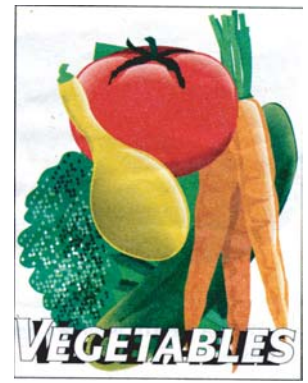


There is more to GPS guided tractors than straight lines

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From one end of a Salinas Valley vegetable field a young, energetic Stanford Ph.D., Mike O'Connor, briskly jogs over freshly listed soil toward the center of the field. At the other end idling in the turnrow is a Caterpillar Challenger tractor, its operator occasionally moving the Cat slightly forward and then backward to get a better look down the rows.

The focal point of the Cat driver and O'Connor is Don Ostini, a longtime Salinas area fertilizer and pesticide salesman, taking his first spin in a new John Deere rubber-track row crop tractor listing perfectly straight rows by Global Positioning System (GPS) technology without Ostini touching the steering wheel.

O'Connor is all smiles as he bounds lightly over the rows en route to the group of people on hand to see a GPS-guided tractor operate for the first time in the Salinas Valley.

The glass is tinted in the Challenger so there is no expression to gauge the reaction of the tractor driver. Long-time agricultural engineer John Inman, now retired from University of California Cooperative Extension is confident the look on the Challenger's operator is puzzlement.

He is trying to figure out how the Deere is listing such straight rows without any markers arms or guide arms," said Inman.

He also may have been bewildered at the rear lister, added Inman.

"Farmers here have always used front-mounter listers. They say they can do a better job with front-mounted listers because they can see better."

There's no need to "see better" with the system developed several years ago by O'Connor and a handful of other graduate students at Stanford University. GPS connected to the tractor steering mechanism is the eyes of the driver, who takes over from the computer only to turn at the end of the row.

Marketed first time

The system is called "Autofarm" and is being marketed for the first time this year by a company called IntegriNautics in Menlo Park, Calif., in the heart of the Silicon Valley.

Many of the company's principals were O'Connor's fellow grad students who under the guidance of Stanford professor Brad Parkinson with a grant from Deere and Co. developed a satellite-based automatic control system that guides a tractor far better than any tractor driver. Parkinson, a professor in Stanford's Aeronautics and Astronautics



Department, is considered a pioneer in adapting GPS technology to commercial applications.

Autofarm is one of two GPS tractor guidance systems introduced into California this year. The other is Beeline Navigator from Australia. There are more similarities than differences between the systems. One big difference is price. Autofarm sells for about \$38,000. Beeline's package is \$50,000.

Autofarm, according to O'Connor, can drive a tractor in a perfect line with an inch or less variation just like its competitor, but it can also put down contours.

Sold out at show

IntegriNautics took about a half dozen of its AutoFarm computer and guidance systems to the California Farm Equipment Show in February and sold out. O'Connor said more are being manufactured.

There is a third GPS tractor autopilot system from Trimble Navigation that was introduced in Tulare, but reportedly not yet commercially available.

The two in the field now offer breakthroughs for farmers by giving the ability to:

---Create perfectly straight rows.

---Operate in any weather condition and at night.

---Establish permanent traffic patterns, reducing overall field compaction.

---Improve pesticide application efficiency by eliminating the need for overlapping.

---And, generally improve overall field operation efficiencies.

That last one comes in a variety of ways.

One, according to Merced, Calif., farmer Clay Nordman, is that a farmer can fully utilize implement widths.

"If you run a 20-foot disk, you have to overlap to make sure all the ground is

covered. The same is true for spraying and other field operations," he said. "That means you figure on an 18-foot wide-wide swath with a 20-foot disk.

"With this GPS guidance system, you don't need to overlap because you know exactly where you have been, and you get full value out of all your equipment," he said.

Nordman started using Autofarm last fall, acting as a farmer R&D field lab for IntegriNautics. "They wanted to make sure it was user friendly, and we changed some things toward that goal," he said.

"However, the system has worked from the start," he said.

"Operators love it, and they are harsh critics of anything new - especially anything new that does not work right the first time. If it does not show promise right away, they want to abandon it," said Nordman. Once the GPS receiver is set up at field's edge, the operator establishes the first row on the computer and from then on

it's a no-hands operation. "It takes about five minutes to set up the portable GPS antenna," said O'Connor.

Nordman has used it to list, put up in-field irrigation ditches and line up berms for 550 acres of new almond trees.

He has listed cotton, corn and cantaloupes on 30 and 40-inch," he said.

Free up tractors

Ostini operates a custom listing service in the Salinas Valley and said the ability to convert front to rear listers thanks to GPS accuracy will free up tractors for a wider array of tasks.

"When you front list, basically you are tying up one \$100,000 rig for one job," he said. "With a rear lister, you can take off the tool bar, hook up other implements and use the tractor for a lot more jobs."

Much of the focus for these systems has been in the San Joaquin Valley where fields are large. "Here in Salinas it is common to have five-and 10-acre fields, especially now when most of the vegetable farmers are cutting back acreage because of excess production and low prices over the past two seasons," he said.

However, Ostini said the GPS accuracy is needed in small fields just as in large fields, and maybe more so because of high crop values. Poorly listed fields often end up with injured crops during cultivation.

O'Connor is the director of the Autofarm Systems at IntegriNautics, which has used a similar technology to automatically land a Boeing 737 more than 100 times.

Another Autofarm user is custom planter David Braga of Caruthers, Calif., who saw it at the farm show and bought it. He planted 1,000 acres of trees and vines in three months after the farm show.

"We grid the field and run nine (tree or vine) lines at a time with the planting tractor basically guiding itself across the field," he said. Until GPS came along, Braga used laser to line up vine and tree rows.

"Laser is very accurate - when it is flat," said Braga. But many of today's orchards and vineyards are going in on hillsides.

"With a laser you can barely make a half mile," he said. "With GPS I can go approximately six miles in a straight line."



GPS, he said, takes the human error out of lining up rows. "And, it is much quicker. I planted 200 acres in rolling hills in Yuba City this spring in 24 hours. Before GPS that would take four or five days," he said.

The Autofarm system Ostini and Braga are using are both on electronic steering John Deere tractors. "I would like to use a wheel tractor, but at this point they cannot hook it up to hydraulic steering," said Braga. Nordman said IntegriNautics is working on that with a Cat Challenger at his farm.

O'Connor said GPS guidance within an inch is plenty of accuracy for farming. "We spent hundreds of hours talking to farmers to learn what they needed and wanted, and we are still learning," said O'Connor, who does not come from a farming background. However, his Stanford professor does. Parkinson grew up on a Minnesota farm.

Deere's involvement with developing the no-hands GPS guidance system and IntegriNautics beyond the funding for the Stanford research project is something O'Connor would not comment upon. However, he hinted the nation's largest agricultural tractor manufacturer has more interest in what the young graduate students developed and are now marketing as businessmen than making the GPS system an option on its tractors much like grain monitors are on combines.

It is probably no coincidence that the little icon on the Autofarm monitoring screen that tells the driver whether his line is straight is Deere green

"Many of the design elements on a tractor today are related to driver visibility and operation. The location of the engine is one example of that," said O'Connor. "With GPS taking over for the eyes of the driver, you can begin to think about redesigning tractors.. You could design more efficient tractors...do such things as lower center of gravity..

