European Network GPS and future directions

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INTRODUCTION

Farmers are now a significant user group for the GPS (Global Positioning Systems) industry in Australia, Europe and in other parts of the world. The agricultural GPS market is separated from surveying based GPS markets, such as mining, construction and local government. The companies working in the agricultural area have chosen to cut the price on GPS receivers to farmers to encourage uptake. Farmers may think the systems are expensive but GPS receivers and base stations sold to the surveying industries cost 50 – 100 % more for technically similar equipment. This has caused a much bigger uptake by farmers using intelligent farming practices like CTF.

Supplying GPS to farmer at a lower price has also some drawbacks. If the receivers and base stations where completely identical, surveyors would spoil their market by buying the agricultural GPS receivers. The technical difference between the two markets is mainly lack of communication standards in agriculture. Most agricultural suppliers have implemented their own communication protocol. For example, Trimble in agriculture use the CMR-w protocol which is a variant of the open and published CMR+ protocol used in the surveying industry. For Trimble this ensures that surveyors cannot buy the agricultural base stations. The more expensive but technically identical base stations using CMR+ can be used by agriculture so to share across agriculture and surveying, the surveying base stations have to be used. Some agricultural suppliers also protect their systems by use of different radio types.

Major investments have been made by some companies in setting up base stations across agricultural areas. The company then has a competitive position, for supplying corrections to new users in the area.

For ease of reading, we have used the term GPS to describe all GNSS (Global Navigation Satellite Systems). GPS is the tradename of a GNSS run by the American army.

DIFFICULTIES FOR THE FARMING INDUSTRY

A farmer investing in his first auto steering system wants a reliable system where high accuracy can be achieved on his entire property. The most inexpensive solution is usually to set up an agricultural base station with approximately 10 km range at a high point. Most farms can be covered by a single base.

Difficulties most often arise when farmers wish to work together. Contractors, e.g. harvest teams, have major difficulties as their steering system may not be compatible with the local base stations. If they use the same brand as the customer there is a good chance but no guarantee, as the radios may be of different types.

No absolute accuracy

Most users believe they have an accurate positioning system where they can document with cm accuracy the work done on their farm. This is not the case for most agricultural users because most agricultural base stations are not surveyed in to the true position. The position is most often created by the base station itself by averaging the positions gathered over some hours. This can cause deviations of several meters compared to true cadastral positions. It also means that all recorded positions are linked to the specific base station. If a position is typed into a steering system, that uses another base station, e.g. at a neighbour's farm, the tractor may end up several meters from the tracks laid out. A minor deviation in heading may occur as well. This problem can be solved if base stations are

surveyed in to their true position. To keep the cost down this is seldom done, and the farmer is not informed about difficulties that may occur in the long term.

An intermediate solution when setting up more base stations is to use corrections from the first base station to position the other stations. This means that a user can shift between these base stations and still stay on track. But the positions recorded are not true cadastral positions. So at least the first base station should be surveyed in. If more base stations are set up individually and already in operation, they can not easily be converted into a local network. Preferably all base stations should be corrected to their true positions and all track records re-calculated or recorded again. Otherwise machines will not run precisely in the tracks in future.

10 cm systems do not guarantee 10 cm accuracy

In Australia most new users buy RTK systems with a claimed accuracy of 2 cm. Several users upgrade from the lower accuracy 10 cm systems that use satellite corrections from either the John Deere SF 2 service or HP and XP signals from Omnistar.

For many CTF farmers 10 cm accuracy may be adequate. The problem is that these satellite services do not offer absolute precision. The 10 cm measure is defined by John Deere as the accuracy that can be achieved within a 15 minute period – also named "track to track accuracy". Nothing is guaranteed about the absolute accuracy. From operation to operation the positions can shift more than 1 meter. This is a serious problem for CTF users. If tracks are visible, as they will often be in NoTill cropping systems, errors can be corrected by the shift track function that moves the tracks recorded in the steering computer. This is a messy solution.

Another difficulty is an initialisation time of up to 45 minutes before maximal accuracy is reached. Short term loss of satellite signal can cause loss of accuracy as well. Shading from trees can cause sudden shifts in track positions in the order of 30 cm or more.

RTK - NETWORKS IN EUROPE AND AUSTRALIA

High precision RTK positioning is adopted by agriculture independent of other surveying users. In most European countries, it has been cheaper to set up agricultural base stations instead of paying fees for RTK services that are already in operation. But, the increasing numbers of agricultural users should encourage network owners to get their share of this new market.

Suppliers of auto steering systems compete on setting up base stations. Once base stations are established in an area, it is easier to sell more steering systems. Typically, these local networks use non-standardised correction signals to avoid competitors using the networks. The biggest agricultural networks in Australia are established with AutoFarm or Trimble base stations. Local networks are run by farmer groups, and sugar mills own some networks on the east coast. Often networks are set up and run by the importer e.g. GPS-Ag or by local distributors who may be machinery dealers or dealers of electronic equipment. Machinery dealers typically offer RTK service for free the first year followed by a modest yearly fee.

