for in-field digital camera

Description	**Topics** Control Engineering Vision **Background** Vision technology is being introduced in agriculture and it is use in-field operations for, as an example, estimation of clover/grass ration or to classify weeds. But a lot of these algorithms are sensitive to the light and contrast in the picture. Therefore this would optimize the procedure if this also could be improved.	 **Objective** • Development of control algorithm for adjustment and optimizing a digital camera, to make the light and contrast in the picture more suitable for further analysis.
Further information:	Hans Jørgen Olsen, HansJoergen.Olsen@agrsci.dk	

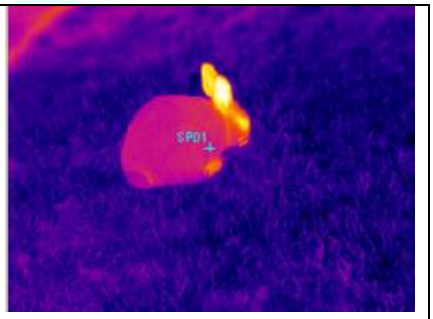
Creating algorithms for optimal route planning for field operations

Description	**Topics** Software **Background** The introduction of auto steering systems for tractors allows the farm manager to decide where to drive and with which precision, as an example using controlled traffic farming, where the tractor only drives in pre-set tramlines.	 **Objective** • Developing algorithm's that optimizes the placing of the tramlines in relation to field efficiency and minimization of traffic affected area.
Further information:	Ole Green, Ole.Green@agrsci.dk	

GIS-analysis of different GPS-mapping and controlling systems

Description:	**Topic** GIS GPS **Background** Auto steering for tractors are more and more used in practical agriculture. To determine the usages of these systems, methods for testing these commercial systems have to be developed. In a research project at Research Center Bygholm several different commercial GPS product are used, and during the use of these product, errors has occurred which was not explainable by the producers. Data is available from tests of sprayers on an ISO-certified track done to determine the movement of the sprayer boom. Under these tests data was recorded on the behavior of the tractor when it was using the auto steering system.	 **Objective** • Determine the reason and the error in a commercial GPS-based autosteering when comparing different mapping systems. • Analyze how accurate auto steering is able to steer a tractor on an ISO-certified track.
Further information:	Ole Green, Ole.Green@agrsci.dk	

Infrared alarm for animals in harms way

Description	**Topics** Software Electronic **Background** When high speed agricultural machinery runs over the field while doing different tasks, animals often comes in harms way. This often kills or injures the animal, which is unethical and can give illness at the farm, if an dead animals enters the fodder for the animals at the farm. **Resources** Possibility for tryouts using IR camera	 **Objective** • Development of a low-cost IR-system able to give an alarm if an animal is in harms way.
Further information:	Ole Green, Ole.Green@agrsci.dk	

ISO-BUS reader

Description	**Topics** Software Electronic **Background** The amount of data collected on-board a tractor or an agricultural machine are dramatically increasing and are available through a can-bus plug in the cabin. The data can be used and are very relevant in advisory systems and in research projects. **Resources** Possibility for tryouts using the mobile research platform on Research Center Bygholm	 **Objective** • Development of a reader system for plug and play mode able to sent the relevant data via the GSM net to a central server.
Further information:	Ole Green, Ole.Green@agrsci.dk	

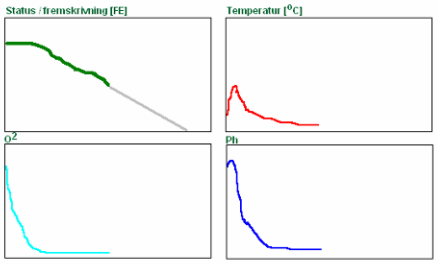
Uniform distributed liquid spray with automation of sprayer boom and nozzles

Description	**Topics** Control engineering Automation **Background** Investigations of large field sprayers have shown large variations in the liquid distribution due to lateral and vertical sprayer boom movement which reduces the accuracy of the spraying liquid application, resulting in lower efficiency or even environmental problems. The movement of the boom is mainly due to the motion of the transport vehicle moving over uneven, rough terrain or vehicle yaw motion and turns. **Challenges** The challenge in this project is the establishment of a control strategy (perception, processing and control) for a liquid spraying device capable of delivering a uniform spray without being affected by the changes in the lateral and vertical displacement of a sprayer boom. The strategy could e.g. include information on the pitch, roll and yaw collected by co-located sensors, filtered using a model based filtering technique, and motion compensation using the hydraulics (lateral motion) and a nozzle dose regulation (vertical motion), taking into account the delay in the control mechanisms. boom motion.	 **Objective** • The objective is a control strategy, i.e. hydraulic control and nozzle dose control, for a liquid spraying device capable of delivering a uniform spray without being affected by the changes in the lateral or vertical displacement of the sprayer boom. **Resources** To support the development, experiments should be carried out and data collected with RTK-GPS and attitude a GPS that may serve as a starting point for investigations of the
Further information:	Michael Nørremark, Michael.Norremark@agrsci.dk	

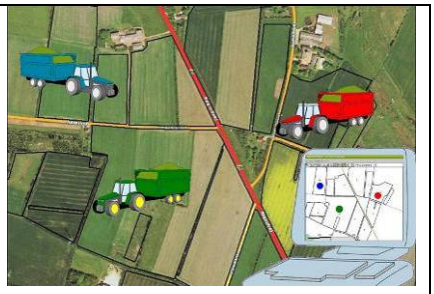
Vision analysis of leafs, clover-grass-ratio

