

# Long-Term Visions for Equipment

Opportunities for Innovative Equipment, and  
Some Challenges

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# Equipment are Tools that:

- **Increase/Multiply Human Ability/Capacity**
  - hydraulics, wheeled equipment, speed, over-the-horizon radar, computers
- **Extend/Supplement Human Ability**
  - ultrasound, IR/UV, precision, flying
- **Enable Humans to Go Where They Cannot Survive**
  - underwater, outer-space, hazardous environments

# New Resources Available Now/Soon

- Sensors – single-chip ultrasound, tactile, cheap lidar
- Miniature machines
- Processors and software – vision & sensor input
- Multi-spectrum vision systems – visual, IR, sound, etc.
- 30 cm accuracy GPS (L5), or better if needed
- 3D Manufacturing
- Augmented Reality (AR), Artificial Intelligence (AI)
- IP Remote feedback, <200ms and <500ms delay
- Overhead Platforms – UAV, pole, balloon
- 3D GIS Maps with feature definition
- Transparent photovoltaics – windows that create electricity

# Opportunities

- One operator controls many semi-autonomous machines
- Primarily semi-automation, some full automation
- Intuitive controls – less learning curve
- Sequenced worksite – multi-unit oversight from above
- Interconnected work zones, employees, equipment, vehicles, bicyclists, and pedestrians
- Auto-sense impaired/tired operators by voice pattern?
- Micro-machine applications?
- More Safe - reduce accidents and injury/deaths?
- Faster - remote and automated work 24/7 instead of 8/5?
- Less Cost – can overall cost decrease?

# Challenges

- **Human Factors**
  - Operator controls multiple equipment pieces simultaneously
  - Intuitive controls
- **Software and Sensors**
  - Semi-automation, automation, and multi-machine sequencing and coordination
- **Mapping**
  - GIS and feature mapping the right-of-ways
- **Support and Maintenance**
  - OEM/Distributor maintain ownership and users pay a fee when using equipment?
- **Security**
  - Vandalism of remotely-located items
  - IT, remote control
- Envision continued daily fuel truck visit, but this is good since it means daily hands-on and eyes-on inspections.

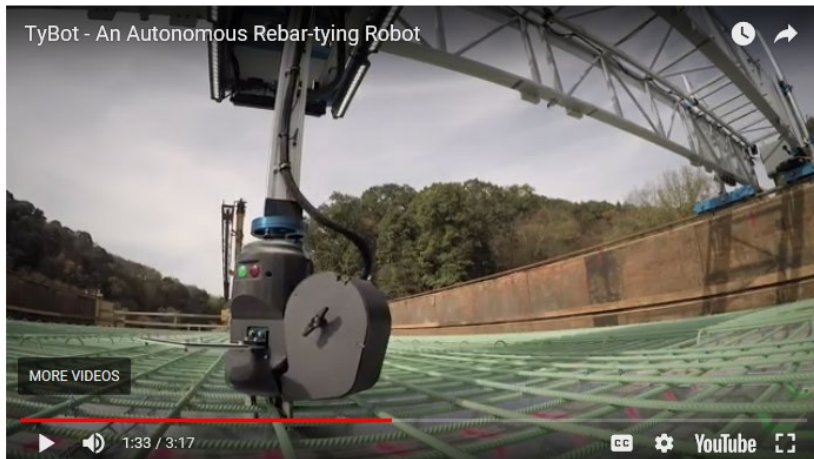


# Its Already Begun

## [VIDEO] Autonomous Rebar-Tying Robot Could Revolutionize Bridge Construction

Contractor-designed Tybot can tie rebar automatically with only one worker supervising the operation and could ultimately halve rebar-tying labor hours

NOV. 2, 2017

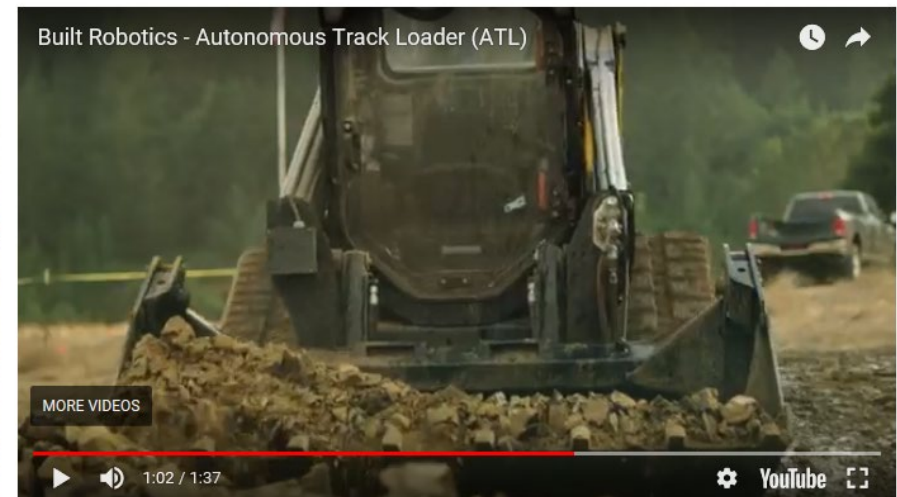


ADVANCED CONSTRUCTION ROBOTICS INC.

