AGV Navigation: Pros and Cons

Presented by:
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Navigation Considerations

- Accuracy
- Repeatability
- Flexibility
- Environment
  - Block Stacking
  - Temperature
- Floor sub-structure
- Traffic pattern
- Preferences on preserving floor
AGV Navigation - History

• 1953 – First AGV is developed with Wire Guidance in Illinois by Barrett Electronics - Arthur “Mac” Barrett
• Mid 1980’s – Inertial Guidance released
• Late 1980’s – Laser & Inertial Navigation were introduced
• Late 1990’s – Natural Feature Guidance was introduced
• Early 2000 – 3D Vision Guidance & SLAM
Navigation Types – Wire

• Pros
  – Historically proven
  – Very accurate
  – Mature hardware
  – Negligible effect from snow, ice, dirt
  – Usually limited in speed

• Cons
  – Floor movement affects the wire over time
  – Frequency generators needed for path change. Complicated loops.
  – Inflexible
  – Hard to change
  – Requires antennas at both end for bidirectional travel
Navigation Types – Tape

• Pros
  – Low cost
  – Great for Assembly Systems
  – Optionally rubber bar embedded in floor

• Cons
  – Usually limited in speed
  – Needs antennas in each direction
  – Shallow rebar can be problematic
  – Takes time to modify
Navigation Types – Spot/Inertial

• Pros
  – More durable than tape
  – Spots can be transponders or magnets
  – Gyro improvement has reduced spots
  – Can be used outdoors
  – Good high speed control

• Cons
  – More expensive than tape
  – Can be time consuming to install
  – Potentially time consuming to modify
  – 2 antennas needed
  – Potential issues with metal plate flooring
Navigation Types – Laser / Targeted Triangulation

• Pros
  – Very High Accuracy
  – Very easy to modify path
  – Reasonably fast installation
  – No civil installation
  – Can be used outdoors
  – Great high speed control

• Cons
  – Block stacked loads
  – Targets can be removed or damaged
  – Vehicle Cost
Navigation Types – Laser – 2D Feature/Natural

• Pros
  – Very quick installation time
  – Good high speed control

• Cons
  – Not suitable for all facilities or conditions
  – Not suitable for outdoor use
  – Resolution tied to sensor type and layout typically not as good as targeted laser
Navigation Types – Others

- 3D Vision – stereoscopic camera
- RF Triangulation
- Optical (floor)
- Chemical path
- GPS & Differential GPS (only outdoors)
It’s More Than Navigation

• Great systems have:
  – Robust offboard system controls; non custom code
  • Ability to run emulation/simulation
    – [Navigation is not traffic control]
  • Ability handle complicated traffic patterns with numerous vehicles – 50+
    – Reliable mechanical design
    – Reliable navigation
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