Description	**Topics** Vision **Background** Vision technology is being introduced in agriculture and it can be use in-field for estimation of clover/grass ration. The problem is that the algorithm needs to be working on simple basic while the process time for the computer is an important issue in the data processing.	 **Objective** • Development of algorithm for clover-grass-ratio.
Further information:	Hans Jørgen Olsen, HansJoergen.Olsen@agrsci.dk	

Web-interface for biomass storage survey

Description	**Topics** Software HTML **Background** Wireless sensors for biomass storage have been developed to increase quality of the products. To optimize the use of these sensors a web-interface needs to be developed, that can distribute relevant information automatically, so it is possible for a farmer or the advisor to gain access to the data. **Resources** Possibility for tryouts using access to online sensors placed in biomass storage	 **Objective** • Creating a web-interface that can distribute relevant date based on relative simple algorithms in an easy und understandable way to farmers and advisors.
Further information:	Ole Green, Ole.Green@agrsci.dk	

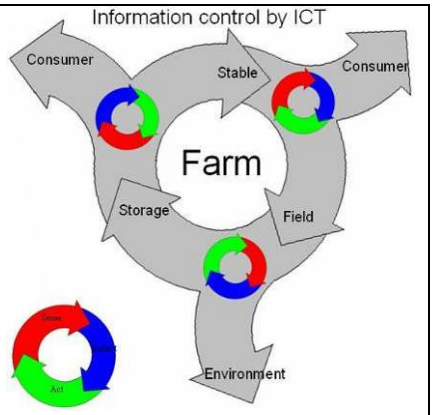
Supply chain management for biomass feedstock

Description	**Background** The objectives of the project are to optimize the harvest and logistics for the transport of oilseed crops and suitable agricultural residues to production facilities and return the process residues for agricultural use as a part of the overall biomass feedstock infrastructure. The approach employed for the logistics of the harvesting, collecting and storing of the biomass feedstock will include process innovation in terms of properly addressing the dynamics of the supply chain. The approach will ensure considerations of the dispersed fields of production, low-density material (high costs per ton-km), difficulty in handling the material, seasonal availability, environmental impact, etc.	
Further information:	Claus Grøn Sørensen, Claus.Soerensen@agrsci.dk	

Measuring grazing time using 2 or 3D accelerometers

Description	**Background** Modern dairy farming is highly sophisticated in calculating diets that fit the high production levels and optimizing fat, protein, energy, starch and digestion rate. This is one of the reasons why many modern dairy farms abandon grazing strategies. By registering grazing time, preliminary research has indicated the grass dry matter uptake can be estimated, giving the manager a perfect tool to optimize the diet indoor. Possible online Near Infra Red (NIR) analysis of the grass could progressing feed the management feeding optimization.	
Further information:	Frank Oudshoorn FrankW.Oudshoorn@agrsci.dk	

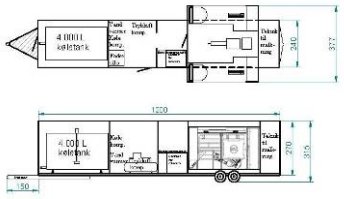
Information feasibility and rational agency as the basis for ICT design in agriculture

Description	**Topics** Value Chain Management **Background** ICT systems have the potential of providing significant amount of useful data and information for process management and process documentation along the food chain. The historical development of ICT systems in agriculture has involved a "bottom up" approach, where technical innovations, like GPS, various sensors, etc., have primarily been the drivers, whereas the application of acquired data and information have received less attention. Future ICT systems will have to be specified and designed by adhering to new results from empirical decision research, allowing for an adoption of the implemented	 **Objective** • To develop and enhance the quality of contextual design processes for ICT systems and demonstrate their feasibility
Further information:	Claus Grøn Sørensen, Claus.Soerensen@agrsci.dk	

Optimizing animal infrastructure around in field robotic milking

Description	**Background** Robotic milking is developing rapidly. It offers the farmer many new possibilities for flexible working times and specific data analysis on cows, milk and animal behavior. However the grazing is difficult, as cows prefer being out on the grass, instead of coming to the robot and being milked. Fetching cows is not an option, as the main reason for the farmer investing in robotic milking was labor savings. The objective of this project is to design and try-out an guided automatic infrastructure for continuous flow of milking and grazing of dairy cows in the field	
Further information:	Frank Oudshoorn FrankW.Oudshoorn@agrsci.dk	

Energy optimization of stand-alone automatic milking robot using generator for power supply

Description	**Background** Robotic milking is developing rapidly. It offers the farmer many new possibilities for flexible working times and specific data analysis on cows, milk and animal behavior. Robotic milking in remote areas demands stand-alone power supply. Until now this has been supplied by diesel driven generators, continuously active. The challenge of this project is to design a steering system for the generator to shut down when the robot is not in use, using buffered energy for the constant demand of cooling the milk storage tank.	
Further information:	Frank Oudshoorn FrankW.Oudshoorn@agrsci.dk	

Optimization of ozone treatment of liquid waste systems

Description	**Topics** Ozonation Proces control Emission reduction **Background** Ozonation can be used to reduce emissions of environmentally important contaminants from liquid waste materials **Resources** Experimental lab-scale studies on ozone treatment of liquid waste and model systems, including analytical facilities and sensors. Activities will be associated with ongoing projects on ozone treatment.	 **Objective** • Optimization of ozone treatment of liquid waste systems • Improved process control of ozonation • Mechanistic and kinetic investigations of ozonation in relevant water-based model systems
Further information:	Anders Feilberg, anders.feilberg@djf.au.dk	