AGROCOM VISION

Company profile

Local Positioning System

AGROCOM VISION

AGROCOM VISION is a branch of the German based AGROCOM Verwaltungs GmbH, a company of the CLAAS Group. AGROCOM VISION's business is development of guidance and auto-steering solutions based on computer vision technology. The company is focused on supplying to the Agricultural sector and the products are sold to both OEM customers and via the distribution market, under the name Local Positioning System (LPS).

The LPS is used for automatic precision guidance of e.g. tractors and implements in order for the farmers to obtain improved efficiency of various field operations. The guidance systems can within agriculture and vegetable farming improve the field work, by increasing travel speed and at the same time reducing the stress put on the operator.

The backbone in AGROCOM VISION´s guidance system is computer vision technology. Digital cameras capture 2D color information from the field scenes. The Data are analysed in a vision computer and the output information from the scenery, via intelligent adaptive software, creates updated steering information used to correct the steering command to e.g. an implement or a vehicle.

In 2006 AGROCOM VISION launched its second generation vision technology based on 3D camera technology. The 3D technology will, in addition to the features of the above 2D technology, be able to capture field scenes where depth/height information can be used.

Based in Denmark, the company is located in Kvistgaard 30 km north of the Danish capital, Copenhagen.

2D Plant Camera

Since 2001 AGROCOM VISION has marketed and sold their 2D plant camera. The product is today operating in fields across Europe, Japan and North America. The plant camera system has been sold to both existing implements via local distributions channel and to new implements via OEM manufactures.

The mechanical movement of the implement, guided by a signal from the camera, is done by either a three-point hitch solution or a steerable coulter/wheels. Most mechanical solutions are available today. For the after market AGROCOM VISION offers various local manufactured hitch solutions. On new implements the mechanical movement is solved by the implement manufacture via built in parallelograms or steering assisting by discs/wheels.

Customer benefits

The customer benefits of AGROCOM VISION's guidance system are the following:

- Higher travel speed due to the camera technology that keeps the implement exactly in line at all times. The operator just needs to drive the tractor within the rows, which results in increased forward speed.
- Increased working capacity due to the higher speed and by working closer to the rows.
- The system operates without any physical contact with plants or soil. This gives a smooth operation without any breakdowns caused by, for example, mechanical feelers plugging up.
- Ability to use less skilled drivers. The system takes care of the positioning of the implement and experienced operators are no longer necessary.
- Very user-friendly operation. The system is operated via a monitor panel available in different languages. Menu structure is very simple and no computer skills are necessary to operate the system.

Customers / References

The following are brief portraits of OEM customers using the current plant camera product:

Yanmar Agricultural Machinery Manufacturing is a division of the Yanmar Group. Yanmar has since 2001 co-operated with AGROCOM VISION regarding implementation of computer vision into Japanese agriculture.
www.yanmar.co.jp

In 2000 Tim-Thyregod A/S decided to manufacture a row crop cultivator based on AGROCOM VISION´s guidance system. The cultivator is guided by a smooth parallelogram built in the toolbar. Tim-Thyregod also offers band spraying equipment to the cultivator. Today the cultivator is one of Tim-Thyregods established products among beet harvesters and forage trailers.
www.thyregod.com

The Dutch machine manufacture Steketee incorporated in 2001 AGROCOM VISION´s guidance system into their row crop cultivator with a design that allows the camera system to be used also on narrow cultivators. This is very beneficial for smaller growers. A year later Steketee developed the first 3-sectional row crop cultivator, which hoes 3 beds in one tractor pass. This development has generated a great interest among vegetables growers, who have tripled their working capacity using this innovation.
www.steketee.com

Schmotzer´s optitronic camera-guided hoeing system is based on AGROCOM VISION´s computer vision technology. Co-operation between Schmotzer and AGROCOM VISION has existed since 2003. Schmotzer´s cultivator is guided by a pair of steering wheels that together with the camera signal generate a perfect guidance of the cultivator.
www.schmotzer.de

Since 2004 has the French cultivator Agronomic been using AGROCOM VISION´s vision system on their row crop cultivator. The cultivator system is manufactured for corn and sugar beet, which are both very common crops grown in France.
www.agronomic.fr

Camera Applications

The plant camera (2D) will track any green plant row, independent of the crop, e.g. corn, sugar beet, lettuce, broccoli, spinach, etc.

