Be Level-Headed with Non-Contact Sensors

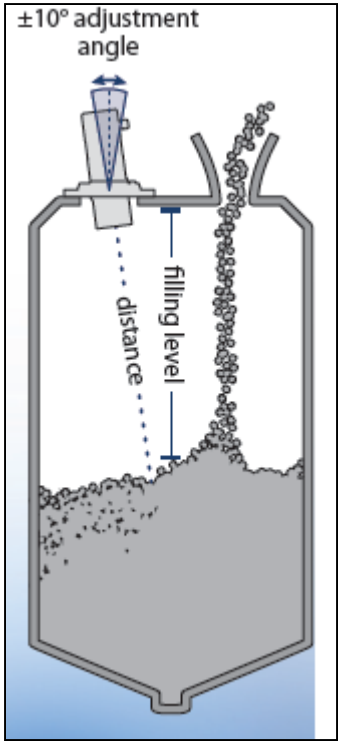
September 20, 2016

What You Will Learn

- Differences in non-contact technologies
- Do you need level or volume
- How to get volume accuracy in large silos
- Side-by-side technology comparison
- Configuration and data communication options
- What you might expect to pay

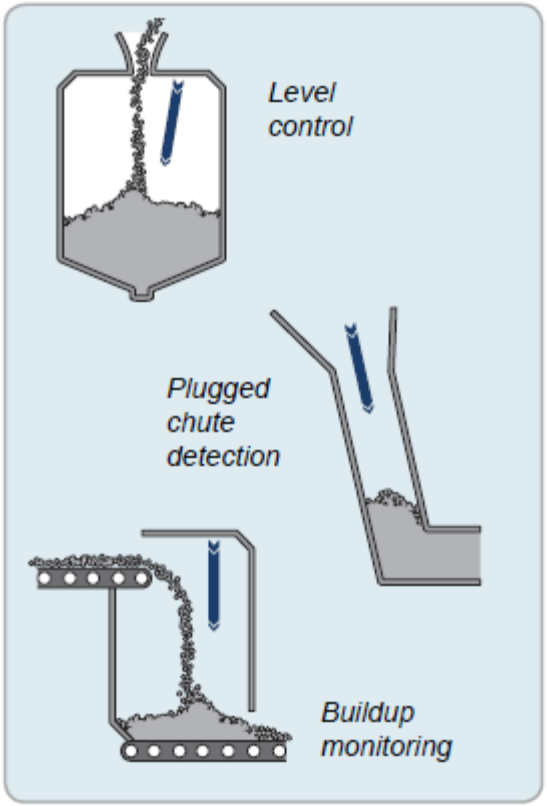
Laser – How it Works

- Sensor is mounted on top of the silo using an adjustable 10° mounting flange for aiming the laser to the desired output location
- Sensor sends timed laser pulses to the material surface
- Minimum and maximum distances are set using 4 and 20 inputs configured on the sensor
- Distance is calculated using complex algorithms that convert the laser pulses to a data output
- A compensation for “slant range” is made based upon the angle of the beam to ensure accurate level measurement



Laser – Applications

- Low or no dust environments
- Level control in narrow vessels containing solids
- Plugged chute detection
- Restrictive chutes and hoppers where precise targeting is needed
- Monitoring buildup when installed above or pointed to the sidewall
- Opaque liquids in applications where the beam must be precisely targeted to avoid walls or structure



Laser – Pros

- Adjustable, swiveling mounting flange is flexible up to 10 degrees
- Narrow beam can be directed to avoid obstructions
- Easily configured in the field using a USB port
- Configuration can be performed without filling or emptying the vessel
- Fast update rate of 8 times per second
- Integrated dust protection for minimal maintenance
- Can also be used in opaque liquids

Laser – Cons

- Not recommended for use in dusty environments
- Only measures a single point in the bin
- Subject to interference from falling materials
- May need an air purge option to keep lenses free of dust for reliable performance
- Not recommended for liquids with excessive vapor that is too opaque for the laser to “see through”

