AGV/AGC navigation technology selection is the critical factor in achieving a system design that optimizes system performance, reliability, maintenance costs, flexibility and ease of use.

Savant offers unique ‘Virtual Path’ CAD map navigation on all its automatic guided vehicle and guided cart models.

- Our inertial navigation technology operates without the need of floor tape, saw cut grooves for wire or magnetic rod, structure-mounted reflective targets or any reliance on fixed structure/continuous wall sensing.
- Virtual Path navigation just needs a floor surface and a small, zero-maintenance, floor flush marker. This allows operation, without restriction, in typical facility environments with large open areas.

Savant’s internal navigation employs a solid state inertial sensor (also used in smartphones to detect rotation) to determine AGV/AGC heading and positional information as it follows a ‘virtual’ CAD map of the system path.

Inertial Navigation sensor chip
Floor-flush magnet

(Similar to one in a smartphone)
(Size of AAA battery)

Savant ‘Virtual Path’ navigation maintains sub-inch tracking accuracy. The onboard inertial sensor and virtual path are maintenance-free.

Unlike rotational laser navigation sensors, floor tape, vision cameras or natural/contour Lidar navigation controls, Savant’s inertial sensor and virtual path are not subject to costly wear-out or damage replacement.

Savant is a full service AGV system supplier. Manufacturing of vehicles & controls, software, system installation and aftermarket support are executed in-house. Our business dates back to 1954 and our staff averages over 20 years’ experience in the AGV market.

Benefits of Savant Inertial Navigation
- Reverse travel ready (with option rear safety sensor) for off-aisle load or cart pick/drop
- Non-wire, ‘tape & target-free’ autonomy
- Inertial sensor has no moving parts to wear. It’s not a costly navigation wear item
- Eliminates periodic replacement of rotating laser head at ~$8,000/vehicle.
- Operates on uneven, rough floors, and ramps
- No line of sight/blacked target or tape maintenance issues

Our 4th generation of Virtual Path navigation is standard on all Savant AGVs and AGCs allowing complete intermingling of paths and vehicle types as needed by the user.

Savant AGV Inertial Navigation Principle

AGV/AGC Navigation Technologies By Others:

- Magnetic or Optical Tape
  - Drawbacks – damage and repair

- Laser Reflective Target
  - Drawbacks – requires line-of-sight to targets

- Saw Cut Groove for Magnetic Bar or Floor Wire
  - Drawbacks – costly to change

- Vision-Camera or Natural-Contour Structure Recognition System
  - Drawbacks – poor accuracy/requires walls
### Automatic Guided Vehicle/Guided Cart

#### ‘VIRTUAL PATH’ AGV/AGC NAVIGATION

<table>
<thead>
<tr>
<th>Compared to Laser/Target Inertial Navigation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is immune to “line of sight” blocked/missed target issues which stop vehicle</td>
</tr>
<tr>
<td>Does Not require installation of additional target mounting posts in large open areas</td>
</tr>
<tr>
<td>Is Not susceptible to damage or sabotage</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Compared to Floor Tape Inertial Navigation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eliminates system stoppages because of torn/missing tape spots</td>
</tr>
<tr>
<td>Has No limit to size or complexity of the guide path network</td>
</tr>
<tr>
<td>Does Not use floor code markers (RFID tags, tape, plates) that get damaged</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Compared to Vision or Natural/Contour Inertial Navigation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is Able to auto-reverse accurately</td>
</tr>
<tr>
<td>Has accuracy required to support automatic load pick and drop</td>
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<tr>
<td>Offers vastly superior traffic intersection flow efficiency = higher throughput</td>
</tr>
</tbody>
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**Laser (Target) Navigation**
- Targets at fixed elevation estimated ~7” must have clear line of sight
- Target size: ~16” x 6”
- Targets spaced every 20-50 feet, on both sides of path (x2)
- Targets surveyed post installation
- Laser navigation is augmented with distance measuring (wheel encoders)
- Tracking accuracy ±1”, nominal

**Savant Inertial (Internal) Navigation**
- Markers (magnet) flush with floor
- Marker size ~0.75” x 0.25”
- Markers spaced every 25-50 feet along path
- Markers surveyed post installation
- Inertial navigation is augmented with distance measuring (wheel encoders)
- Tracking accuracy ±1”, nominal

**Tape (Magnetic/Optical) Navigation**
- Sticky tape affixed to cleaned floor
- Station, branch and action markers (tape, RFID tag, plates) affixed to floor
- Marker size ~ 2” x 3”
- Markers and tape moved with path changes
- Path patched with new tape as needed
- Markers subject to damage
- Tracking accuracy ±1”, nominal

**Natural/Contour Navigation**
- Vision Camera
  - Hi-def scan for ceiling reference structure
  - Compares vision data to digitized database
- Lidar Laser
  - Rotational scans for floor level references
  - Compares to cleaned digital database

**Common to Both**
- Highly dependent on reference structures (walls, etc.) for accuracy (open aisles environments are a problem.)
- Very sensitive to object movements obscuring line-of-sight to critical reference structures
- Susceptible to dust/obscuring camera or Lidar lens
- Requires software engineer to eliminate noise/bad data from navigation scan database
- Very crude, inefficient multiple vehicle traffic control
- Poor tracking accuracy ±6”, typ. does not support required alignment for automatic load transfer or auto-charging
- Up to 50% more expensive compared to Inertial-Magnet or Laser-Target

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**NOTE:** SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE BASED ON PRODUCT IMPROVEMENTS OR TECHNICAL REQUIREMENTS.

**FORM:** 0518NAV

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