Farming by Satellite is an EU initiative by the European GNSS Agency

European
Global Navigation
Satellite Systems
Agency

Official partners

CLAAS

Bayer CropScience

Project managed by

HELIOS

FARMING BY SATELLITE

Rewarding Success and Innovation

Press Information

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About the prize – www.farmingbysatellite.eu

The prize is an initiative of the European GNSS Agency (GSA), the EU agency responsible for European satellite navigation activities, and is sponsored by CLAAS, a leading manufacturer of agricultural engineering equipment, and crop protection experts Bayer CropScience. It ran for the first time in 2012. This is the second issue of the prize.

The aim of the competition is to promote the use of satellite navigation in agriculture and its benefits to end users.

Entrants must be under the age of 32 and can take part as individuals or as a team. They can submit case studies of trials, or new ideas and innovations, particularly those relying upon European Geostationary Navigation Overlay Service (EGNOS), the forthcoming GALILEO system and COPERNICUS (the European Earth Observation Programme).

The winning team/individual receives a cheque for €5,000 and a day's business mentoring to develop their idea further. Second and third placed teams/individuals will receive cheques for €3,000 and €1,000 respectively.

There is a Special Africa prize of €4,000 for the best submission to the judges relating to Farming by Satellite in or for Africa.

Statistics

This year the prize generated **96 registrations** and **43 eligible submissions** from **11 European and 8 African countries**.

From those 43 submissions five independent judges invited **a shortlist** of 6 European teams and 3 African teams to make their final presentations to them on Wednesday 11th June. The European teams are from Czech Republic, Germany, Portugal, Romania and the United Kingdom. The African candidates are from Kenya, Rwanda and South Africa.

During the time the competition has been open (October 2013 to June 2014) the website has received 8,500 hits from 5,300 users generating 32,000 page views from 84 different countries around the world.

Czech Republic

Movement optimization of forage harvester and conveyances

Ing. Jan Chyba, Ph.D., Ing. Lukáš Beneš, Ing. Petr Novák, Ing. Jakub Lev, Ph.D.

Graduates of the Department of Agricultural Machines, Faculty of Eng., Czech University of Life Sciences

All team members are graduates of the Department of Agricultural Machines, Faculty of Engineering, Czech University of Life Sciences Prague. Team members are currently in positions of Ph.D. students or postdocs. Each member is engaged in other sectors of agricultural machinery. Ing. Petr Novák deals with problems of soil erosion and his hypotheses are oftentested on his own farm. Ing. Jakub Lev, Ph.D. also owns a farm and he is an expert in material throughput capacity sensors and mathematical models. Ing. Lukáš Beneš deals with hydraulic systems of traversing mechanisms of self-propelled harvesting machines. Ing. Jan Chyba, Ph.D. deals with crop yields, physical and infiltration properties of the soil in the controlled traffic farming technology. The varied focus of each team member contributes to solving a range of issues, such as their contribution to the Farming by Satellite competition.

The current design of maize harvesting is difficult logistically to manage. In practice forage harvester downtime is a common occurrence due to poor organization of vehicles. Although the power of forage harvesters constantly grows, the logistics of transport and storage of chopped straw very often remain at the same level. For optimum utilization of the forage harvester it would help if the navigation of the forage harvester might predict the movement and position of vehicles on the field. This would be done on the basis of the signal obtained not only from the navigation, but also from the sensor of current crop yield, as well a laser scan head which scans the procedure of filling the vehicles. This information is then passed to the navigation of vehicles and used for movement through the field to the next location. This system would greatly speed up the interchange of vehicles, minimize crossings on the land and reduce fuel consumption and technogenic soil compaction. In this system the vehicles are equipped with navigation that during actual filling optimizes their position relative to the forage harvester. The laser head would only regulate the flight envelope of chopped straw for optimal filling of the vehicles.

