

# Look, Ma - No Hands

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By John Inman and Mary Shepherd

*A guidance system which frees the tractor driver to be a field operator is not a technological dream of the future -it is here today.*

Ride and drive demonstrations are always popular at farm equipment shows, but those offered by Beeline Navigator, IntegriNautics and Trimble Navigation at the 2000 California Farm Equipment Show in Tulare offered a different experience. Because the tractor was being steered by a guidance system, it was literally the "Look, Ma - no hands" approach to driving.

In reality, the operator turns the tractor around at the end of the field and then engages the guidance system to steer the tractor back across the field. Although the three companies use a global positioning system (GPS), they use different approaches to the correction signal and addressing the pitch and yaw of the tractor. Each guidance system is said to have relatively-easy installation, including mounting the GPS antenna or antenna array, setting up the computer control unit and tying into the tractor's electronic or hydrostatic steering system.

Using a guidance system, the farmer can eliminate row overlap and establish controlled traffic or permanent wheel tracks for operations such as spraying or fertilizing. So-called "guess rows" between implement passes are eliminated and, with accuracy in the sub-inch range, even relatively unskilled operators can do close cultivation and other precise operations. Operations can be done at night and in fog and other low visibility conditions.

Precision guidance benefits both the bottom financial line and the operator, according to the manufacturers. For example, input costs are reduced by the elimination of overlap and conventional markers. Skips or underlaps in planting or spraying are eliminated. When timeliness is necessary, the guidance system enables the machine to operate 24 hours a day.

Permanent wheel tracks can reduce soil compaction losses. In the West, where buried drip irrigation is increasingly used, a major problem is keeping the bed centered over the drip tape. By laying the tape with a guidance system and using the system for subsequent operations, manufacturers say the tape can be used for additional years, resulting in substantial savings for the grower.

## **Beeline Navigator**

Beeline says its Navigator guidance system has proven to work successfully for field preparation, field listing, planting, cultivating and spray application for row crops. Using sub-inch survey grade GPS equipment, the system uses real time information to guide the tractor and implement precisely down the desired row by controlling the steering system.

In March, Beeline precision guidance systems were installed in John Deere 8400T and John Deere 8410T tractors for trial demonstrations in Kings County and Fresno County, California. Training sessions for the farm's managers, equipment foreman and drivers included a presentation of the technology and in-cab, hands-on use of the system.

"Training is very important to ensure that everyone is involved in the implementation process. This will ensure rapid realization of the financial of adopting the Beeline technology," said John Hill, vice president of corporate development.

The drivers in training and Beeline field engineers started with 60' harrows for pre-planted seedbed preparation, using the race-tracking scheme which gives the farmer the option to reduce the number of required tractors and implements by 20 percent. In one case, a conventional harrowing operation finished 700 acres in the same amount of time that the Beeline operation finished 900 acres. They then planted cotton with 18-row and 15-row planters and took measurements of the seed row. Beeline's target goal was 30" +/- 1" with a 95 percent confidence level. This goal was achieved, with the average accuracy of the system 29.82". On 6,000 acres, total cultivation time with the Beeline system was one-third faster than conventional cultivation, according to Hill.

"We can also guarantee that the farmer will be able to install drip tape, then relocate the beds precisely on top of the tape in subsequent years," Hill said. "This will increase the longevity of the tape, so the farmer will be able to amortize his investment over more crop years."

The Beeline Navigator guidance system had its start in 1993 near Goondiwindi, Australia. Looking for a more reliable marking system, farmers Robert Mailler and Michael Mailler recognized the potential of the Global Positioning System for making precision guidance a practical and affordable reality. They developed the Beeline system for their own use, then started a company to make the system available to other growers.

"Any broadacre or row crop farmer who takes the precision farming concept seriously cannot afford not to consider this technology," said Michael Mailler.

Today, 115 Beeline guidance units are in commercial use. And more than 25 makes and models of farm vehicles - from a D8 Caterpillar bulldozer to a John Deere 4700 self-propelled sprayer - are being automatically steered with the Beeline unit.

"Because Beeline uses an inertial navigation system, combined with GPS, the result is a very reliable and robust vehicle guidance system," Hill said.

The Beeline Navigation system, introduced to North America at the 2000 California Farm Equipment Show, is currently being sold directly by the manufacturer, beginning its initial US marketing in California. The company plans to develop a US dealer network after the brand gains some recognition, possibly as early as 2001, and will sell the system at prices competitive with other guidance systems, he added.

