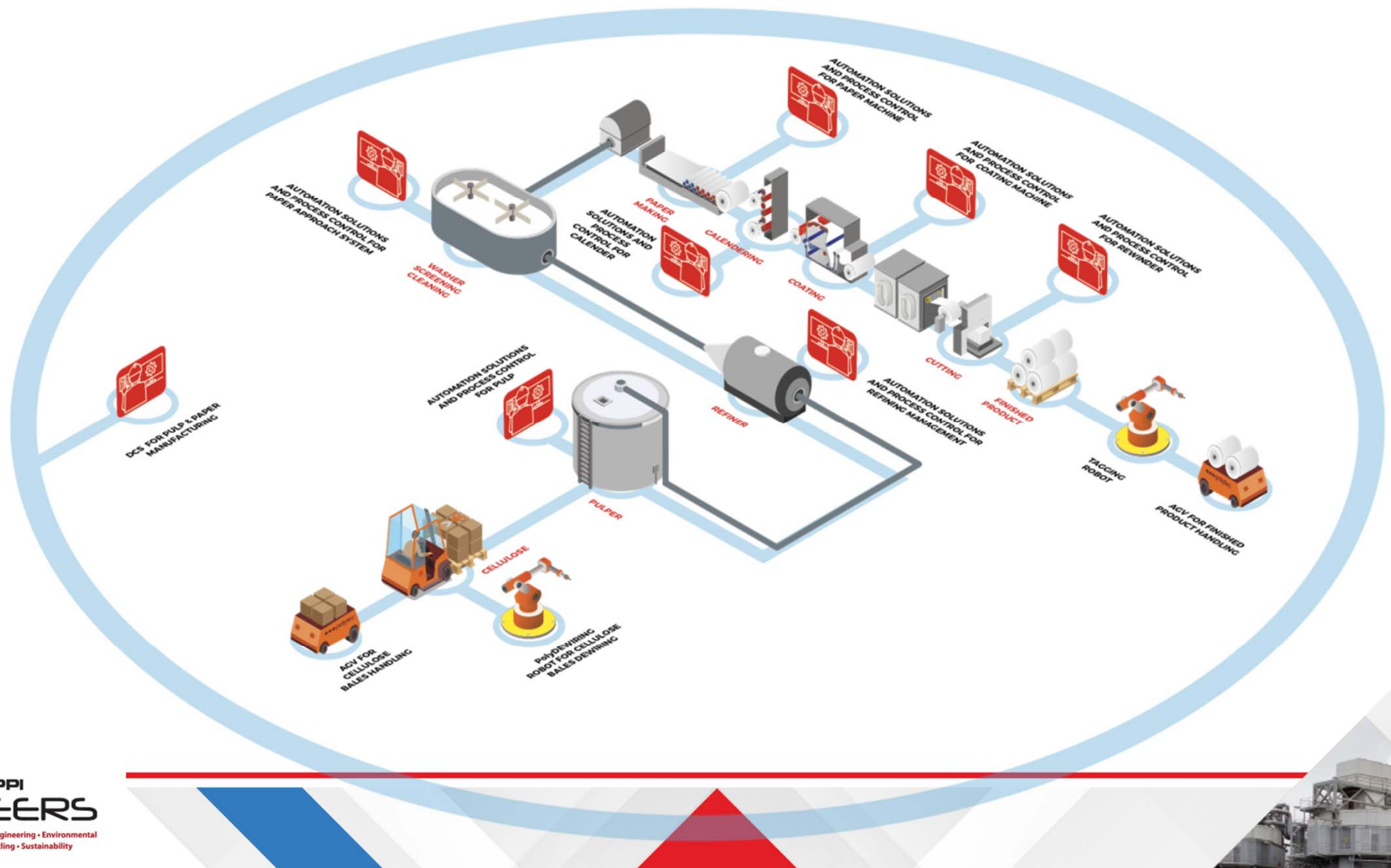


Application of 3D Vision, Robotic Arms, and Robust Algorithms to Stock Preparation Feeding Lines