Germany

Savings through RTK based guidance in field vegetable growing

Daniel Hege

Student of Geisenheim University

Daniel Hege from Germany graduated from his Master degree in Horticultural Sciences at Geisenheim University. The topic of the thesis was "Opportunities for efficiencies in mechanical weed control in onions and spinach, through the use of GPS." He laid the basis for this in his bachelor thesis with the topic "Savings in field vegetable growing through the use of a GPS automatic steering system (RTK) taking into account the minimum cost combination." He takes his research ideas from the daily work on the vegetable operation of his parents in Rhineland Palatinate (Germany), which he leads together with them, since the completion of his studies. Because, there were still some questions from his previous research, he is undertaking time trials as an external PhD student at the Geisenheim University. The aim of his doctoral thesis is an improved handling, as well as an extended range of applications of GPS guided systems.

In a first field trial in 2008 it was shown that, unlike the experiences with arable crop farming, in vegetable production there are gaps. On average 1.6% of the planting area will not be processed during manual driving, which means that for a cultivated area of 63 ha, 1 ha will be unprocessed. Subsequent calculations showed that the savings in lettuce amount 118 €/ha, in spinach 35 €/ha and in washing carrots 161 €/ha. The necessary growing area is in the best case is 34 ha. Thus, it could be shown that the GNSS technology is economically viable for small and medium sized growers. In a progressive field trial in 2013, the potential savings in the mechanical weed control in field vegetable production were studied. Here, an active implement steering system was used. Thus, it was possible to increase the driving speed while hoeing from the usual practice at 3km/h up to 9 km/h. By increasing the driving speed, the work time requirement can be reduced by more than 40%. At the same time, it is possible to process multiple beds simultaneously; thereby a reduction in processing costs of up to 60% is possible.

Portugal

ISAM - Intelligent System for Animal Monitoring

Nuno Pinto

Student of Instituto Politécnico da Guarda

Nuno Pinto graduated in computer engineering from the Polytechinc Institut of Guarda in 2011.Currently he is a second year Masters student in Mobile Computing at the same institution. He works as an analyst / programmer in the Magickey company. The company specializes in developing solutions for people with disabilities.

ISAM aims to track each animal using GPS, it measures biological signals, using a low cost communication system, powered by solar energy, which improves the continuous operation over time without human maintenance.

For each animal the system periodically collects data showing its spatial position on the farm, as well its temperature.

The ambient temperature and the battery status of the animal module will also be collected.

The automatic analysis of collected data, made by a computer application, will detect deviations from standards of each animal that will enhance the alerts generation in real time to the farm leaders.

These alerts are an important asset for the integrated management of the farm since it will allow better monitoring in real time of the health status of each animal.

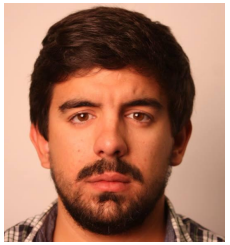
To implement this communications system, fully powered by solar energy, will not involve any increased operating costs, but only the installation of the infrastructure. This infrastructure, based on the modular ZigBee systems communication also has a low cost.

Portugal

Selective Harvesting - efficient routes based on remote sensing management for traditional tree agricultural systems

Manuel Penteado

Student of Instituto Superior de Agronomia, UL



Manuel is 24 years old. He was born in Lisbon, where he still lives and studies. He studies Agronomic Engineering at Intituto Superior de Agronomia, and he is currently finishing his Master's degree. While he was working on his Master's dissertation about remote sensing for cork oak forest management, his interest in remote sensing and precision agriculture started to grow, so he applied for an internship at RapidEye Ag (BlackBridge) where he learned a lot about satellite imagery. After finishing his Master's degree he hopes to have the opportunity to continue learning more about precision agriculture which he believes to be the future for a sustainable agriculture.

Nowadays one of the important things in agriculture is to improve the efficiency of its processes and so, the idea is to draw a harvest route that can be used by the harvesters through a GPS receptor, for selective harvest in traditional arboreal (agriculture or forest) systems.

Using high resolution satellite images, we can calculate vegetation indices able to describe the spatial variation of the production. This way we can generate maps that represent different production plots within the same land (with selective production), and afterwards the farmer is able to define the most efficient route that the harvesters can use on the field being guided with a GPS receptor to harvest one specific quality product plot.

With this idea farmers can take a lot of advantages such as improve the efficiency of the processes, reduce carbon emissions to the atmosphere and even reduce soil compaction, without forgetting the advantages generated with the segmented harvest, like the creation of homogeneous and higher value plots.

