Advances in Pipeline Condition Assessment & Mapping Technologies

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Importance of Pipeline Inspection, Condition Assessment & Mapping

You must know what is in the ground to understand your system

- Key components of successful asset management programs
- Proactive condition assessment prevents failures
- Basis for informed, risk management decision making
- Improves budgeting & capital management
- Critical for selecting rehabilitation/ repair methods

Because if you ignore your pipes, they will ignore you…

The Old Days: How pipes were commonly inspected & mapped

Entry inspection

CCTV Inspection

Utility locates & as-builts

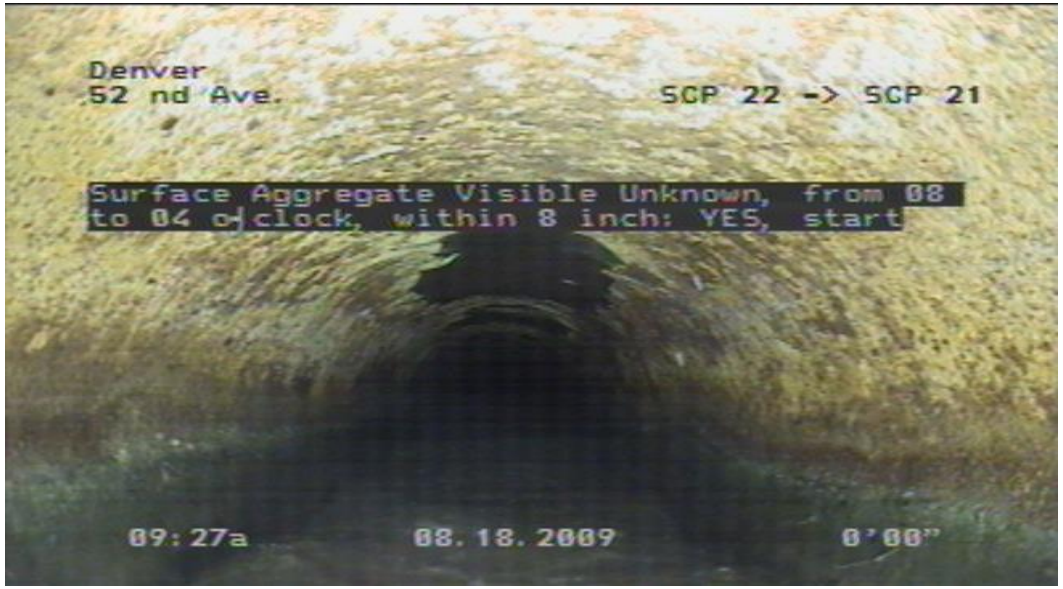
Destructive evaluation

Or no inspection at all!!

CCTV has been the backbone of pipeline inspection

- Most gravity pipeline condition assessment data has been (and still is) collected using CCTV systems
- Some pressure pipe inspection is conducted with CCTV
- Basic visual inspection information, above the waterline
- Basis for NASSCO PACP/ LACP rating system for sewers
- Cost effective, consistent
- Non-destructive
- No man-entry
- Readily available
- Helps identify defects, run lengths

Non-quantifiable information



Technological Advances in Pipe Inspection Now Provide:

- Now we can obtain **quantifiable** inspection information
- Ability to see-through pipe walls, wall thickness
- Underwater inspection capabilities
- Quantification & identification of leakage
- Pressure pipe inspection capabilities
- PCCP and Metallic pipe inspection
- 3D mapping and imaging capabilities
- Emerging AI & machine learning

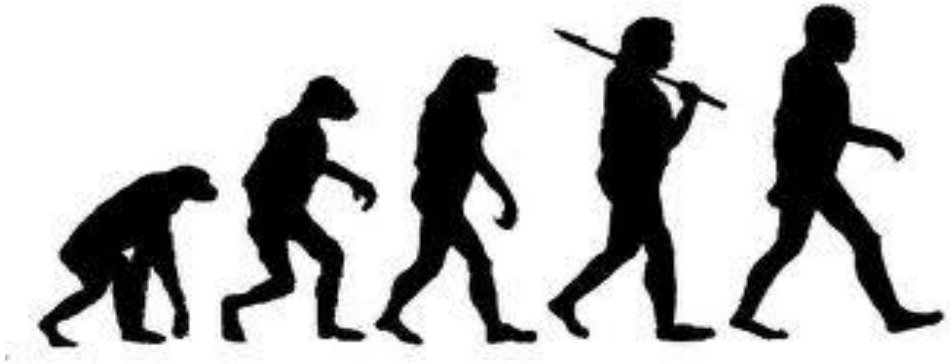
A wide variety of options the inspection toolbox!