Results and Development of the Installation

Tony Tellez, Polytec USA





●●● CASE HISTORY: SAPPI GROUP



IMPROVE **SAFETY**

ENHANCE & OBJECTIFY THE PRODUCTIVITY

● METER THE **PERFORMANCES**

● COLLECT **REAL DATA**

● RELOCATE **PERSONNEL** TO DIFFERENT TASKS

● REDUCE THE **MAINTENANCE**

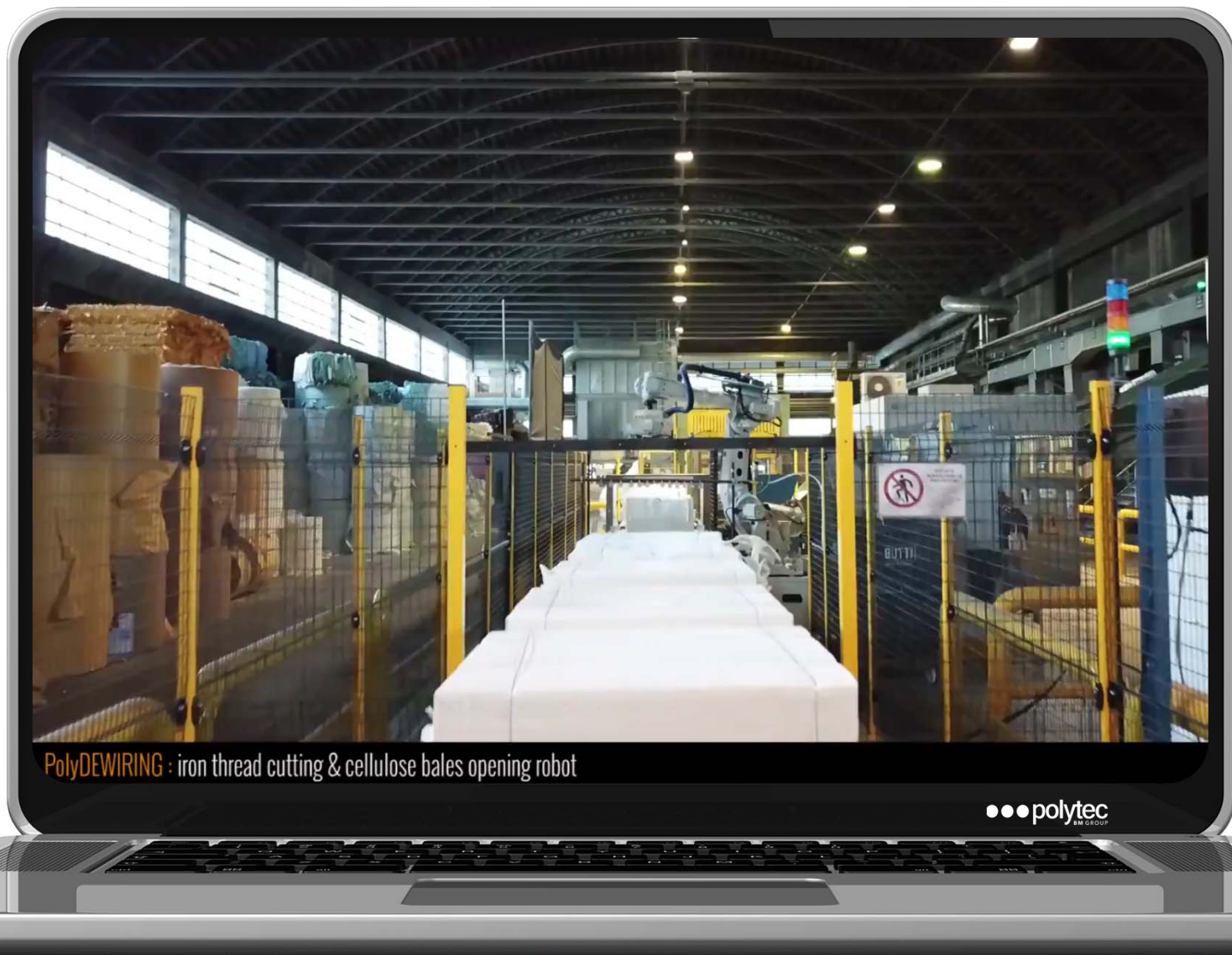
● **CONTROL** THE CRANE FROM MAIN PULPIT



●●● CASE HISTORY: ROBOT



CASE HISTORY: SAPPI



●●● AUTONOMOUS MOBILE ROBOTS

‘‘A mobile robot is a software-controlled machine that uses sensors and other technologies to identify its surroundings and move around it’’

The main characteristics are autonomy in navigation, safety and robustness.

This implies that the robot must be able to perform some complex tasks, which are mainly:

- Mapping
- Navigation: Localization
- Navigation: Route planning
- Navigation: Running the route
- Working with other systems



●●● FUNCTIONALITIES OF AMRs

Mapping

- What environment is the robot in?

Navigation - Localization

- Where is the robot located within the environment?

