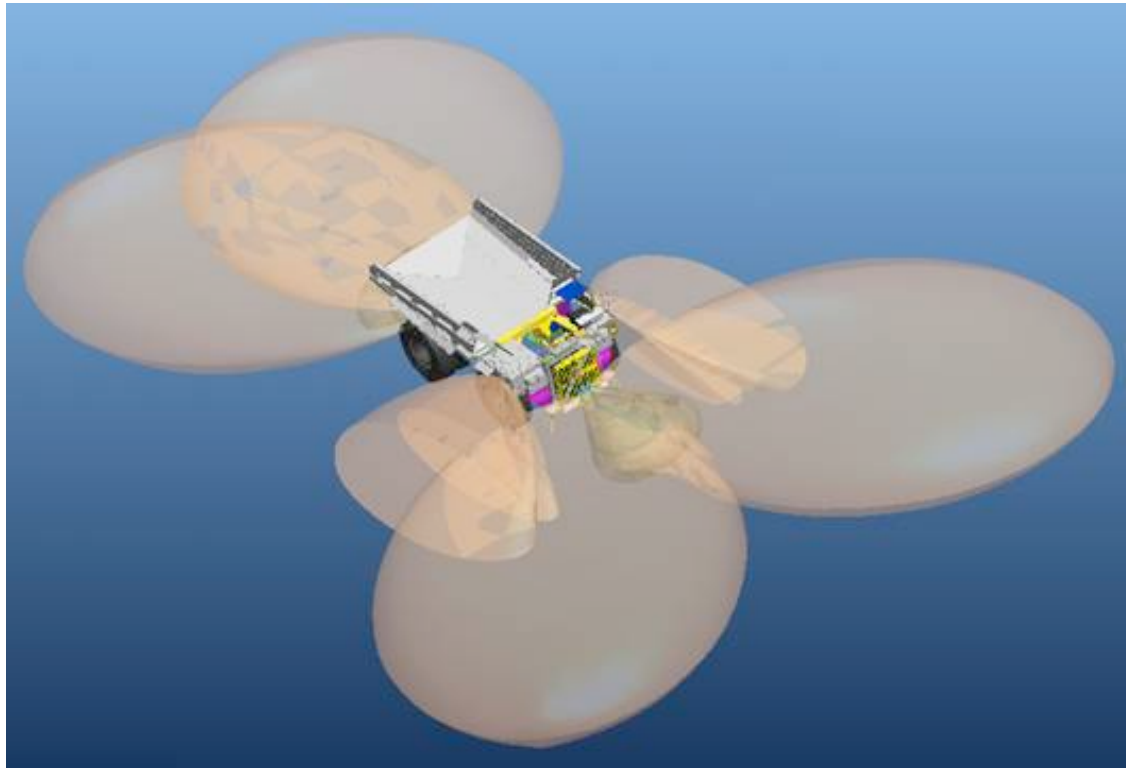


Slow Speed Object Detection for Mining Trucks:

CATERPILLAR[®]

Integrated Object Detection System[™]