Romania

Agricultural decision support system for Romania

Marius-Florin Paslaru, Teodora-Arina Tanasie

Master students of West University of Timisoara

Marius-Florin's major research expertise focuses on spatial planning using Geographical Information Systems and Remote Sensing. He presented his research results to a series of student conferences in Romania and got invited by Esri Romania to a series of training events due to the use of GIS in his research. He currently works as a GIS specialist for Fauna & Flora International on the project Life Connect Carpathians. His major research expertise focuses on GIS applied on spatial planning, especially on problems regarding forests and agricultural land.

Teodora-Arina's field of research is Geography with a special emphasis on spatial planning with Geographical Information Systems and Remote Sensing. She presented her studies in a series of student conferences in Romania, were she got invited to a series of training events at ESRI Romania. She currently works at SC Gauss SRL Romania as GIS Technician on projects regarding GIS Databases for the oil company OMV Petrom.

We present a Geoportal as a Decision Support System (DSS) for farmers from Romania, that will contain parcel based information about drought risk, plant health and the risk of insect infestation.

The information will be updated once every 2 weeks based on the remote sensed data obtained from very high resolution satellite images. Also a drought prediction will be made using artificial neural networks for the next crop season, and based on previous research the farmers will get parcel-based advices concerning what is most suitable for seeding next season.

All the information will be available to farmers only based on their farmer code received from the Romanian Investments and Payments for Agriculture Agency (APIA). The geodatabase containing agricultural parcels of all the farmers will be obtained from APIA. Based on these facts once a farmer will log on he will be able to see all his agricultural parcels and also to download information for precision agriculture equipment. The DSS can be applied to other countries across Europe if certain modifications are made.

United Kingdom

Demeter – Autonomous Precision Seed Planting Robot

2nd

James Meadows, James Chapman, Miles Metcalfe, Glen Ebsary

Students of Harper Adams University

The team consists of four final year MEng Engineering students at Harper Adams University based in Shropshire, UK. Harper Adams is the UK centre for precision farming and specialises in agriculture and land based studies. Their degrees specialise in Agricultural Engineering and Off Road Vehicle Design. As part of their degree course they have all completed a year in industry at companies such as JCB and CLAAS. During their final year, along with their Masters Thesis, they have completed modules such as strategic business management and evolving engineering topics. They are all from farming backgrounds and have a strong passion for emerging technologies with a particular interest in the use of GNSS for precision agriculture. In the future they hope to pursue careers within the test and development industry both in the UK and abroad.

Over recent years the weather has played havoc with agricultural field operations, resulting in production decreases of around 30% in certain areas of the UK. With the current trend of agricultural machines increasing in size the working window for field operations is getting smaller.

Our solution to this problem is Demeter, a small lightweight autonomous precision seed planter capable of planting a variety of seeds without human supervision. Weighing less than 350kg it has an extremely low ground pressure giving it the ability to operate in a much wider working window than traditional machines.

The vehicle uses laser scanning technology for obstacle avoidance and route planning working alongside the GNSS input for accurate and safe navigation. Safety is an important part of this concept and as a result the vehicle has several levels of safety in place to significantly reduce the likelihood of accidents from occurring. As the vehicle is much smaller than traditional seed planting equipment it may be necessary to have a swarm of robots operating alongside one another to increase the work rate. With the use of a mobile fuelling station and seed hopper the vehicle could operate 24/7 providing conditions are suitable.

Special Africa Prize

South Africa

"BeeFriendly": Harnessing Satellite Information to Establish an Effective Yearly Migration Route for Beehives While Assessing the Bee Pastures' Carrying Capacity

Yaara Harel

Student of The Hebrew University, Jerusalem, Israel

Yaara Harel was born in Peru 29 years ago to a South African mother and a Syrian father who was the military attaché for Israel in South America.
At the age of three she moved to Israel with her family and grew up in a small agricultural community. After an intensive career as a skipper on cruising yachts she decided to go back to her routes and study agronomy in the Hebrew University's Agriculture Faculty specializing in water and soil sciences. During her first year in university she took on a niche specialization in Geo-Information, in the hope to lead the precision agriculture revolution in the Mediterranean region.
Yaara is an accomplished competitive sailor, racing internationally year round. She plays the Baglama in the Jaffa Greek Orchestra. Yaara spends a lot of her time maintaining her Hebrew, English, Spanish, French, German and Arabic since she aspires to head international agriculture-environmental related projects.