Selected Field Operations Using the Current Plant Camera

Below illustrates and describes some of the field operations where the Local Positioning System is being used today:

Mechanical Weed Control

Benefits:

- More effective weed control by cleaning closer to the rows.
- Reduction of working hours spent on manual hoeing in organic farming. Substantial cost reductions for organic products.
- Eliminate cultivator blight.

Comments:

Pull-type cultivation is guided by a signal from the camera that moves a three-point mounted hitch attached to a drawbar.

Sectional Mechanical Weed Control

Benefits:

- 3 beds or planting modules treated in one single pass – working width and capacity tripled.
- More effective weed control by cleaning closer to the rows.
- Eliminate cultivator blight.

Comments:

The 3 sectional guided implement is working with 3 independent cameras that each guide a section.

Chemical Weed Control

Benefits:

- More effective chemical control by spraying in a closer band around the row.
- Increased working speed, due to more focus from the operator just driving the tractor within the rows.
- Up to 75 % reduction of pesticides in conventional row crop growing by precise control of band sprayers.
- Substantial costs reductions and environmental benefits.

Comments:

Front mounted band sprayers can also be guided by steering the tractor, which avoids the mechanical hitch solution.

Sectional Chemical Weed Control

Benefits:

- 3 beds or planting modules treated in one single pass – working width and capacity tripled.
- More effective chemical control by spraying in a closer band around the rows.

Comments:

Today band spraying is rarely used, due to low capacity. The band sprayer can only be as wide as the planter. Camera guided sectional band spraying will bring band spraying back in agriculture again. The capacity of the sectional guided band sprayer is comparable with that today used wide broad sprayers.

Fertilizer Placement

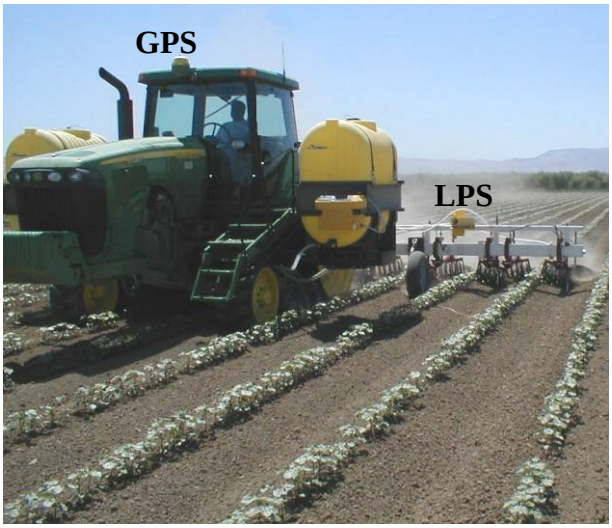
Benefits:

- More effective fertilizer utilization by placing the fertilizer in the right distance to the plant rows.

Comments:

Precision fertilizer placement is normally done together with cultivation.

Field Operations where GPS and LPS is combined



Benefits:

- Increased accuracy, due to precision steering of the tractor (GPS) and the implement (LPS) at the same time.
- Reduced driver fatigue.

Comments:

Because of the LPS sensor's accuracy, AGROCOM VISION's guidance systems represent a large potential in a combination with high-end DGPS. The DGPS may be used for "approximate steering" of the tractor and LPS for precision guidance of the implement.

3D Camera

The new 3D-camera has the same features as the current 2D plant camera, but the new 3D camera adds an extra dimension that allows this camera to also detect a number of different shapes and structures.

Camera Applications:

The new camera can have several applications in the same camera and hence will allow the farmer to use the same camera for several different field operations. Examples of possible new features are described below.

- Furrow application: detects any clear furrow marked on the ground.
- Ridge application: detects ridges.
- Swath application: detects various types of swathes.
- Edge application: detects any visible crop edge.
- Tramline application: detects tramlines in a full-grown crop.
- Stubble application: detects any standing stubble row.

Examples of Field Operations for the New Camera Technology

Below are illustrated some operations, where we have tested the concepts and operations where the 3D camera technology may be useful.

Pull-type Planting

Benefits:

- Eliminate implement tail out on hillside and under uneven soil conditions.
- Optimizing guess-rows.

Comments:

A marker furrow or a track after the tractor could be detected by the camera. The signal could guide either the drawbar or wheels/coulter on the pull-type implement. Camera guided pull-type planters combined with GPS guided tractors.