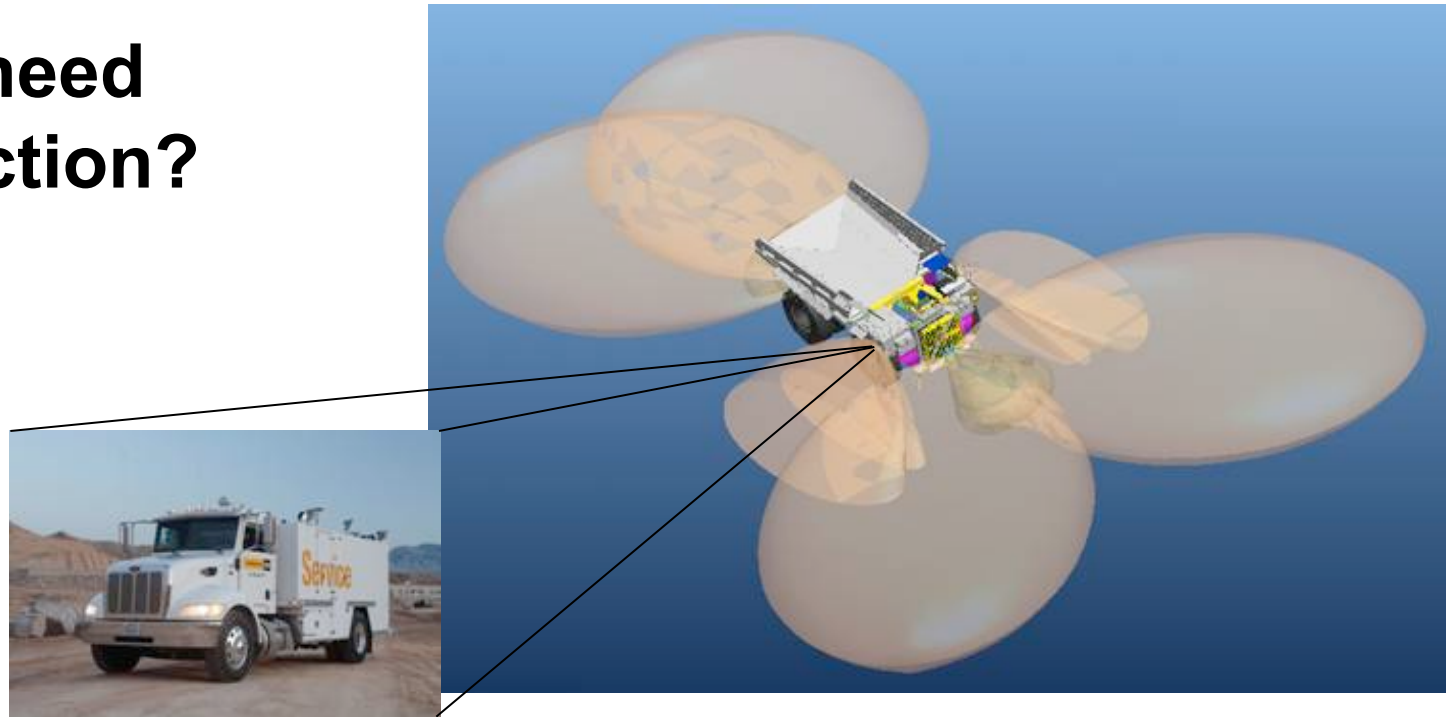
What is Object Detection?



- A system that aids the operator's awareness of their surroundings
- The system consists of
 - Color touch screen display
 - Medium range radars
 - Short range radars
 - Cameras
 - Harnessing
 - Mounting Hardware
- Display integrated with machine controls
- Radar alerts operator to objects
- Cameras allow operator to identify objects



Why do we need Object Detection?



- Haul trucks have large “blind spots” from operator’s seat
- 79% of collisions at mine sites involve large truck
- 59% of large truck collisions involve another piece of mobile equipment (38% immobile objects, 3% people)
- 69% of collisions occur at low speeds
- System needed to alert operator of object



Other Detection Technologies

- Ultrasonic
 - Performance affected by rain, ice, snow vibration
 - Limited range
- RFID
 - Need for off-board infrastructure
 - Does not detect untagged objects
- Infrared/Vision
 - Immature technology
 - Greater computing resources required
- GPS
 - Need for off-board infrastructure
 - Limited GPS coverage in remote areas
 - Objects w/o GPS system not detected



Why radar?

