
Visualize Your Enterprise with Seegrid Robotic Solutions

# Seegrid® Corporation

# Vision-Guided Ground Vehicles

Presented to NDIA Ground Robotics Capabilities Conference,

August 13, 2014

# Outline

- Seegrid Background
- Technology
- Products
- Future Opportunities

# Seegrid's Breakthrough Technology

- Using stereo cameras, vehicles equipped with Seegrid's technology can reliably navigate in any unmodified environment.
- Uses statistical analysis of large amounts of data to provide robust and reliable location mapping and guidance for mobile robotic devices and autonomous vehicles.
- Leverages commercial sensor and computing technologies to ensure continuous performance improvements.
- WalkThroughThenWork® simplifies deployment

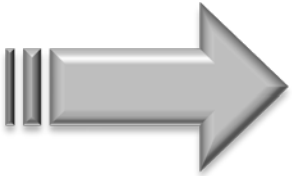
# Background


- Extensive experience in robotics, automation, software, manufacturing, warehousing and logistics

- 2003 spin-off of renowned Robotics Institute, Carnegie Mellon University (CMU)
- Seegrid Co-Founder and Chief Scientific Officer, Dr. Hans Moravec
- 35+ years of development under Dr. Moravec
- Designer and manufacturer of the world's FIRST and ONLY vision-guided automated guided vehicles
- Strong and experienced management team
- 40 International patents

# The Business Imperative

$30/hour

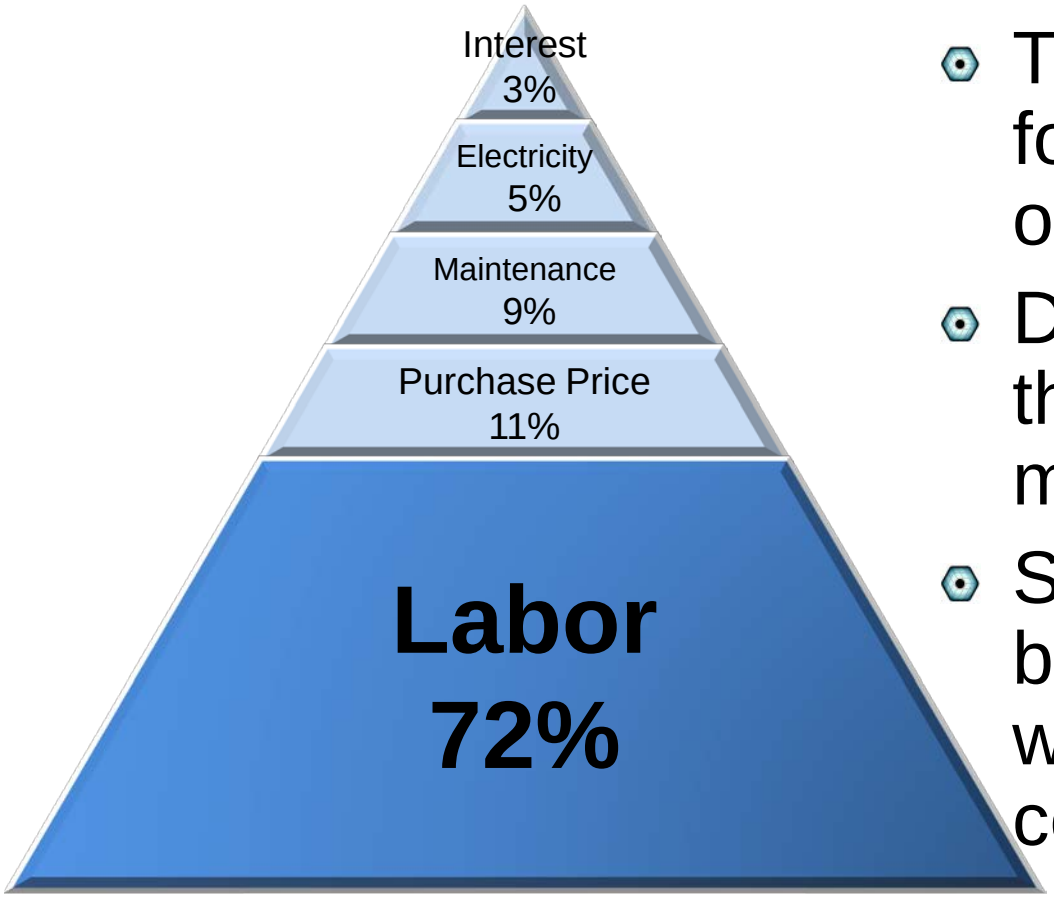


$3/hour

- Labor represents 70-80% of total operating costs
- Different shifts and employee downtime lead to operating inefficiencies
- Employee related accidents lead to downtime and increase in workman's compensation claims
- Reduce labor costs (in certain applications, 90+%)
- Minimal downtime leads to improved operational efficiency
- Improvement of safety associated with robotic vehicles