The worldwide decrease in bee numbers has brought to the public's attention the immense importance of bees on our environment, nutrition and health.

Bee Farming is estimated at billions of dollars every year, but there is more than honey involved… Flora is vastly dependent on bees as pollinators, and so are many commercial crops.

The most recent trend in apiculture is, not unlike in humans, to put an emphasis on nutrition as a key element in the hives' strength. The idea behind it is as simple as this - well-nourished bees will be less susceptible to bacteria, fungi and other possible hazards.

"BeeFriendly" aims to use information derived from satellites, namely, combining remote imagery detection of wildflower beds, GIS software for mapping of crops and land use ,and GPS data of hive locations in order to demonstrate that when combined, they could eventually be a strong in and ex situ decision making tool for bee farmers worldwide, allowing the realization of the hives' full potential by improving the conditions provided and optimizing the beekeepers' yearly migrating routes so that they will bear the best production and therefore higher revenues while increasing crop yields and benefiting the environment.

Rwanda

Drones for Agricultural Development - Revolutionizing Agricultural Practices in Rwanda Using Modern Technology

Winner

Faith Mwiza

Student

Faith Daniella Mwiza was born in Lusaka, Zambia and moved back to Rwanda after the 1994 genocide. She comes from a family of seven, with three brothers and one sister. Upon completing her high school education, she received the Rwanda Presidential Scholarship to further her education in the United States.
She obtained her undergraduate degree in Electrical and Computer Engineering from California Baptist University. Currently, she works as a research consultant with NASA DEVELOP National Program where she creates models using remote sensing to improve agriculture monitoring in Rwanda. She is also pursuing a certificate in Geographic Information Systems.
Her dream is to be able to go back home and make a difference by introducing new technologies and creating opportunities. Presently, she is working on obtaining a license to export drones from the United States with the aim of revolutionizing the way agriculture is practiced.

Information is wealth. Lack of sufficient data introduces a disability in the constant monitoring of agricultural practices. Situated in the heart of Africa is the small but aspiring country of Rwanda, where over 90% of the population is engaged in subsistence farming. With a population of 11 million projected to grow to 16 million by 2020, there is an increasing necessity to introduce modern techniques to improve food production.

The Government of Rwanda is introducing new practices to change from subsistence to commercial farming. One of the obstacles lies in the continuous monitoring of implemented practices. This project aims to incorporate high and medium resolution satellite data with in-situ information, collected by drones, to monitor cultivated lands.

Futuristically, drones or Unmanned Aerial Vehicles (UAVs) fitted with an aerial camera, thermal imager and Global Navigation Satellite Systems (GNSS), can be introduced to collect data from the ground at regular intervals. They can also be used in crop health monitoring and for precision farming at commercial levels, to reduce cost in spraying fertilizer and seeds. Data from the drones combined with satellite imagery could be used to model future yield.

Kenya

Optimization of forest rehabilitation planning using GIS remote sensing and GPS

Paul Ouma

Student of Jomo Kenyatta university

Paul is from Siaya County in western Kenya. He holds a bachelor's degree in Geomatic engineering and Geospatial Information Systems from the Jomo Kenyatta university (JKUAT). He is also pursuing his Master degree in GIS and remote sensing (JKUAT) and is in the process of setting up a GIS and Remote Sensing consultancy that will in future provide earth observation, GNSS, GIS and Geodetic services to a variety of institutions including local, regional and international organization. He has a lot of interest in environmental information studies and agricultural systems believing that there is still a lot that satellite based systems can offer to such fields more so in developing countries. He hopes that this competition will serve as a stepping stone; to have the idea go through further research and see it being adopted as it covers crucial areas of environmental sustainability.