Navigation - Route planning

- Where should the robot go?

Navigation - Execution of the route

- How does the robot move along the planned path?

Coexistence with other systems

- Are there other agents who can influence decisions?



●●● NAVIGATION TECHNOLOGIES

Main navigation technologies: Line Following, Tags, Triangulation
Laser, Simultaneous Localization and Mapping (SLAM)

Infrastructure cost

Installation time

Positioning accuracy

Reliability

Robustness to environmental changes

Easy reprogramming

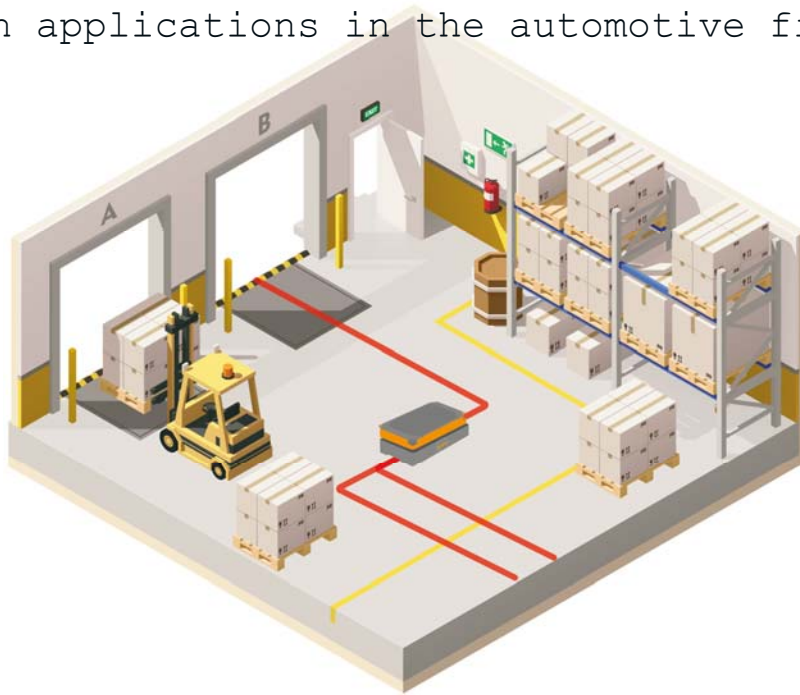
Maintenance cost

Fleet management



●●● AMRs – LINE FOLLOWING

- Magnetic stripe, inductive cable, colored tape
- The sensor located under the vehicle detects the discrepancy from the guideline
- Main applications in the automotive field



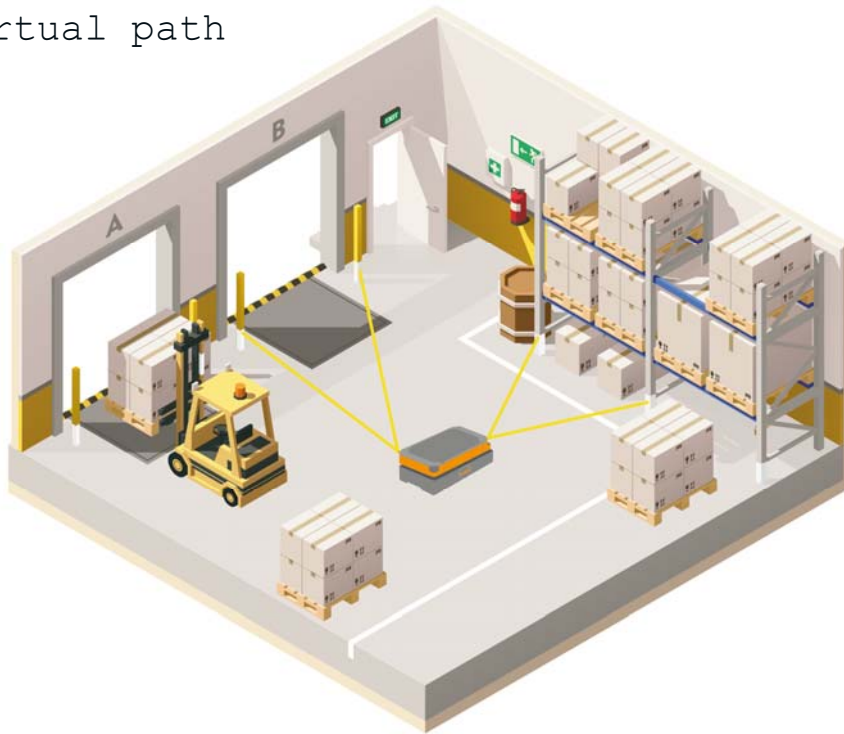
●●● AMRs – TAGGING

- Technology similar to line following. QR codes, RFID, and magnetic dots can be used.
- Camera or sensor to detect/read points on the floor, each point has actions associated with it
- Typically applied to e-commerce