Evolution of Pipeline Inspection Technology

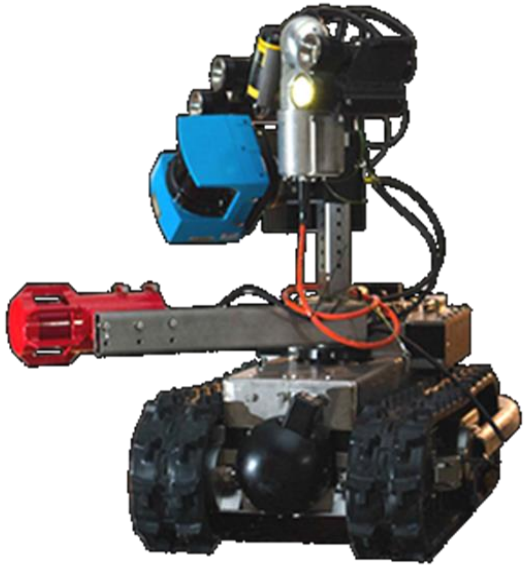
Entry Inspection

CCTV

Multi-sensor Systems &
Advanced Inspection Technology



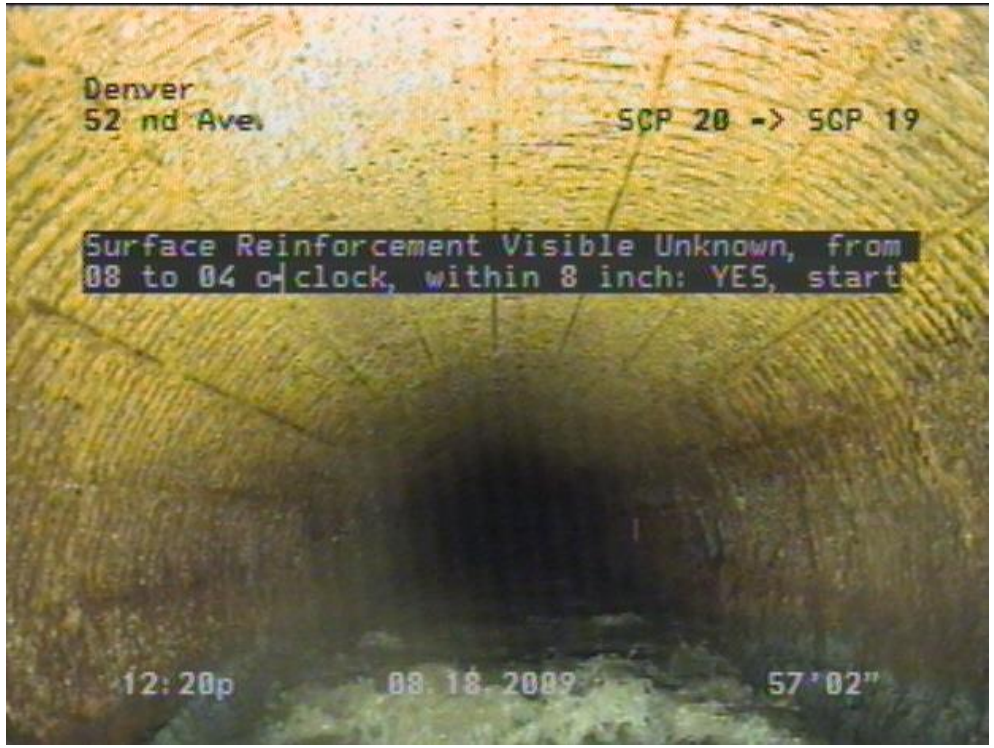

CLEANFLOW

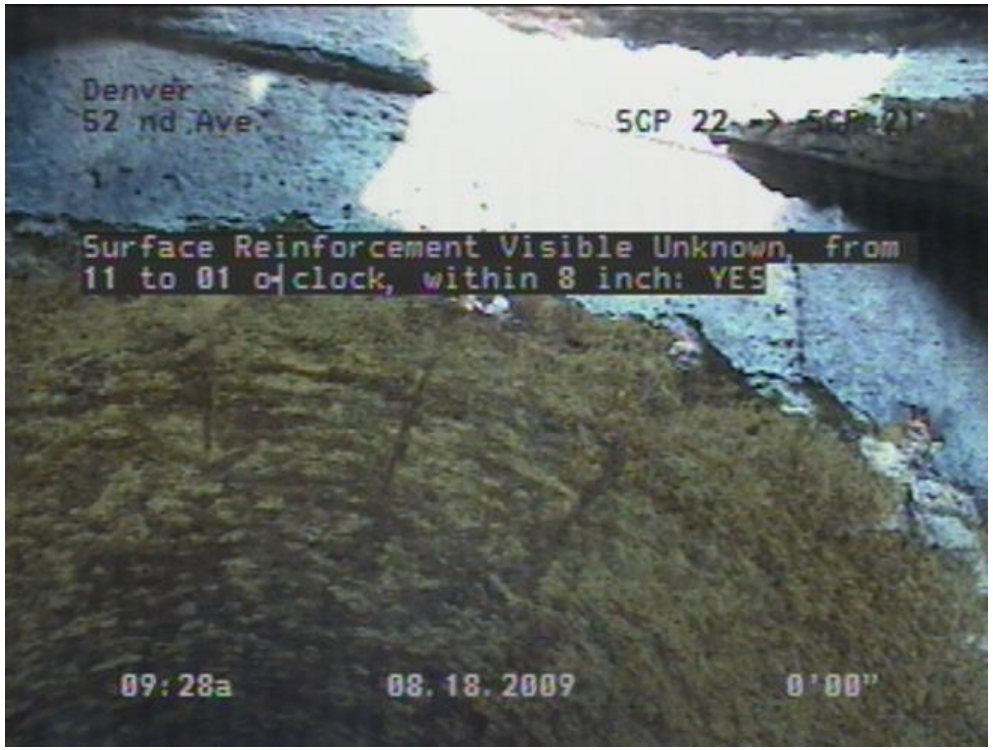



SewerVUE

Traditional Pipe Inspection & Condition Assessment

Example inspection data from CCTV

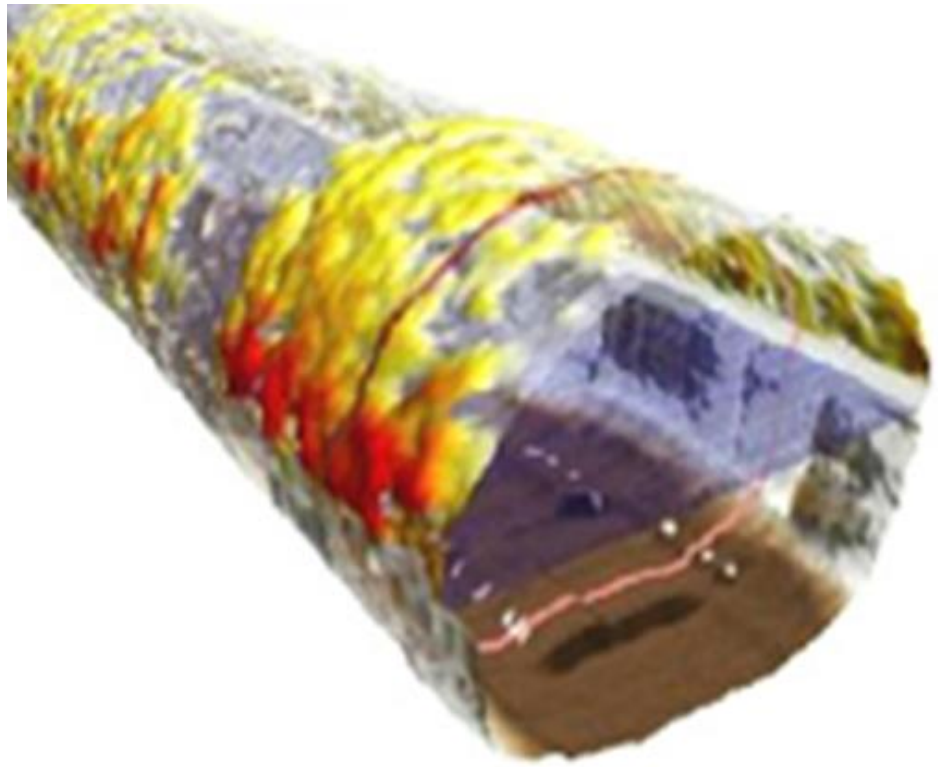


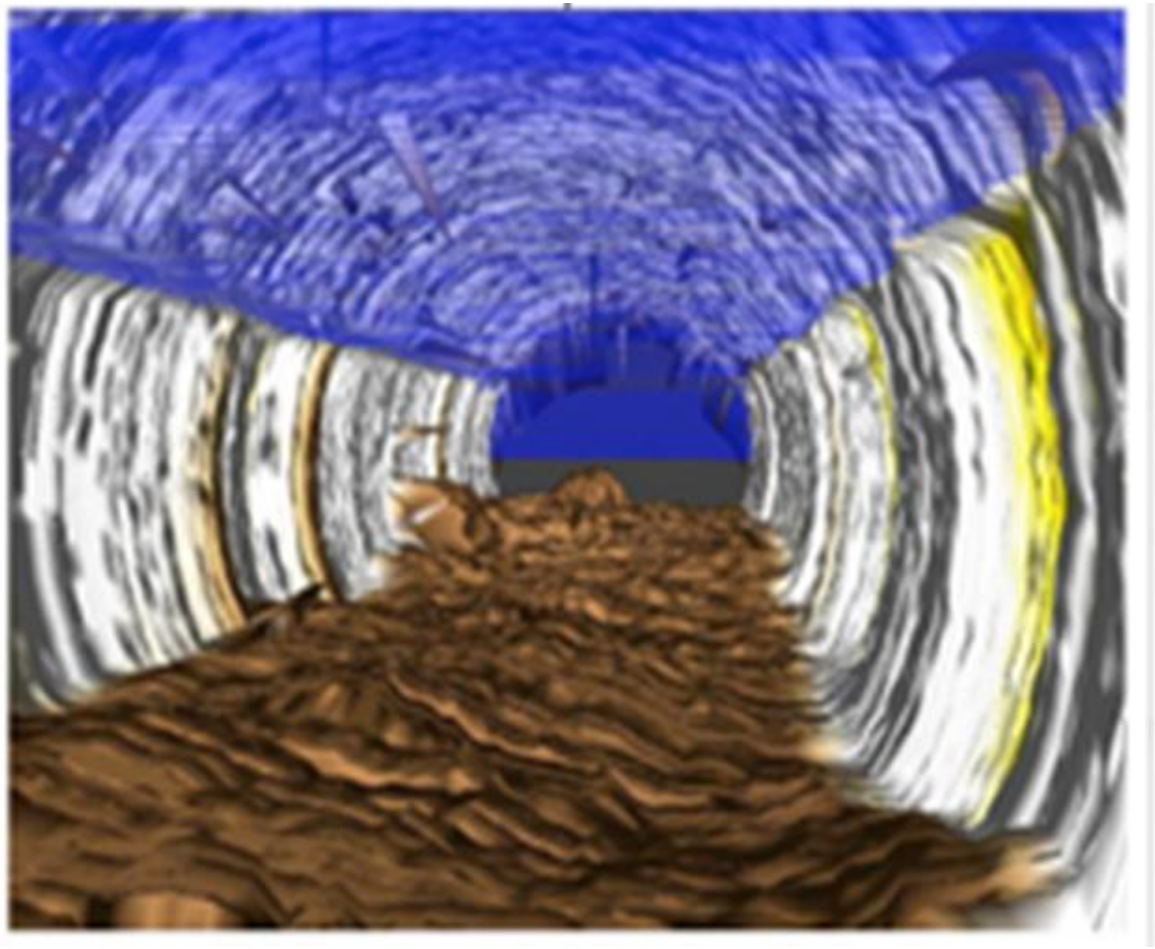


Compared to…

Advanced Pipeline Condition Assessment

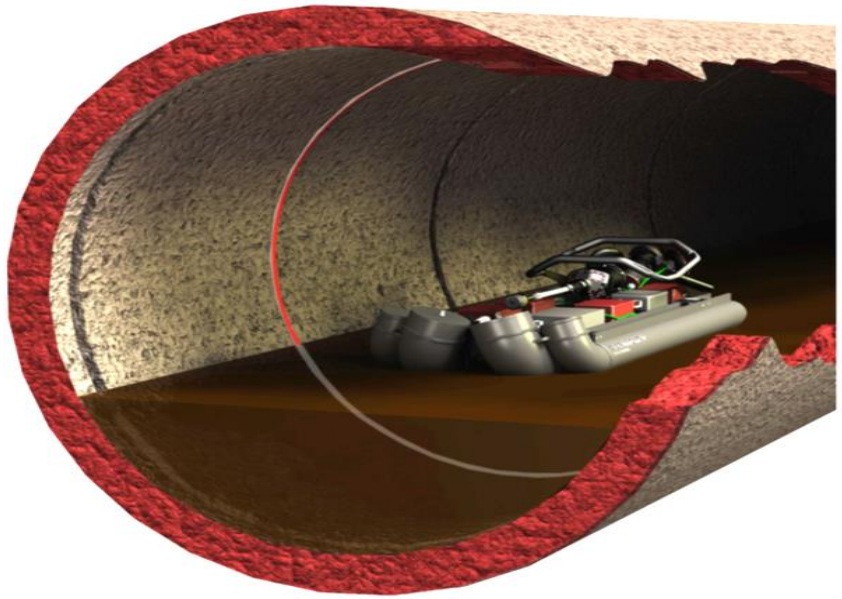