Forest rehabilitation requires sound planning to ensure that the forest ecosystem is completely restored. Those rehabilitation projects that have not succeeded identified that poor planning with regard to spatial information, evaluation and monitoring of projects were the causes. The issues that are normally not considered include the total area that requires rehabilitation, the best method for reforestation, and most appropriate species to use when planting physically. The study involved generation of the land covers so as to estimate the total area to be rehabilitated. The best method for reforestation to be used for specific areas was also determined and species site matching performed by use of a program that compares the tree species catalogue to ecological conditions chosen. Results obtained were approximate areas available for rehabilitation which was about 15000 Ha with those that could be protected for natural regeneration approximately 96 Ha. With regards to species site matching, it was found that about 44% were able to survive well in different patches of the study area. A handheld GPS was then used to locate the correct locations for planting the different tree species.A portable windows program that can be used in other rehabilitation sites was also produced.

Farming by Satellite Prize goes to Germany

The promise of an all-expenses paid trip to Prague, a first prize of €5,000 with a day's business mentoring, second and third prizes of €3,000 and €1,000 respectively for European teams, plus a €4,000 special Africa prize proved especially attractive to young people involved in agriculture and life sciences this year.

The winners of the Farming by Satellite Prize were announced on Thursday 12 June at the European Space Solutions conference taking place in Prague, Czech Republic.

First prize went to **Daniel Hege, of Geisenheim University in Germany** for his submission: "Savings through RTK based guidance in field vegetable growing".

Second and third prizes were awarded to the UK and Portugal respectively. The UK team from **Harper Adams University** developed an autonomous precision seed planting robot called Demeter. The Portuguese entrant from **Instituto Superior de Agronomia** proposed selective harvesting using remote sensing management for olive groves and cork oak plantations that could also be applied to other forestry and crop groups.

The special Africa prize was given to **Faith Mwiza of Rwanda** for her proposal for using drones for agricultural development, early famine warning systems and decision support systems for farmers in Africa.

The 2014 prize generated 96 registrations and 43 eligible submissions from 11 European and 8 African countries. From those 43 submissions an independent judging panel chose a shortlist of 6 European teams and 3 African teams.

Chair of judges, Dr Andrew Speedy comments: "The standard of entries was even better than last year. Contestants showed good knowledge of the technologies and possibilities of satellite applications in agriculture. Several students described projects at their universities where they had built and tested prototype machines and measured real data in

fields and orchards. The application to improving efficiency in field operations for forage harvesting was further developed by the shortlisted Czech team, who narrowly missed out on a prize.

Others reviewed the technologies in relation to practical application in their countries, including adapting to use on small farms. This was a factor in the prize winning entry from Daniel Hege, which proved how precision agriculture benefits small vegetable growers with upwards of 34 hectares, with processing savings of up to 60% on offer.

There was much interest this year in the use of drones (UAVs) in measuring crop data through imaging and reflectometry. These data would be able to tell farmers how healthy their plants were, whether there were diseases or bugs, whether there was enough fertilizer, and enough water. This was the topic of Faith Mwiza's winning African entry. Others suggested ultra-low ground pressure vehicles and even airships as ways of gathering georeferenced data from above.

Water was also a recurring theme this year, recognising that water availability and drought stress are major factors in agricultural productivity and food security.

Contestants covered a wide variety of applications including crops, vegetables, fruit, forestry and livestock. The last of these was also the theme for several entries where GNSS can provide ways to monitor the location and even the health of animals (fitted with chips) on the farm.

The new category of African entries provided another dimension of satellite applications in farming for improved incomes and food security. Contestants covered precision agriculture, product traceability and project monitoring. There was even an entry on bee farming (apiculture) that much appealed to the judges for its innovation.

The judges looked for relevance, feasibility, innovation and potential market when judging the diverse ideas put forward. The five judges marked the entries and then discussed the scores, taking account of different perspectives from the different countries as well as the age and experience of the contestants.

All the entrants are to be congratulated on their varied imagination and innovation as well as the quality of their writing and presentation."

Further information on the winning entries will be posted on www.farmingbysatellite.eu in the coming days. For specific queries, please contact the competition organisers.

Ends.

12 June 2014

Additional information

The GSA has contracted UK consultancy Helios to manage the Farming by Satellite prize. For further information about the prize please contact Andrea King or Laurette Royer from Helios on +44 1252 451 651 or email: info@farmingbysatellite.eu.

About EGNOS and precision farming:

EGNOS is essentially Europe's 'pre-Galileo' system, its first concrete venture into satellite navigation. EGNOS delivers services based on GPS and GLONASS signals, providing augmentation signals re-transmitted by geostationary satellites and a network of ground stations.