**Full payback in 4-15 months based on utilization**

# The Big Benefit: Vehicle Labor Reduction




**Vehicle Ownership Costs**

- The operator accounts for >72% of the total operating cost
- Dramatically reduce the cost of material movements
- Stay competitive in business environments with rapidly rising labor costs

# Seegrid Products

- Flexible AGV's
- Vehicle Navigation Kits
- Vehicle Navigation Controllers
- Stereo Ranging Cameras
- System and Fleet Controllers

# Robotic Industrial Trucks

GT3 Tow Tractor


GP8 Pallet Truck

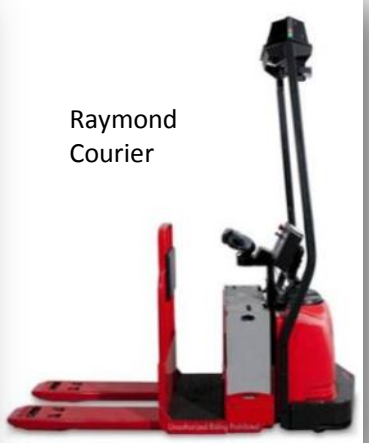

GP8 Towing Attachment

S-KIT


GT10 Tow Tractor

Linde P50C

GWS35



Raymond Courier


Yale MO50T

# How It Works

Walk or drive AGV through desired route


AGV camera takes 360°images of facility, builds 3D map

Operator loads pallets or attaches carts

Operator enters trained route and activates the “Push to Work” button

AGV travels on pre-trained route, delivers goods, and returns for more work

# S-Kit: Common Autonomy Platform


Standard Manually Operated Industrial Vehicle

+

Vision Guidance Unit

Graphical Operator Interface

Vehicle Interface Module

Power Distribution Module

# The Core Technologies

## TECHNOLOGY

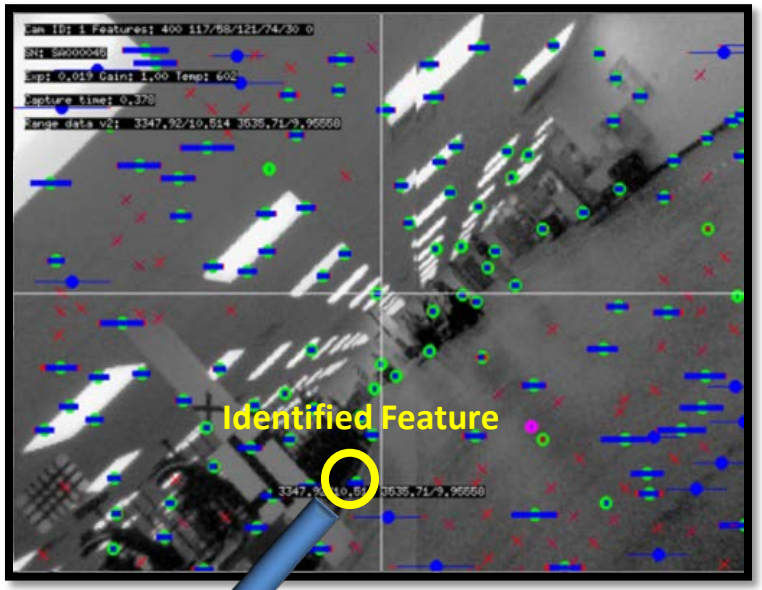
- Stereo Vision Sensing
  - Captures large data sets quickly – can range 100's of points/second
  - Software centric
- 3D Evidence Grids
  - Complex, Compute intensive
  - Compensates for Uncertainty

