Sensors not only have to support the steering of agricultural machinery but also the alignment of the field sprayers – attached booms can sometimes be over 30 meters in width

Lawn Chess

Sensor systems provide the basis for many precision farming applications and support farmers on their way towards efficient and environmentally-friendly field cultivation

The agricultural sector is exposed to changing external factors like no other commercial environment. Last summer in Europe demonstrated this in a most extreme way with a combination of long periods of drought and the sudden occurrence of heavy rainfall. Many farmers recorded substantial losses in harvest as a result.

Agricultural businesses are already under severe pressure to optimize production if they are required to reach the goal of global food security by 2050. In a nutshell, the agricultural sector has to succeed in achieving continually increasing yield, in spite of the continued loss of cultivatable land in many places, in order to compensate for the forecast growth in world population to nine billion people and catch up on nature conservation at the same time.

The use of modern digital technologies can make a significant contribution here. Today's measuring instruments are now able to acquire data on the condition of soils and enable farmers to make assessments with little effort. This in turn provides possibilities for making the operation of machinery more efficient and increasingly more autonomous. Representatives of the sector have been discussing this kind of potential in terms of precision farming, smart farming or also precision agriculture. In many studies, the digitalization of this economic sector has been described as probably the most important lever currently for maximizing the harvest in an environmentally-friendly way. The endeavor to produce with greater precision and fewer losses is nevertheless

QUICK READ

The next development stage of the agricultural sector is data driven and requires robust sensor technology in the field. Turck products are enabling the operation of driver assistance systems, the herald of fully automated work processes. In a steer-by-wire system QR20 encoders measure the steering angle of axles or assist in the opening of the spray arms of a field sprayer. Ultrasonic sensors and inclinometers are suitable for aligning the position of the sprayer boom, while the compact TM18 light barriers of Banner Engineering can monitor the material flow in the grain lift of a combine harvester.

as old as agriculture itself. With Industry 4.0 scenarios, however, agriculture is in the middle of a development offering many new possibilities to users.

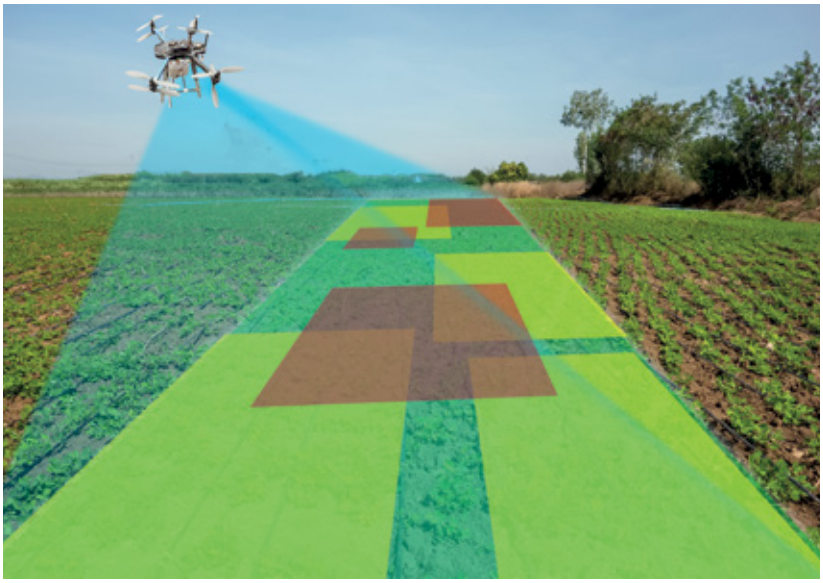
Surface analysis for coordinated field cultivation
In a high-tech agricultural process, the farmer increasingly takes on the role of a planning supervisor without continuously taking over all the control steps of the machinery. The beginning of a typical example of this process is taken up with a soil analysis, which is based on the idea of forming homogeneous areas in an actually heterogeneous field. In one area, plants could be watered more sparingly due to the greater availability of ground water reserves, while a particular sector may possibly require more fertilizer than required in other sections. This optimum method of soil and plant cultivation is carried out here through accurate prestructuring, which results in areas with as similar requirements as possible. This gradually forms a map out of the information, with which farmers can cultivate the soil according to the requirements of specific subareas.

Many small auxiliary components are used in the operation. Modern tractors and harvest machinery have now been provided with intelligent driving assistance systems and sometimes perform processes automatically. GPS positioning and location data from the cell phone network enable machinery to follow set routes precisely, which for example prevents the overlapping use of pesticides or fertilizers. Another benefit is the reduction in fuel consumption. As part of a possibly already automatically controlled drive operation, compact and robust sensors are now being used in a wide range of applications, such as low-wear steering, the alignment of field sprayers or the monitoring of material flow.

Maximum performance thanks to sensor support
The steer-by-wire technology is regarded as an established guidance process for autonomous drive systems in the future, in which a joystick can be used for the control in exactly the same way. The direction command used here is no longer given mechanically but transferred electrically to the actuator. Turck's contactless encoders measure the steering angle of the axle in this system and are resistant both to humidity (degree of protection to IP68/69k) as well as to shock. If required they can even be completely installed in the axle.