"Beeline's focus is on service," Hill said. "All precision guidance systems will work, but technology like this will be adopted by farmers only if manufacturers of this equipment take their service seriously. That's why we believe service is the key to success in this market."

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*Contact: Miranda Hale-Johnson, marketing coordinator; Beeline Navigation; ph: 559-256-2333; fax: 559-256-2330; e-mail: miranda\_johnson@BEELINEnavigator.com; web: www.BEELINEnavigator.com.*

## **IntegriNautics**

The AF5000 Autofarm precision guidance system grew out of research at Stanford University. In its early days, the research focused on using GPS

technology for automated aircraft landings. The IntegriNautics Corporation was formed in 1994 to expand that research-proven navigation system into applications that required a high level of performance, beginning with adapting the technology for use in automatic landing of unmanned, small fixed-wing aircraft for the US military. Recognizing the potential of using GPS for agricultural uses, other researchers at Stanford began working to build an automated tractor - one that could steer itself. The system developed by researchers first successful at golf cart, and then at guiding an unmanned tractor which had been donated to the project by John IntegriNautics technology into A u t o f a r m which was also in Tulare in 2000, and has extensively California system was aftermarket closed cab, w h e e l e d

Dave Braga, a who does



vineyard planting in California's San Joaquin Valley, has gotten a lot of use from the AF5000 system he purchased and mounted on his John Deere 8400T. He says he is "very pleased" with the system and has had no problems with it.

"It saves a lot of labor by eliminating cross marking and measuring," Braga told I&T. "The system is very simple and anyone can drive the tractor."

The physical unit on the vehicle includes a color touchscreen display, steering control unit, compact GPS antenna array and steering valve. Installation by trained service reps takes only about 2 hours.

The system is anchored in the field by the base station reference which, in conjunction with the GPS satellites, results in a high degree of accuracy, according to Michael O'Connor, technical director of Autofarm Systems. In operation, the system constantly measures tractor's position with GPS and corrects the steering five times per second to seamlessly maintain the vehicle's position along the row, "The intelligence in the AF5000 system allows it to track a row to one-inch accuracy, driving forward or backward, on hills or flat terrain, and at all typical farm speeds," O'Connor said.

Cost of the unit is \$38,000. This price includes installation and on-site training, an operations video, a toll-free number for 24-hour assistance and two years of free support. The company plans to sell the system through a network of sales representatives and dealers.

Gregory Gutt, CEO of the company's TrueTrack Division, told I&T that the natural use of the IntegriNautics positioning and control technologies is to automate equipment that harvests and manipulates the materials of the world.

"AutoFarm is the first step toward this vision," he said.

Contact: Lars Leckie, marketing manager, IntegriNautics Corporation; 1505 Adams Dr.; Menlo Park, CA 94025; ph: 650-833-5616; fax: 650-833-5601; e-mail: [lars@IntegriNautics.com](mailto:lars@IntegriNautics.com); web: [www.IntegriNautics.com](http://www.IntegriNautics.com).

### Trimble AgGPS Autopilot

Although it won't be available on the market until later this year, Trimble is already beginning to market its AgGPS Autopilot at equipment

equipment shows around the country. The system connects to the tractor's power steering hydraulic system and automatically steers the vehicle in



straight rows.

A display is used to select the field pattern and show the system's operating parameters. Once the operator gets near the beginning of a row, the operator engages the AgGPS Autopilot and oversees operation of the system.

The system utilizes a high performance Trimble AgGPS navigation controller with dual redundant processors and other safety-monitoring features. An AgGPS 214 high precision RTK receiver, an in-cab display, lightbar and AgGPS70 remote display and logger are attached to the navigation controller. A local base station completes the system.

"Once the Autopilot is engaged, the operator just drives normally," said Erik Arvesen, Trimble's precision agricultural systems marketing manager. "He can focus on the field operations. It's that easy."

In recent field tests, Trimble found that field results have shown up to a 20 percent speed improvement. Trimble also demonstrated the ability to not only accurately prepare rowcrop beds and bury irrigation drip tape, but also validated that subsequent preparation in the field did not damage the buried drip tape, according to Arvesen.

He said the AgGPS Autopilot system will be available later this year from Trimble dealers worldwide.

Contact: George Huber, sales & marketing manager, Trimble Navigation Limited; 9290 Bond St., Ste. 102; Overland Park, KS 66224; ph: 913-495-2701; fax: 913-495-2750; e-mail: [george\\_huber@trimble.com](mailto:george_huber@trimble.com); web: [www.trimble.com](http://www.trimble.com).

IntegriNautics Corporation

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