## BENEFIT

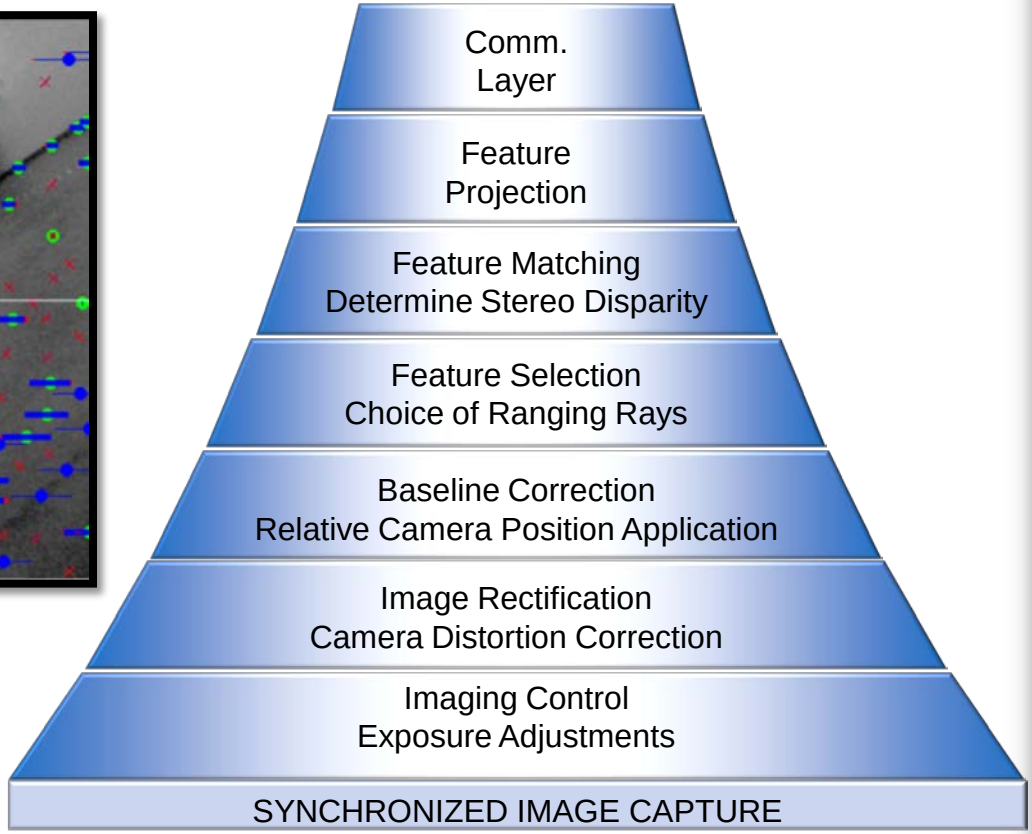
- Non-Radiating, Infrastructure-Free
  - Usable in stealth and existing operations
  - Long range, low energy
  - Low cost
- Robust, Adaptable
  - Based on statistics, not heuristics
  - Allows full 3-D modeling