The inductive encoders have fully contactless operation and are therefore completely wear-free – a very important benefit in view of the naturally short time frame available to agriculture and the risk of machine failure. The QR20 encoders have also offered proven use in the measurement of angles on field sprayers. The sensor here measures the projection angle so that the spray arms are always located in the correct position. This demonstrates once more the ongoing trend towards continuous position measurement using measuring sensors instead of end position switches.

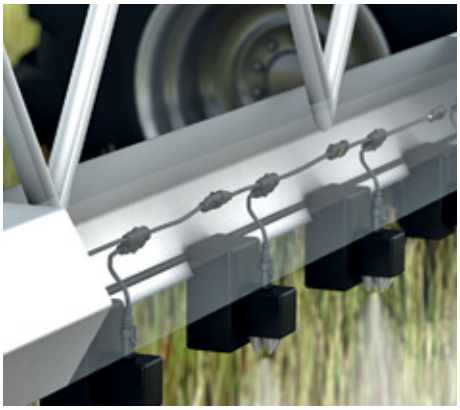
The distance to the crop determines the height at which the sprayer boom is to be positioned. Ultrasonic sensors can be used to supply information about this distance. Turck's compact and PTFE-coated sonic transducers can be used here. These come with detection ranges from 30 centimeters up to three meters. The integrated temperature compensation keeps measuring data constant over the entire range from -40 to +70 degrees centigrade, thus ensuring users accurate alignment of the spray arms. The parameters can be set to individual requirements according to the application via teach buttons or a teach cable.



The data of a soil analysis is used as the basis for precision farming. This divides up a field into areas with similar requirements

Turck's PTFE-coated ultrasonic sensors measure the distance between sprayer boom and field or crop and are resistant to commonly used plant pesticides

Contactless, wear-free encoders such as the QR20 encoder are suitable, for example, for use as angle sensors for the spray arms of field sprayers or as components of steer-by-wire solutions



Turck's pre-assembled Y splitters can be combined in modules to connect spray valves, Superseal plug connectors guarantee a reliable connection, even with vibrations

Reliable inclination measurement

The inclination of a vehicle is an important information point in most agricultural machinery, regardless of whether farmers are spreading pesticides or liquid fertilizer via a field sprayer or operating a combine harvester. If, for example, the threshing unit is always required to work horizontally on uneven ground, Turck's robust inclination sensors can detect and signal lateral deviations and deviations in the direction of travel. Severe vibrations and unforeseen shocks during operation do not corrupt the measured values since these are masked out by individually adjustable filters.

Once the thresher unit has separated the wheat from the chaff, a lift conveys the harvested grain into the grain tank. This material flow can be monitored here by photoelectric sensors. TM18 photoelectric sensors in IP67 and IP69k designs from Banner Engineering can also be used here for mounting in restricted spaces and can be aligned quickly to the receiver. Unlike other sensors, these are screwed into the grain lift with their threaded lenses, thus saving the designer the use of complex and fault prone fittings involving deflection mirrors. Data related to the quantity of grain is thus detected and is used to determine the operation of the grain lift. The seeds of a sowing machine can likewise be detected, using contactless capacitive sensors to provide level information.

Precision brings financial as well as environmental benefits at the same time

The applications illustrated show how intelligent sensors are important trailblazers in the field of precision farming. They enable farmers to use fertilizers and pesticides more efficiently and thus help to save resources and conserve the soil at the same time. This combination is a central driver of investment in the digitalization and automation of agriculture. Through more precise field cultivation, experts hope to achieve tangible ecological benefits, such as the prevention of direct contamination of river water, the reduced use of chemicals in soils, or savings in fuel consumption.

For farms on the other hand, these solutions offer improved profitability. In future, self-driven machinery in particular should open up new solution fields, including accurately timed operations during particularly favorable weather conditions. Farmers previously only took their hands off the controls for forward movement and carried out turning maneuvers themselves. However, these kinds of movements can also now be carried out precisely with the help of angle sensors.

Turck products can increasingly provide greater support to autonomously operating control systems for measuring and transferring parameters; thanks to the robust designs which are suitable even in demanding application environments, in which aggressive liquids, extreme temperatures or rugged surfaces affect technical components.

Author | Nils Watermann is sales manager for mobile equipment at Turck
Info | www.turck.com/farming
Webcode | more11905e

CUSTOMIZED PLUG CONNECTORS FOR DISTRIBUTION CABLES

CAN valves are frequently used to regulate the spray volume on field sprayers, in order to constantly deliver the correct quantity of plant pesticides. Turck's pre-assembled Y cables likewise enable these valves to be wired both individually and error-free. The fully overmolded CAN distribution cables are resistant to aggressive spray media. Cable jacket, grip body and overmold are made entirely of durable thermoplastic polyurethane (TPU). Superseal connectors guarantee reliable fitting, even when subject to severe vibration. And should a cable nevertheless be damaged, only the defective splitter has to be replaced. This saves time and service costs.