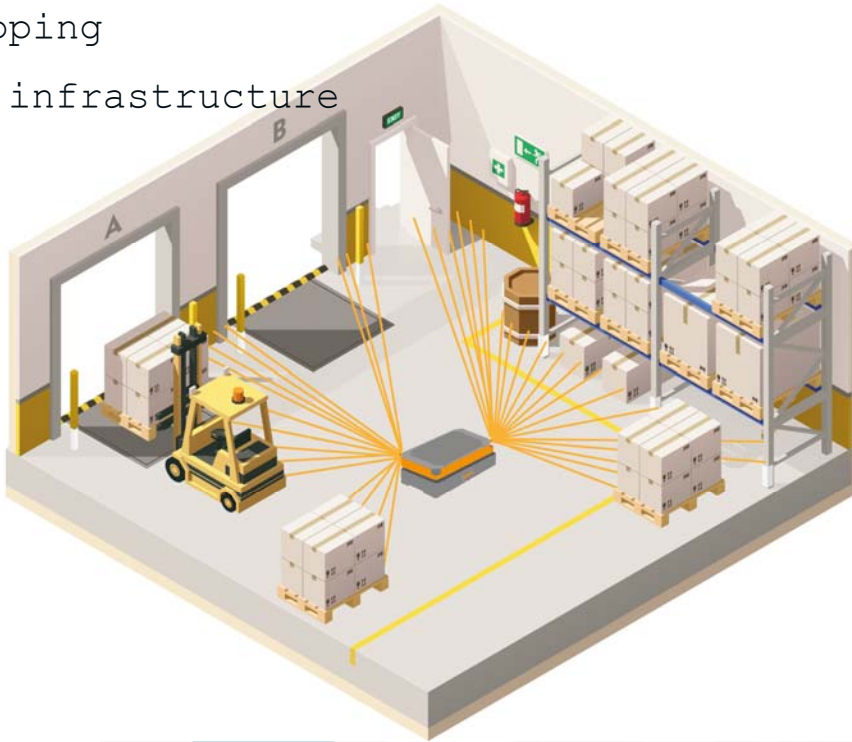
●●● AMRs – LASER TRIANGULATION

- Vehicle position identified by laser triangulation
- Standard before the advent of natural navigation
- Virtual path



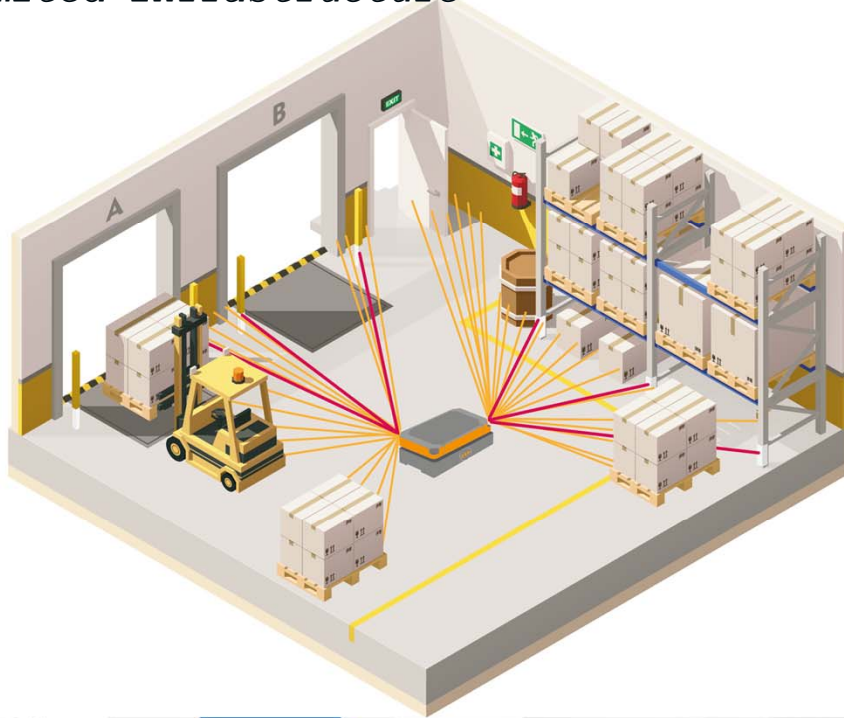
●●● AMRs – SLAM OR NATURAL NAVIGATION

- It uses information from laser scanners to identify the surrounding area
- Compare the current 2D scanner information with the previously created mapping
- No infrastructure