**Leverages Moore's Law**

# Stereo Ranging Technology

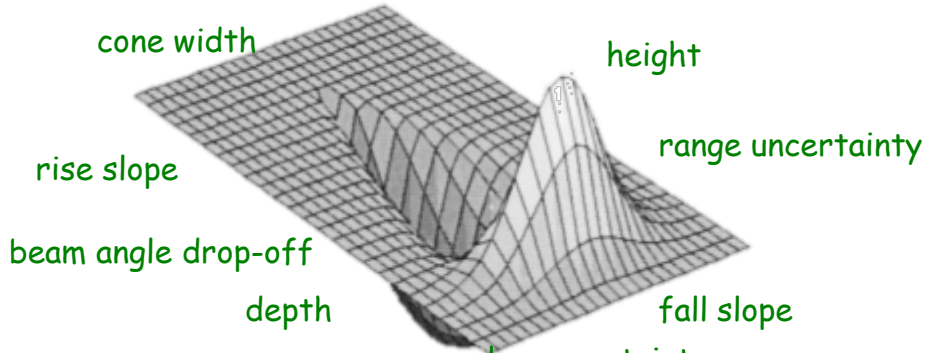







**Software Stack**

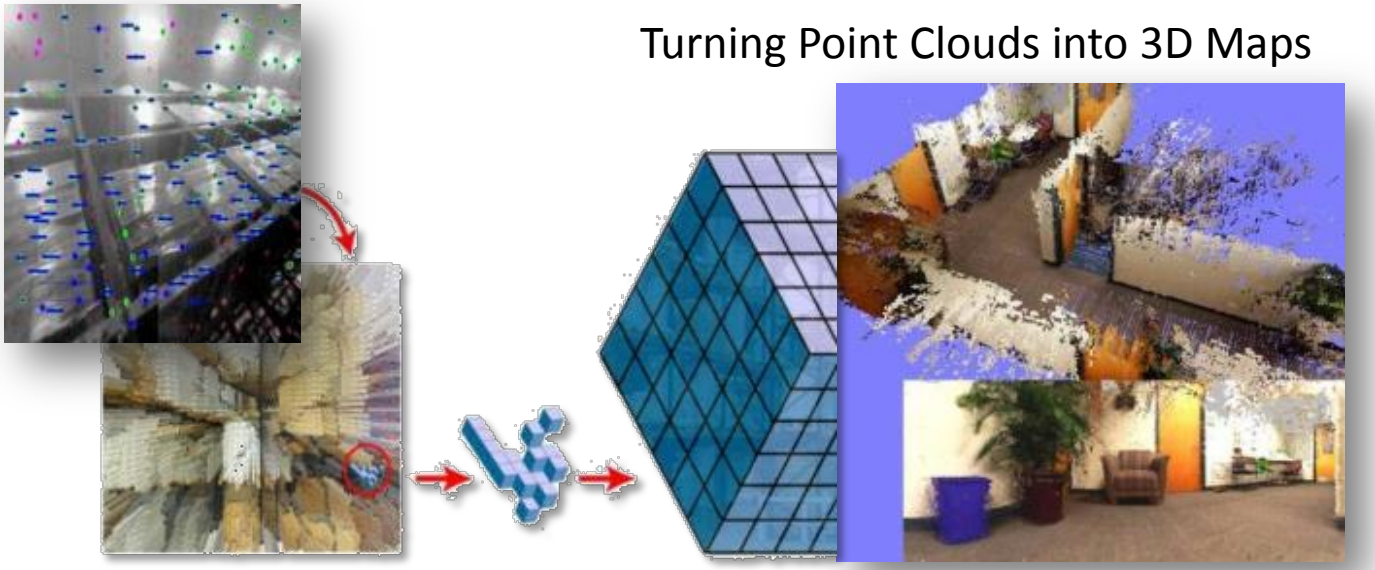
# 3D Probabilistic Modeling Technology




Range Data Uncertainty

*Managing imprecision and uncertainty to provide accurate representations*

Turning Point Clouds into 3D Maps

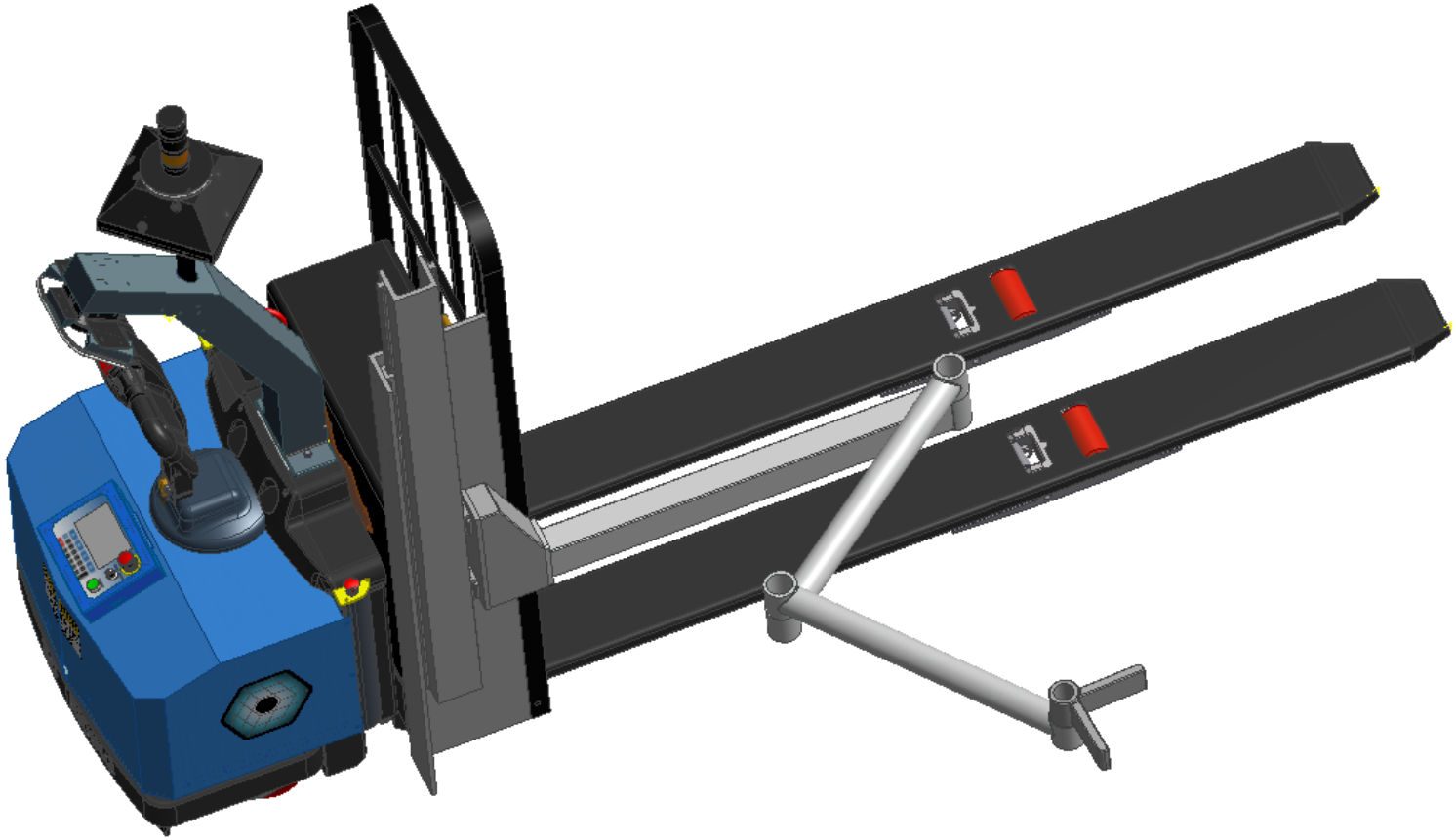


# Technology in Action

# Seegrid Benefits

- Flexibility
  - No infrastructure required for navigation: no wires, lasers, tapes or magnets
  - Scalable
  - Quickly modify and change routes as needed
  - Operational in both manual and automatic modes
- Safety
  - Eliminate costly employee injuries
  - Zero product damage
  - No facility and equipment damage
- Affordability
  - Reduce labor, operating, and maintenance costs
  - Rapid return on investment