Direct Seeding or Strip-Till in Standing Stubble

Benefits:

- Sprayer boom always parallel with the surface.
- Increased effects of the pesticide.
- Reduced driver fatigue.

Comments:

Reduced field work is getting more and more common. This type of field management requires precision guidance of both the tillage- and the seeding operation. A camera application detecting the stubble could improve the quality of the work that needs to be done by either guidinge the implement or the tractor.

Autopilot on Tractors

Benefits:

- Relief of the driver from monotonous and fatiguing precision steering of tractor.
- The driver can direct his attention towards the essential field operation.

Comments:

Today AGROCOM VISION´s plant camera system has already been used on tractor front- and belly-mounted row-crop cultivators.

The new 3D camera could be useful for the following tractor guided field operations:

- Seeding/planting to improve the guess-rows.
- On-land plowing, improve keeping the correct distance to the furrow.
- All field operation in potatoes for example planting, spraying, cultivation, harvest etc.
- Baling, raking and harvest of windrowed crops, etc.
- Tractor operations following tramline for example broad spraying and fertilizer spreading.

- Cutting grass where the grass mower is front-mounted.

Autopilot on Self-propelled prayers

Benefits:

- Relief of the driver from the fatiguing precision steering of the high speed operating sprayer.
- The driver can direct his attention towards for example boom control.
- Will follow the exact plant row, ridge or tramline, not just drive the sprayer straight.

Camera application:

To achieve the full use of a camera guided self-propelled sprayer various camera application such as plant-, ridge-, stubble- and tramlines detection is needed.

Technology

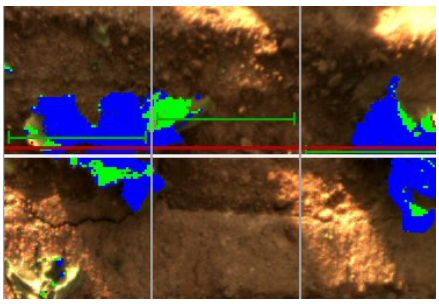
The backbone in AGROCOM VISION's Local Positioning System is computer vision technology based on digital cameras. AGROCOM VISION has succeeded in becoming the first company to commercialize computer vision for outdoor real-time applications.

The product portfolio consists of two products. The Plant camera is based on 2D technology using color segmentation and was launched in 2001. The contour camera is based on 3D Technology using depth/height recognition and will be launched in 2005.

Camera Types

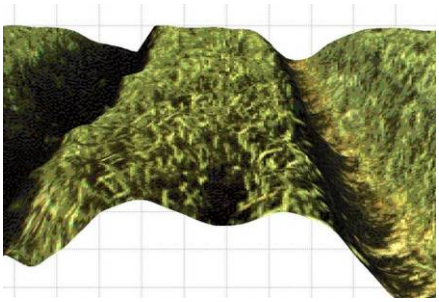
2D-vision

The technology used in the 2D cameras is based on color recognition. The plants and soil are separated (segmented) on basis of knowledge about plant and soil colour, the changing daylight and the sensors' color perception. The 2D-camera technology can track any green plant row, independent of the crop, e.g. corn, sugar beet, lettuce, broccoli, spinach, etc.



3D-vision

The output from the 3D camera is a picture representing the range to the objects seen by the cameras. The technology is based on minimum two cameras placed with a fixed distance. The principle is similar to the human depth recognition. The 3D image is transferred to a powerful vision computer that analyses the information and then outputs the results e.g. a guidance signal.



International Awards

AGROCOM VISION's Local Positioning System (LPS) has received the following awards:

AGROCOM VISION wins the Product Award, 2006 instituted by *Ingeniøren* Denmark, for the innovation of the product Eye-Drive.

In July 2003 AGROCOM VISION won the AE 50 award granted by ASAE (American Society of Agricultural Engineering). The award is given for "outstanding innovation in product and system technology".

In 2002 AGROCOM VISION was among 300 entrants elected to receive the 1st Prize and 200,000 EURO in Europe's biggest competition for the most promising IT development.

In 2000 AGROCOM VISION received among 250 entrants the Danish Agromek Award for the most promising development within arable farming.

In 2000 AGROCOM VISION received the Wageningen Innovation Prize, among 500 applications.

In 2000 AGROCOM VISION received the RAI Award in the Netherlands.

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