## [VIDEO] Built Robotics Develops Autonomous Track Loader for Construction

Prototype autonomous compact track loader designed specifically for construction completed its first project this summer

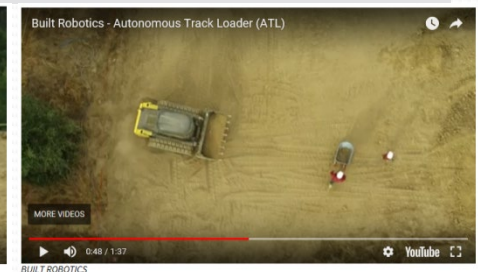
OCT. 20, 2017



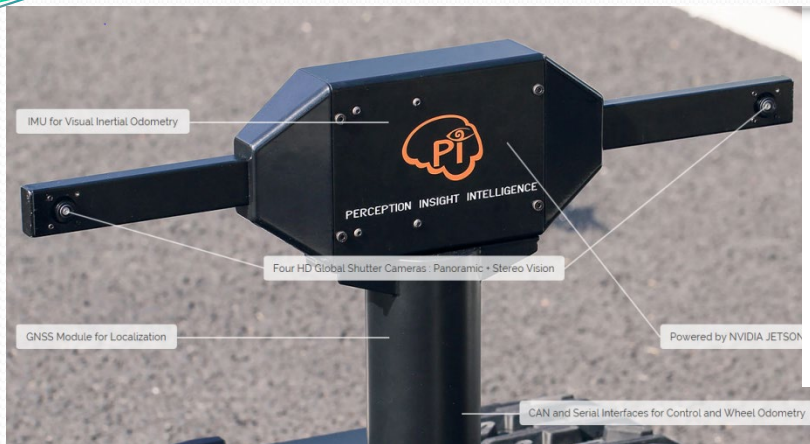
BUILT ROBOTICS



BUILT ROBOTICS



BUILT ROBOTICS



# Perceptin's Under-\$10K Self-Driving Vehicle

It's a slow-driving pod, but that should be good enough for corporate campuses

By Philip E. Ross

PerceptIn provides core technologies and solutions for the next generation of robotic computing platforms



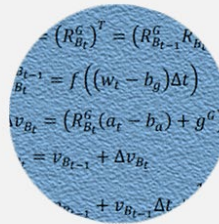
Hardware

Multi-Sensor Computing Module  
Factory Calibration  
Hardware Synchronization



Software

User-Friendly SDK  
Heterogeneous Computing  
Dynamic Workload Scheduling



Algorithm

Sensing  
Perception  
Decision



# Asphalt-Printing Drones Could Be Solution to Potholes

Researchers have "trained" image recognition algorithms to detect potholes and then installed them into drone cameras. After the damaged areas were identified, a drone is dispatched to the site, using an on-board asphalt 3D printer to patch the hole.

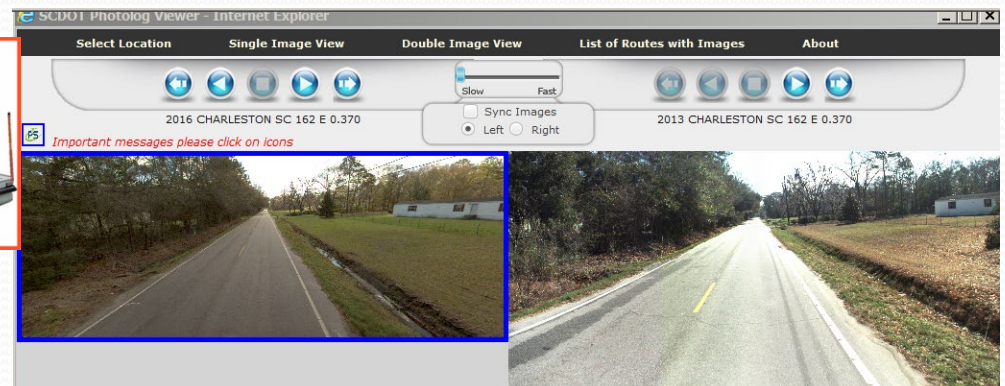
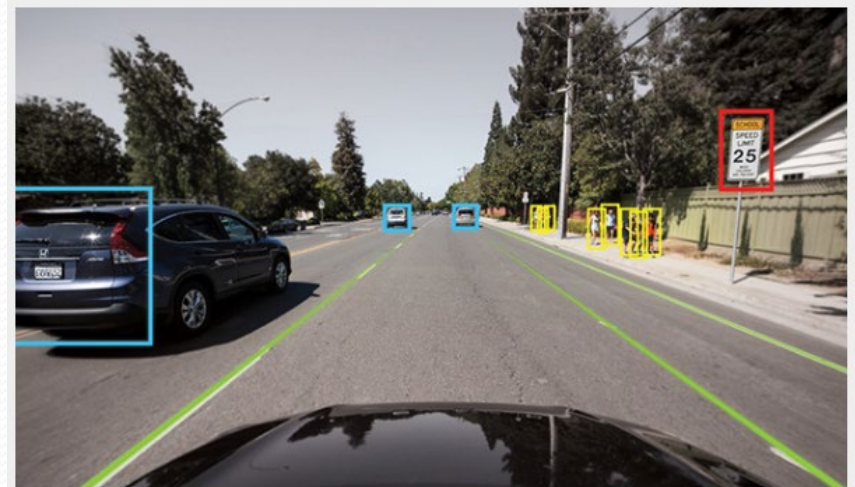
JUNE 25, 2018



[VIEW GALLERY](#)



# Imagine if we move beyond today...



## Invest in Innovation. Invent new.

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