  - Low total cost of ownership
  - Eliminate dependence on seasonal staffing and temporary employees
- Efficiency
  - Reduce long and inefficient manned travel
  - Operate 24/7
  - Operational from day one
  - Quick uptime improves productivity immediately

# Future – Material Handling

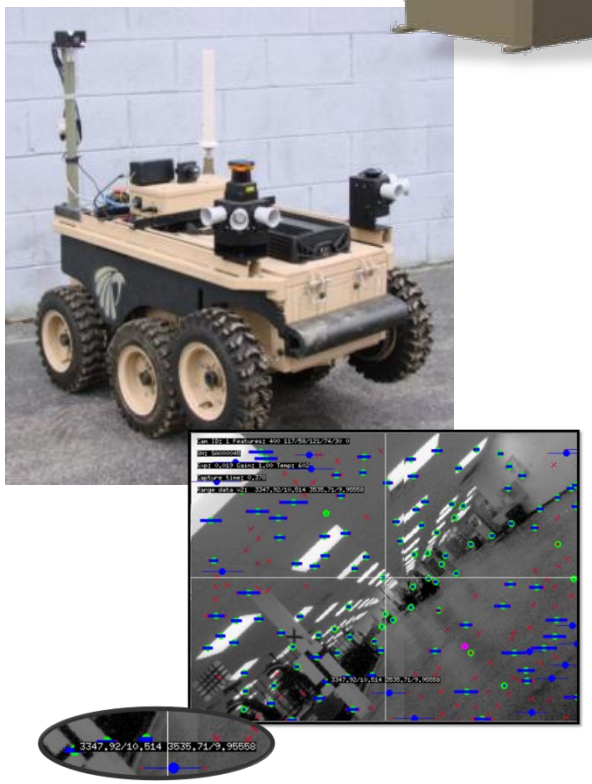


# Future -- Automotive

- Obstacle Avoidance
  - Warning, Active Control
- Augmented Control
  - Simplified Driving
- Autonomous Functions
  - Parking, Retrieval
- Autonomous Driving
- Embedded Design

# Future - Defense

- UGV Capability Modules
  - Robot Return, Targeting, Operator Augmentation, Autonomy
- Convoy Clearance
- GPS Denied Navigation
- Personnel Localization
- Threat Location



# Future - Security

- Perimeter Monitoring
- Threat Identification
- Access Control
- Airport and Port Security
- Sensitive Facility Security