Non-Contact Radar – How It Works

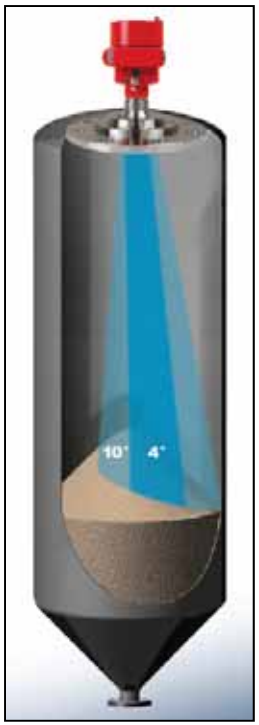
- Sensor emits an electromagnetic pulse through the antenna
- The emitted signal is reflected by the material and received by the antenna as an echo
- The frequency of the received signal is different from the emitting frequency
- The frequency difference is proportional to the distance and the height of the material being measured
- The difference is calculated using special algorithms contained in the sensor's electronics
- The material height is converted and output as a measured value

Non-Contact Radar – Applications

- Grain, seed, feed, ingredient bins – granules or pellets
- Very tall, narrow silos for single point level measurement such as those at grain elevators
- Segmented silos with narrow compartments
- Bins with excessive noise, dust, or high temperatures
- Bins where precise aiming is needed to avoid internal structure, flow stream, or sidewall buildup
- Mounted over piled material or in flat storage warehouses
- Over conveyors belts to prevent overloading or detect when belts are running empty

Non-Contact Radar – Pros

- Powerful 80 GHz radar significantly outperforms old 26 GHz technology
  - 4° versus 10° beam angle for better precision
  - Substantial 393 foot measuring range
  - Sensor technology used by self-driving cars
- Strong signal performs well in dust
- Narrow beam can be precisely targeted to avoid structure
- Fast reaction/update time tracks filling or emptying activity
- Versatile for use in solids, liquids, and slurries
- Signal not affected by corrugation
- Loop power capability



Non-Contact Radar – Cons

- Measures only a single point (comparable to 3D scanner RL model)
- Not recommended instrument for precise volume for inventory management
- Cannot detect topography of material such as uneven piling or cone up or down
- Air purge may be required for extreme conditions such as in soybean meal
- Price of options can add up quickly

3D Scanner – How It Works

- Scanner is mounted on top of the bin at an optimal location recommended for superior surface coverage
- Acoustic pulses that sound like chirping crickets are sent to the material surface in a 15°, 30° or 70° beam angle
- The material surface is measured and mapped at multiple points to detect uneven topography
- Distance is calculated using advanced algorithms convert the difference in timing of the echo sent and received to a distance
- Data is sent via 4-20 mA or RS-485 output to software (or an HMI or PLC)
- Software records the data and calculates, level, volume, and mass and creates an optional 3D visual of bin contents

3D Scanner – Applications

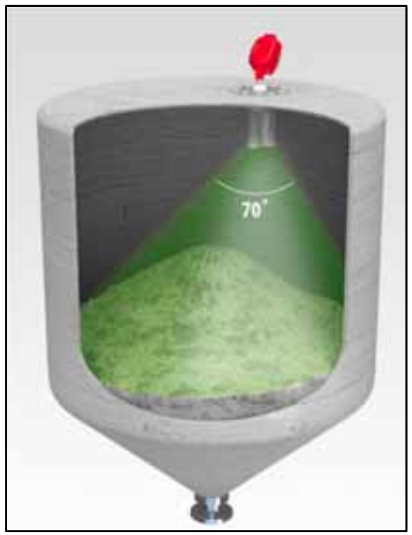
- Bins with high levels of dust
- Bins, tanks, and silos with irregular topography
- Bins with multiple filling and emptying points
- Very large or wide silos such as 90’, 105’, or 132’ diameter
- For accurate inventory management at ethanol plants
- Monitoring DDG storage bins
- Precise inventory of meals and flours that don’t flow and pile unevenly
- Inventory management in domes or flat storage buildings

3D Scanner – Models

- Model selection is driven by vessel size, desired accuracy, and need for 3D visual