- Self contained system
- Robust and mature technology
- Range fits application needs
- Good value for capability
- Resistant to effects of rain, snow, fog



Dual beam continuous wave UWB
24 GHz carrier frequency
Up to 7 meters range



Pulsed UWB
24 GHz carrier frequency
Up to 30 meters range



System Research and Development

- System Goals
 - Custom designed for hauling applications
 - Reinforce safe operator behavior
 - Alert operator to immediate threats
 - Minimize intrusiveness
- Caterpillar system targeted to address largest percentage of accidents
 - Optimized for objects pick-up truck sized and larger
 - Smaller objects detected with decreased range and coverage area



System Research and Development

- Field research occurred throughout 2007
 - Installed two systems at mine site
 - 20 operators used system
 - Operators liked system
 - False detections only major issue
- Caterpillar started commercializing this product in 2008
 - Updated software, components, brackets, and harnesses
 - Tested system on four trucks at Caterpillar test facility
 - Spent nine weeks testing system
 - Prototype system field testing on nine trucks



Display Interface

- Graduated warning system
- Integrated four camera system
- Automatic system activation
- Self Diagnostics
- Configurations



Camera View

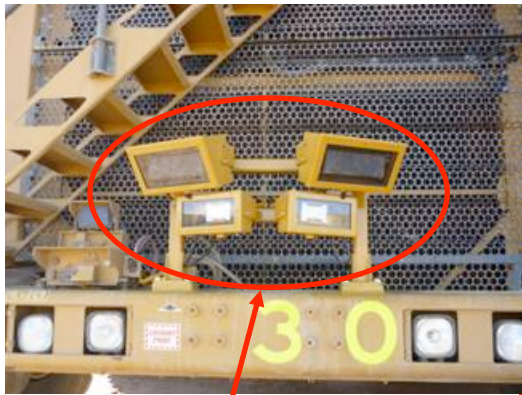


System Status

Radar Information



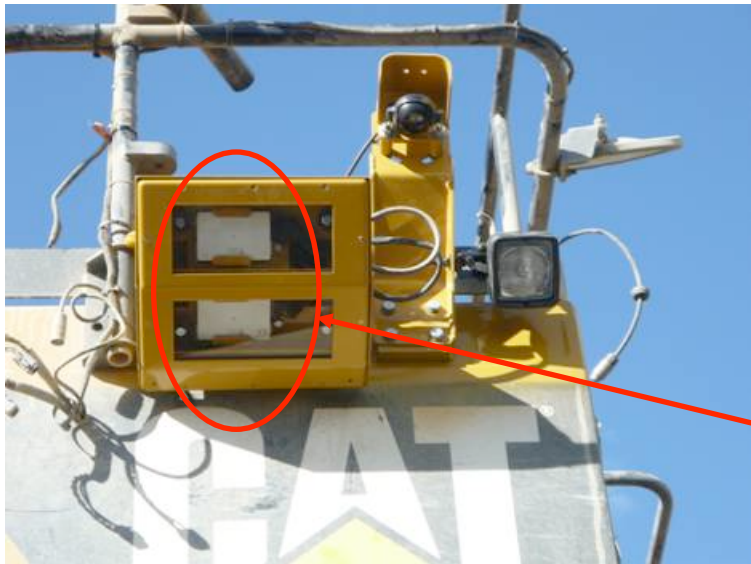
System Installation (793D) - Front



Two Short and Two
Medium Range Radars



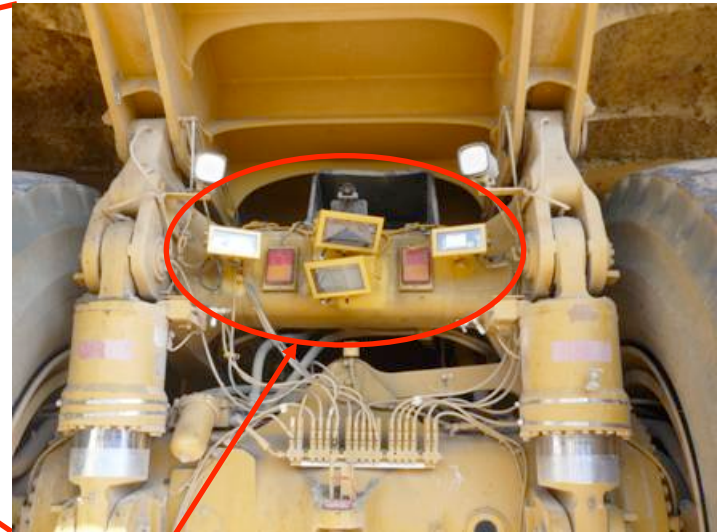
System Installation (793D) - Sides



Two Radars Per Side



System Installation (793D) - Rear

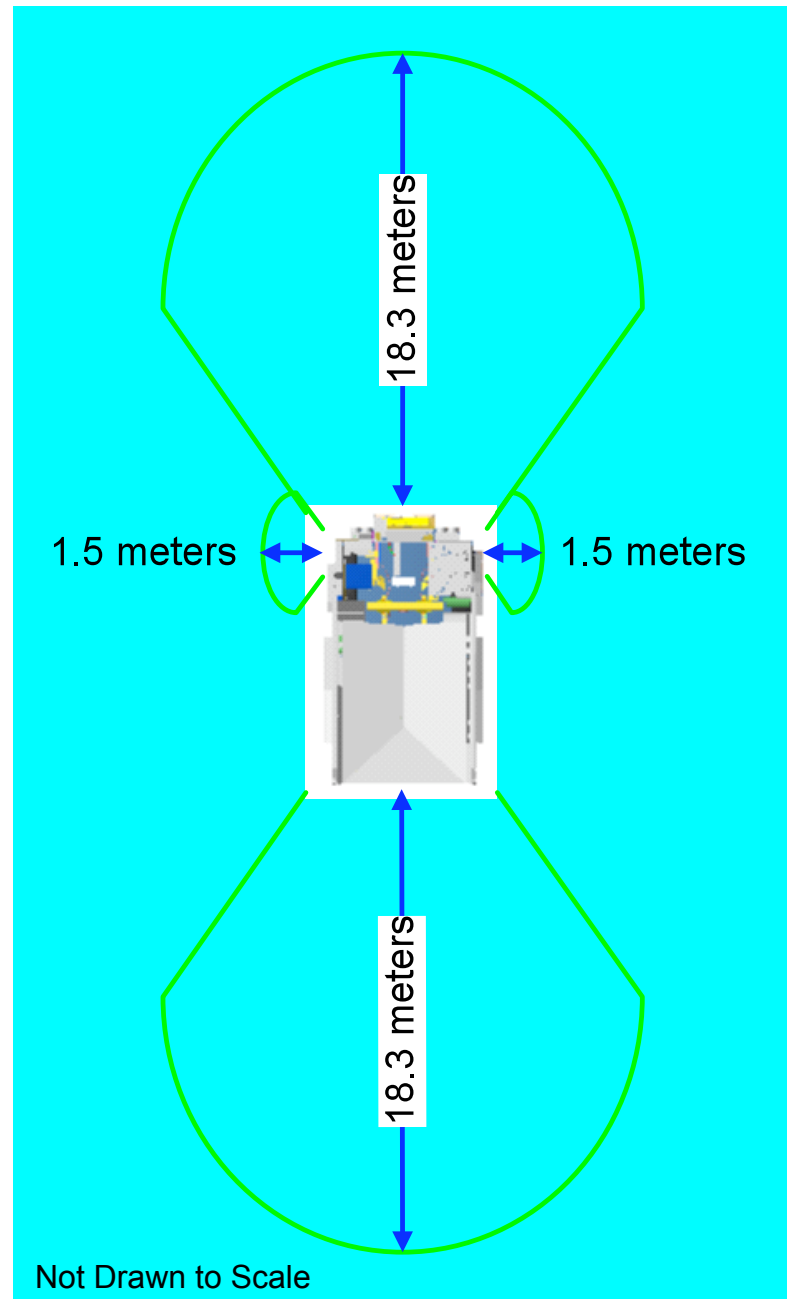


Two Short and Two
Medium Range Radars



System Performance

Illustration shows performance of system using a pick-up truck as object



Summary

- Robust
- Easy to use
- Non-intrusive
- Stand alone
- Available on Caterpillar haul trucks later this year

