

Summary

- Positioning systems for tractors generally allow to save time and increase comfort and accuracy.
- Correction signals and automatic steering systems are expensive.
- For dairy farmers growing mainly maize and grass certainly the more advanced systems are currently not cost efficient.
- More research is required to test the efficiency of advanced field operation techniques such as controlled traffic farming, row operations, etc.



Principles

Positioning systems depend on signals send by satellites. At least 4 satellite signals are required to determine the location of the receiver device. At this moment USA and Russia have their own positioning system. The satellite system from the USA is often referred to as GPS system but its official name is NAVSTAR. The Russian system is called GLONASS. The European system GALILEO is currently under construction, it is expected to be completed in 2014. The name GNSS refers to all these positioning systems.

A system based on only these satellites (e.g. car navigation) has an accuracy of about 10 meters. However, a 10 meter accuracy is not enough for agricultural applications. Luckily correction signals exist that can improve the accuracy of positioning. Table 1 gives an overview of the most used corrections signals in Europe. In short, free correction signals have an accuracy of about 30cm. Licenced signals can improve the accuracy to about 10cm. The most accurate way to determine your position is by RTK signal correction. With the RTK accuracies of 2.5cm, even year to year become possible.

Table 1: Overview correction signals. Prices present a rough indication. In the RTK price automatic steering is included.

Price licence signal	Price equipment	Correction signal	Available for	Accuracy	
				Pass to pass	Year to year
Free	1000-2500€	EGNOS	All	±40cm	±100cm
		SF1	John Deere	±30cm	±75cm
600 - 1500€/y	±7000€	XP Omnistar	Trimble and others	±5-10cm	±10cm
		HP Omnistar	Trimble and others	±12cm	±15cm
		SF2	John Deere	±10cm	±25cm
-	20-30.000€*	RTK	Most	±2.5cm	±2.5cm

For the RTK system two options exist. Generally a local base station in the neighbourhood of the field is required for RTK. This fixed base station sends corrections to the positioning system on the tractor. However, in Flanders the local government offers a RTK-network called FLEPOS for free through mobile internet. When such a RTK-network is available no local base station is required.

Applying the position information

Knowing your exact location is one thing but using this information for facilitating or improving your field operations is another. Currently, position information can be relatively easily applied for steering guidance or even automatic steering. Precision agriculture takes the use of position information one (or even several) steps further.



Figure 1: Greenstar light bar (John Deere)

Table 2: Optimal correction signal for different soil cultivation

Correction signal	EGNOS SF1	Omnistar SF2	RTK
Chemical fertilizer and weed control	*		
Manure application, field preparation, tillage, etc.		*	
Row weeding, striptill, row fertilizing, controlled tracks, etc.			*

Steering guidance can be given by a simple LED light bar as shown in Figure 1 or on a display. The driver still does the steering, therefore signals with an accuracy below 10cm are useless. The simplest systems can be purchased from around 1000€. Steering guidance can be used for field operations with a wide working width such as applying chemical fertilizer, chemical crop protection, etc.

Automatic steering implies that the steering is done by the positioning system using an electric steering wheel or a hydraulic block and sensor. First the driver makes a tour around the contours of the field. After entering the working width of the machine and the preferred row direction, the automate takes care of the steering except for the turning to a new pass. Accuracies around 10cm allow accurate sowing and planting while the RTK accuracy of 2.5cm is required for inter-row weeding, row fertilizing or controlled traffic farming.

Precision agriculture accounts for spatial differences in the field by adapting field operations to the local needs. Currently this technology is still in an early stage.

Available systems

Suppliers of steering guidance and automatic driving systems in Flanders are: Agrometius (Trimble), John Deere (John Deere), Compufarm (Autofarm), Beyne (Müller Elektronik), Hilaire Vander Haeghe (Claas Agrosystems, SBGuidance), Laser Control (Leica Geosystems) and others.

Difficulties

During testing our GPS systems (John Deere, StarFire iTC receiver with automatic steering and SF2 signal) we encountered some difficulties. Many of our fields are surrounded by large trees which caused the SF2 signal to be interrupted regularly. Field operations performed by machinery attached before or after the tractor require a second GPS system on the machine which has to communicate with the GPS system on the tractor. Although the John Deere system is designed to work with other systems if ISOBUS compatible, getting two different systems communicating properly is not straightforward.

Profitability for dairy farmers

The most important advantages of the GPS systems for dairy farmers at this moment is the reduction of overlap, increased comfort for the driver and the possibility to work in the dark. The reduced overlap allows to save time, fuel and cost of fertilizer, herbicides, etc. However, due to the high equipment and correction signal cost GPS systems are generally not cost efficient at this moment for standard field operations done by dairy farmers in Flanders. Further research is required to measure the benefits of controlled traffic farming, specific tillage (e.g. striptill) and row operations.