RL

S



M or MV

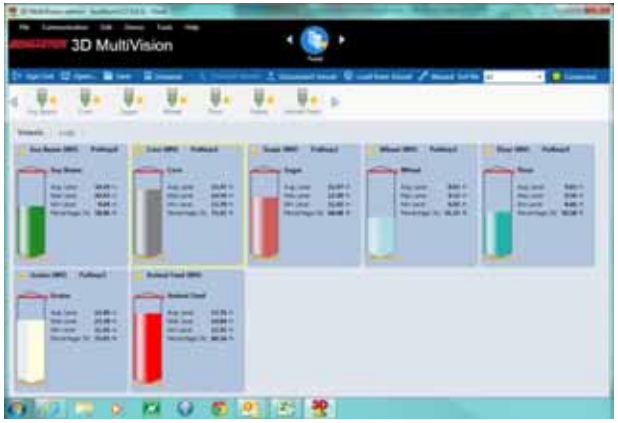
MVL

3D Model Comparison

Model	S	M	MV	MVL
Bin Height	Up to 200’	Up to 200’	Up to 200’	Up to 200’
Bin Diameter	Up to 14’	Up to 45’	Up to 45’	Unlimited. Number of units determined per application.
Beam Angle	30°	70°	70°	70° for each scanner
3D Visual	No	No	Yes	Yes
Output Data	Average distance/level, estimated volume	Estimated volume plus minimum, maximum, and average distance/level	3D visual, estimated volume plus minimum, maximum, and average distance/level	3D visual, estimated volume plus minimum, maximum, and average distance/level
Best Application	Tall, narrow bins with little or no corrugation	Wide bins, taller than they are wide	Wider bins, taller than they are wide	Very wide bins
All models can be used in silos with a larger diameter than specified, but with decreased accuracies as the beam angle will not span the entire surface of the material.				

3D Scanner – Pros

- Multiple point measurement to account for irregular topography
- Precise volume measurement within 1% to 3% of total stored volume
- Detects cone up, cone down, or sidewall buildup
- Only sensor with 3D visual of contents
- Volume accuracy in very large bins
- Uses three independent frequencies to transmit and receive to ensure accuracy
- Self-cleaning with minimal maintenance
- Optional Teflon-coated sensor for clingy or sticky materials
- Best sensor for flours, meals, or powders
- MultiVision software for managing multiple bins

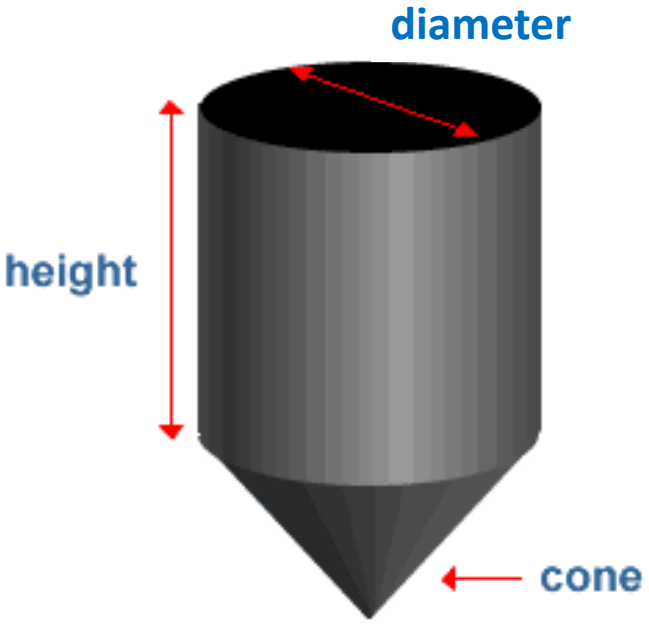


3D Scanner – Cons

- Must be installed in recommended location on silo roof for best results
- Requires an 8” opening for installation
- Start up and system configuration by a trained technician
- Slower update speed and tracking during filling
- Not for very narrow bins with corrugation
- Internal structure may interfere with operation
- No loop power option