●●● AMRs – SLAM + LASER TRIANGULATION

- Vehicle position identified using laser triangulation and SLAM
- Use of laser triangulation when precision is needed
- Limited infrastructure



BACKUP SLIDES



CASE HISTORY: SAPPI



LINE FOLLOWING

Infrastructure cost

- High especially in the case of bands embedded in the floor

Installation time

- High, ground line installation and definition of vehicle actions at junctions

Positioning accuracy

- Good positioning accuracy

Reliability

- High, especially in environments with very dynamic layouts

Robustness to environmental changes

- Localization and navigation are not affected by environmental changes

Easy reprogramming

- Low, need for physical interventions on the layout

Maintenance cost

- High, in dirty and heavily trafficked environments

Fleet management

- Potentially very complex in case of large fleets and numerous crossings



Robustness to environmental changes



Positioning accuracy



Maintenance cost



Easy reprogramming

TAG

Infrastructure cost

- Medium, depends on the type of tag

Installation time

- High

Positioning accuracy

- Excellent positioning precision

Reliability

- High, especially in very dynamic environments

Robustness to environmental changes

- Localization and navigation are not affected by environmental changes

Easy reprogramming

- Low, need for physical interventions on the layout

Maintenance cost

- High, in dirty and heavily trafficked environments

Fleet management

- Potentially very complex in case of large fleets and numerous crossings



Robustness to environmental changes



Positioning accuracy



Maintenance cost



Easy reprogramming

LASER TRIANGULATION

Infrastructure cost

- Medium

Installation time

- Potentially high, installation and cataloging of reflectors

Positioning accuracy

- Good positioning accuracy

Reliability

- Good

Robustness to environmental changes

- Good, unless major changes in layout

Easy reprogramming

- Good in case of small variations

Maintenance cost

- Low, rare maintenance on reflectors

Fleet management

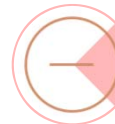
- Good



Reliability



Positioning accuracy



Installation time



Programming of new layout areas

SLAM - NATURAL NAVIGATION

Infrastructure cost

- Nothing, there is no infrastructure to install

Installation time

- Low, software programming only

Positioning accuracy

- Poor

Reliability

- Low

Robustness to environmental changes

- It is greatly affected by even minimal environmental changes

Easy reprogramming

- Very easy to reprogram locations and routes

Maintenance cost

- Low

Fleet management

- Good



Installation time



Easy reprogramming



Positioning accuracy



Robustness to environmental changes

SLAM + LASER TRIANGULATION

Infrastructure cost

- Medium, few reflectors needed

Installation time

- Medium

Positioning accuracy

- Good positioning accuracy

Reliability

- Excellent, navigation based on dual technology

Robustness to environmental changes

- Good, unless major changes in layout

Easy reprogramming

- Good, unless major changes in layout

Maintenance cost

- Low, rare maintenance on reflectors

Fleet management

- Good



Reliability



Positioning accuracy



Reflector installation time

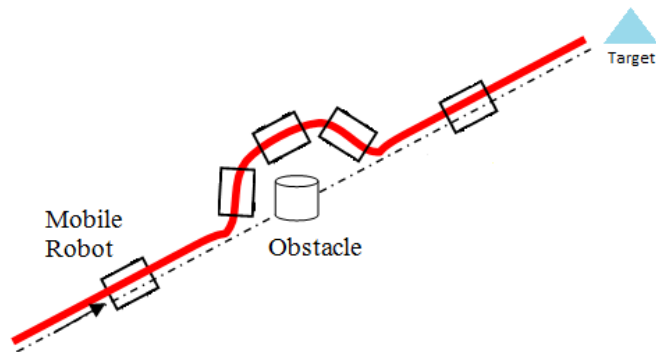


Installation know-how

OBSTACLE AVOIDANCE

What advantages does it have?

When it makes sense to use it?



Spaces available for navigation

Required service times

Stability of the layout over time

Presence of mixed traffic

Stability, size and weight of the load

Number of vehicles in the fleet

SISTEMI MULTI-AGENTE



- Flow and layout analysis
- Forecast of delays
- Delay management
- Dead lock management