As we have discussed in previous articles, 3D machine control and positioning enhance many applications by assisting specific machines. The fundamental principals of monitoring and measuring a machine’s movements as well as its heading and location provide basic positioning. Of course, there are variations ranging from this basic description to more complex systems.

Wirtgen has taken a unique approach to developing AutoPilot. Simplicity in setup, orientation and data workflow were the key focus. AutoPilot is less than a year old and currently provides positioning and control for two Wirtgen slipform offset pavers, the SP 15 and SP 25.

What is different about AutoPilot?
First, let’s understand what is consistent with traditional machine control and positioning. Traditional systems use dual GPS receivers on the machine for computing position and heading. The corrections are broadcast from a base station. Axial sensors on the machine also provide pitch, roll, and yaw to the system. All of this sensory data provides the position of the machine to compare to a design. This goal of matching existing to design is also accomplished by the even more traditional method of string-lines.

GPS L1 Only
The first variance from other machine control systems is that the Wirtgen GPS/GNSS is L1 only. For this...
application and machine speed, this works perfectly, offering affordable GPS receivers that can be less than half the cost of dual frequency, dual constellation RTK receivers.

Laser Elevation Augmentation
The next variance from traditional machine control systems is the way in which AutoPilot addresses the elevation component. GPS offers an elevation accuracy of 1 centimeter. Higher accuracy is required for slipform paving. Matthias Fritz, product engineer at Wirtgen, was tasked with developing the system. He states “It has an augmentation center for vertical control because it requires millimeter accuracy for height.” So to summarize, the machine’s x and y position (along with heading) are calculated by L1 GPS. The elevation component of the GPS is replaced with that of the laser.

Autonomous & Intimate
Another feature that is different from a “retrofit” machine control system, that is, added by a third party manufacturer, is that the 3D system communicates deep into the machine’s “language,” if you will. By guiding and steering the machine at the most intimate level, Wirtgen provides more features possible only by this level of cooperation. One of these features is that the machine can become completely autonomous. Once the machine is configured, its course set and design input, the machine operates without an operator. We see similar integration from other manufacturers such as Caterpillar’s Accugrade System. I believe this will be the trend as manufacturers develop and partner with technology providers.

GPS Localization—Optional
Caution! The following will seem simple to those familiar with GPS localizations and complex to those that aren’t. The good news is that the system is designed to be simple, removing much of the complexity in GPS localization and site calibrations of traditional 3D machine control.

The paver understands UTM north, so any design centerline on UTM north can be followed just by placing the unit on the map or centerline and entering or picking the starting position. By placing the mold at correct grade, wherever you start, the system translates to that starting point and elevation and then follows the correct path for paving. You avoid localization. You avoid finding the “official” starting point. You avoid complicated elevation control—where you start governs. You position the paver at the most convenient starting point, place the form at the correct or practical starting height, then tell it “I’m here!” It translates to that point and
Fully Automatic Paving in 6 Easy Steps

1. Start-up screen with selections of the three basic configurations: straight path, island or combination

2. Enter parameters of basic configurations or load pre-defined configurations.

3. Enter starting point on configuration

4. Select or enter machine heading

5. If required, enter vertical profile

6. If required, enter cross slope profile
then follows UTM north and relative elevations and paves perfectly.

It’s even a mouthful to write it down, but that is the breakthrough. You never have to get on any coordinate system. Instead, you translate to the map and elevations by placing the paver at any desired start point, picking it on the map, getting the form at a correct, workable height, and going. It does the rest. For surveyors, this bends the mind a little, but Wirtgen is onto something here. It can follow a picked centerline (UTM-based) or an entered UTM north azimuth. Or it can just go forward from whatever direction it is pointing.

You can tell it where you are on a figure (for example, an island “cigar”) and it will pave that figure, heading out from the starting direction. In this case, no azimuth or direction from the map is involved. You pick a figure, point and shoot basically. In the case of matching the existing sidewalk in our application movie, pointing or aiming 5 feet of form by the stop sign would not have worked—we’d have been off by at least a foot when we matched the existing sidewalk down the hill. We had to follow an entered azimuth (or selected polyline on UTM north).

**Design Files are Optional**

Most machine control systems rely on digital design files that offer the virtual reference between existing terrain and design. I’ve written about the data as The Fuel for Positioning. AutoPilot, however, allows the data file to be created in the field. Matthias Fritz, “Handling data on the job site is a big deal. That was the basic trigger and we thought that there was a way to change this.”

AutoPilot facilitates this by way of its simple software user interface. The process guides the operator through a series of questions and selectable options. Fritz adds, “The data is generated in the field and the operator tells the machine what to do.”

When I was shooting the Wirtgen AutoPilot Application Video, since it had been prepared, we did load a
design file. This was refreshing, offering the flexibility of being able to load or generate the design file. New and experienced operators, alike, are able to use the system.

**Diverse Profile Shapes**
The AutoPilot system can be used for diverse profile shapes, such as curbs, curb and gutter profiles, safety barriers or narrow paths. It can produce radii of 600mm without the use of stringlines. This dispenses with time-consuming surveying and with the installation and removal of stringlines, saving both money and time. The Wirtgen AutoPilot automatically negotiates obstacles on-site, such as manhole covers. The system comprises a computer integrated machine, as well as a control panel. Meanwhile, two GPS receivers mounted on masts communicate with a GPS reference station positioned on site.

**Conclusion**
3D machine control and positioning technology is finding its way into more and more applications. Simpler systems, simpler workflows, open standards, and decreasing hardware prices all play a role in accelerated adoption. Wirtgen’s AutoPilot has taken steps in several of these areas. I found the system to be straightforward and easy to set up. This will provide less experienced technology operators access to the automation of 3D machine control.

Wirtgen Group is a large machine manufacturer with significant global reach. Their product line includes solutions for road technologies and mineral technologies. Product divisions include cold milling machines, soil stabilizers, cold recyclers, hot recyclers, slipform pavers and surface miners. I would not be surprised if we see variations of the AutoPilot positioning system applied to these other machines. An example of this is that the display for AutoPilot is taken from their milling machine, sharing a common interface.

“Well positioned for our customers” is the Wirtgen Group’s business line mantra. AutoPilot provides an additional dimension.  

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No operator is required once the dimensions and directions are entered. It is really something to watch the machine autonomously.

L1 GPS is used to position the machines x and y values and track heading. The elevation is provided by laser.