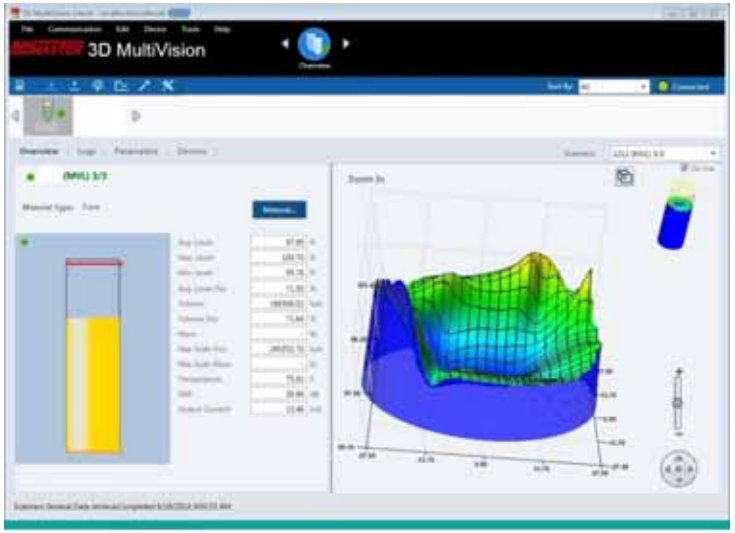
Level versus Volume

- Level: The height of the material from the bottom of the bin
- Distance: The distance from the sensor to the grain surface
- Volume: The amount of three dimensional space the material takes up
- Volume is calculated using the vessel dimensions put into a system and the measured distance to the material surface



Single versus Multiple Point

- A single measurement point used to calculate volume “assumes” the material surface is level
- Multiple point measurement can take into account variations in surface topography
- Volume calculations and inventory accuracy can be impacted by the number and location of the measurements. Generally, more measurement points mean more accuracy.
- However, no volume estimate will be accurate if the bin dimensions put into the system are not correct.



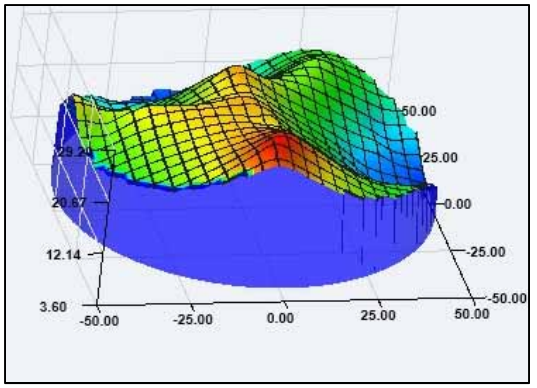
Single point is OK if:

- The material is free flowing
- There is a single filling and single emptying point
- Buildup or bridging aren't a problem
- The sensor is mounted 1/6 in from the outer perimeter
- You are not overly concerned with volume accuracy
- It's what your budget will allow

Mounting a single point device 1/6 from the outer perimeter in free flowing material in a single fill, single emptying point bin will provide the best volume estimate.

Multiple points are needed if:

- Level alone isn't good enough, you want volume accuracy for inventory
- There are multiple filling and emptying points creating an irregular material surface
- Mapping the surface is advantageous to detecting buildup and managing gates
- You want to know if there is buildup or cone up or down
- The material is powdery such as with flour or soybean meal



Performance Comparison

	3D Scanner	Non-Contact Radar	Laser
Works Reliably in Dust	Yes	Yes	No
Silos with Obstructions	Maybe	Yes	Yes
Narrow Silos	Yes	Yes	Yes
Narrow Silos with Corrugation	No	Yes	Yes
Wide Silos	Yes	Maybe	Maybe
Silos with Excessive Noise	Maybe	Yes	Yes
Tracks During Fill	Maybe	Yes	Maybe
Level Accuracy	Yes	Yes	Yes
Volume Accuracy	Yes	No	No

Feature Comparison

	3D Scanner	Non-Contact Radar	Laser
Measuring Range	200 ft	393 ft	164 ft
Update Speed	30 sec to 3 min	5 sec	1 sec
Measurement Points	Multiple	Single	Single
Self Cleaning	Yes	Maybe	No
Hazloc Ratings	Yes	Yes	No
Detects Cone/Buildup	Yes	No	No
3D Image	Yes	No	No
Loop Power	No	Yes	No

Configuration & Data Options

	3D Scanner	Non-Contact Radar	Laser
Modbus Output	Yes	Yes	No
4 – 20 mA Output	Yes	Yes	Yes
Output to HMI or PLC	Yes	Yes	Yes
BinView via Internet	Yes	Yes	Yes
Setup & Configuration	Advanced	Basic	Basic
Software	Yes	Yes	No
Multiple Bins	MultiVision	Yes	Maybe
Automated Alerts	Email, SMS	Email, SMS	Email, SMS

Single Sensor Pricing Ranges

Laser	LL-100 starts at $2,200	Configured averages $2,400
Radar	NCR-80 starts at $2,600	Configured with options $2,800 to $3,500
3D	RL starts at $2,400	MV starts at $7,600

Thank You

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