The competitive rush to set up base stations is starting now in Europe. The highest proportion of farmers adopting auto steering is in the Netherlands and in Denmark. The RTK situation for agriculture in those two countries is however very different. In Holland, base stations have been supported financially by both the Dutch farmer organisation and the government, who see high precision steering and CTF as significant value to the important horticultural industry. It was a requirement that the networks established use open standard for communication, to enable all suppliers to benefit. Opposed to this, the Danish government has chosen to support a few farmers, who demonstrate new precision technologies, but setting up base stations has been left to commercial competitions. Case IH has just announced a plan to establish coverage of all significant agricultural areas in Denmark within the next few years. This will be done by Case to gain market share. Other Trimble based systems are expected to gain from the network as well. The competitors will probably

not just wait to loose market shares. They may join their forces and establish an alternative, perhaps a network that uses open standards for communication.

CORS networks. Ten years ago surveyors used mobile base stations when they made RTK measurements. The base station was placed on a known position to achieve absolute true positions. Now, in most European countries CORS (Continuously Operating Reference Stations) networks are established. Surveyors and other RTK users can subscribe for correction signals from these networks. CORS Networks combine correction information from several base stations and extend the distance between stations, up to 50-75 km. There is no longer need for a base station every 10 km. Corrections to users are sent from a computer server that combines information from several base stations. Fewer base stations are required but continuous data communication is required both from the base stations to the central computer and from the computer to the rover GPS receiver e.g. on a tractor. Trimble, Leica and Topcon have developed software for CORS networks. These systems use open communication standards.

Many countries in Europe are covered by two competing networks, supplied with server software from Trimble and from Leica. Setting up CORS networks in Europe is easy compared to Australia as areas are smaller and broad-band internet is accessible in most areas. The Danish GPS-net network covers Denmark well with 25 base stations. Australia is 180 times bigger than Denmark, but the population is only four times bigger. To cover Victoria alone, a CORS network will require close to 100 base stations. More State agencies are working to establish CORS networks. VicPOS in Victoria is the most progressed and RTK accuracy can be achieved in the Melbourne and nearby areas. A program to extend RTK across the State has just been announced.

Tractors with Trimble auto steering have been linked to CORS networks in Denmark, the Netherlands and Switzerland. Corrections are received through the internet (GPRS) by use of mobile phone technology. Data volume using the compressed CMR+ standard is around 0.5 mB/hour. Operating cost depends on the price set by the network owner. The first experiences shows accuracy similar to use of local base stations. No accuracy tests have been made yet. In the Netherlands the fee is set to 1,000 Euro/yr which is equivalent to the cost of StarFire 2 from John Deere. Several other auto steering suppliers are testing use of CORS network signals for their systems.

RECOMMODATIONS

CORS Networks

For European conditions use of CORS networks can become a good alternative as CORS networks are in operation already. With CORS networks, farmers are not restricted to the range of single base stations. The fee to use the signals needs to be negotiated with the national network owners. Use of mobile phones (GPRS or 3G) is generally cheap in Europe.

In Australia only minor rural areas are covered by CORS networks. There is State Government interest in extending CORS networks to cover cropping areas. Next-G technology may be a good way to transmit corrections, if data transmission is reliable and cheap. Clearly, a mobile phone connection on the rover is required. The recently released Leica rover has a mobile phone built in. CORS network corrections could be sent over the internet to a farm computer and re-broadcast over the farm by radio link. This would have to compete in price with a farm base station.

Use open communication standards and true positions and CORS Networks

Open communication standards and protocols are recommended for all RTK applications in cropping areas. These should also be surveyed for true position. This will allow access by all agricultural users as well as other industries such as surveying, construction and mining. Regional CORS networks have major advantages.

Farmer groups or others involved in setting up networks of base stations should use open data protocols and standardised radio communication. The investment may be higher but the opportunities with the network are a lot bigger as well. Competition will force down the price on these systems as well. A major problem can be that dealers of the auto steering may not be aware of the open and standardised option, as they have been trained to sell the company solutions only. Most auto steering systems can use standardised correction signals. If the auto steering dealer will not supply a standardised network, other suppliers will.

The official public standard for RTK corrections is called RTCM. It exists in several different versions. As an alternative Trimble has published the CMR standard that is also free for everybody to use. CMR+ is the recommended version for agricultural applications.

Back up GPS data

Computers do break. Most often they do not, but when they do it causes a lot of hazards. This is true for auto steering systems as well. With no back up of your A-B lines it is impossible to go back exactly in the tracks. The A-B lines and curved tracks can in most steering systems be exported. Do it - and keep it as backup.

If your base station is hit by lightning or for some other reason needs replacement, then a new base station can easily be installed, if you have recorded the position of your present base station. Keep this information in a safe place.

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