EGNOS represents a European solution for the Satellite-Based Augmentation System (SBAS). There are also other SBAS systems in the world, e.g. Wide Area Augmentation System (WAAS) in the USA. EGNOS augments the two satellite navigation systems now operating, the US GPS and Russian GLONASS systems. Crucially for agriculture, EGNOS also increases the accuracy of existing satellite positioning services to about one metre or better.

Precision agriculture refers to the use of satellite navigation sensors, aerial images, and other tools to determine optimum sowing density, fertiliser cover and other inputs. It also refers to the use of GNSS for supporting machine guidance, virtual fencing, and land

parcel identification. These techniques allow farmers to save money, reduce their impact on the environment and increase their productivity. EGNOS can offer an affordable precision solution.

EGNOS can support:

- Variable ploughing, seeding and spraying – Variable Rate Technology (VRT)
- Tractor guidance
- Individual livestock positioning
- Virtual fencing
- Land parcel identification and geo-traceability
- Post-harvest pick-up
- Supervised livestock tracking
- Field measurement
- Field boundary mapping and updating

EGNOS will help to:

- Enhance precision
- Eliminate waste and over-application of fertilisers and herbicides
- Save time
- Reduce fatigue
- Extend equipment lifetime by optimising its use
- Provide geo-traceability

- Optimise crop yields
- Increase profit margins

About Galileo

Galileo is a satellite system currently being built by the EU aiming to be the single European GNSS. Up to now, GNSS users in Europe have had no alternative other than to use American GPS or Russian GLONASS satellite signals. Yet the military operators of these systems can give no guarantee to maintain uninterrupted service.

Meanwhile, satellite positioning has already become the standard and essential tool for navigating and related applications. As the use of satellite navigation spreads, the implications of signal failure increase, jeopardising not only the efficient running of transport systems, but also human safety.

By being interoperable with GPS, Galileo aspires to be a new cornerstone of GNSS. This worldwide system will henceforth be under civilian control. And with its full complement of satellites, more than the current GNSS systems, Galileo will allow positions to be determined accurately even in high-rise cities, where buildings obscure signals from today's satellites.

Galileo will also offer several signal enhancements making the signal more easy to track and acquire and more resistant against interference and reflections.

By placing satellites in orbits at a greater inclination to the equatorial plane, Galileo will also achieve better coverage at high latitudes, making it particularly suitable for operation over northern Europe, an area not well covered by current GPS signals.

About Copernicus (formerly known as GMES)

The European Earth Observation programme (formerly known as Global Monitoring for Environment and Security or GMES) is an initiative led by the EU. The coordination and management of the Copernicus programme is ensured by the European Commission. The setting up of initial versions of the Copernicus services have been assigned to several projects partly financed through the 7th Research & Development Framework Programme of the EU, while the developments related to the observation infrastructure are performed under the aegis of the European Space Agency for the space component (i.e. Sentinel missions) and of the European Environment Agency and the Member States for the in situ component. The sustainability of Copernicus operational services will be ensured through public funding from the EU, intergovernmental agencies, and Member States. These services should be accessible to any organisation or citizen.

Copernicus consists of a complex set of systems which collects data from multiple sources (Earth observation satellites and in situ sensors such as ground stations, airborne and sea-borne sensors), processes these data and provides users with reliable and up-to-date information. Some of these systems and data sources already exist today, as well as prototype services, but many developments are still required in all domains.

Policymakers and public authorities - the major future users of Copernicus - will use the information to prepare environmental legislation and policies with a particular focus on climate change, monitor their implementation and assess their effects. Copernicus also supports the critical decisions that need to be made quickly during emergencies, such as when natural or man-made catastrophes and humanitarian crises occur.

Users will be (and to a certain extent are already) provided with information through services dedicated to a systematic monitoring and forecasting of the state of the Earth's subsystems.

The following six thematic areas are developed:

- Land monitoring
- Marine monitoring
- Atmosphere monitoring
- Emergency management
- Security
- Climate change

Based on Copernicus services, many value-added services tailored to more specific public or commercial needs (i.e. forecasting services with a local scope, services including socio-economic data, etc.) will certainly be developed.