Example 3-D inspection data from a LASER profile/ SONAR system





Today's Advanced Pipeline Condition Assessment Technology
Gravity Pipeline Applications

- Robotic, multi-sensor, and add-on systems
  - Laser profiling, LIDAR, SONAR, HD-CCTV, Pipe Penetrating Radar, gas monitoring
- Provides comprehensive, **quantifiable** inspection data
- Very accurate, but more expensive than CCTV alone
- Less reliant on defect identification by operator
- Long & deep deployments possible
- Composite results package
- Non-destructive
- No man-entry required in most cases



Today's Advanced Pipeline Condition Assessment Technology Pressure Pipeline Applications

- Cutting edge inspection systems for metallic and non-metallic pipes
  - RFT, MFL, acoustic, pulse wave, multi-sensor, ultrasonics and more
- Provides comprehensive, **quantifiable** inspection data
- Very accurate but can be expensive
- Deployments in limited access areas
- Internal and external systems
- Composite results package
- Non-destructive, long deployments possible
- No man-entry required in most cases

Pressure Pipeline Inspection System Examples

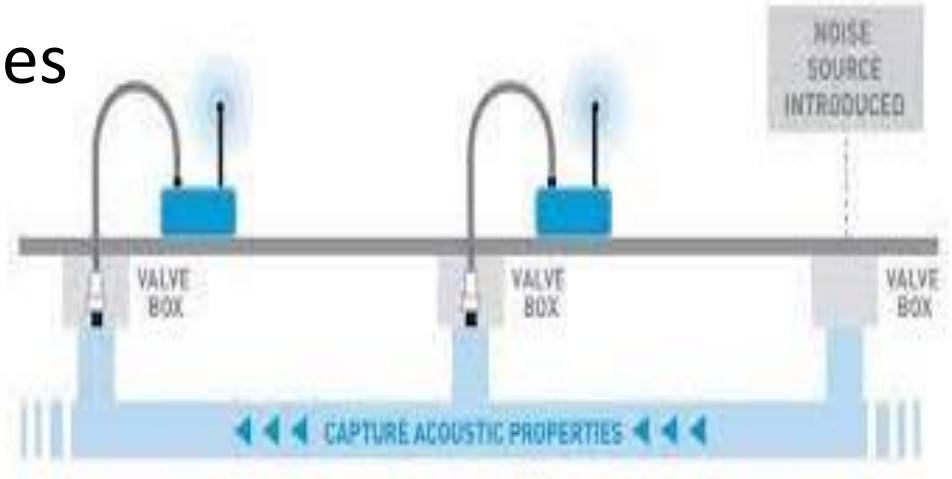
Internal RFT and MFL Electromagnetic Systems

- Suitable for cast iron, ductile iron, steel pipelines
- Can be operated in pipe diameters from 2” to 36” (RFT), larger diameters possible with MFL
- Detects corrosion, pipe wall thickness & pipe defects
- Flexible around bends (RFT systems particularly)
- Can monitor from above ground
- Long deployments are common

Pressure Pipeline Inspection System Examples

External Acoustic and Pulse Wave Systems

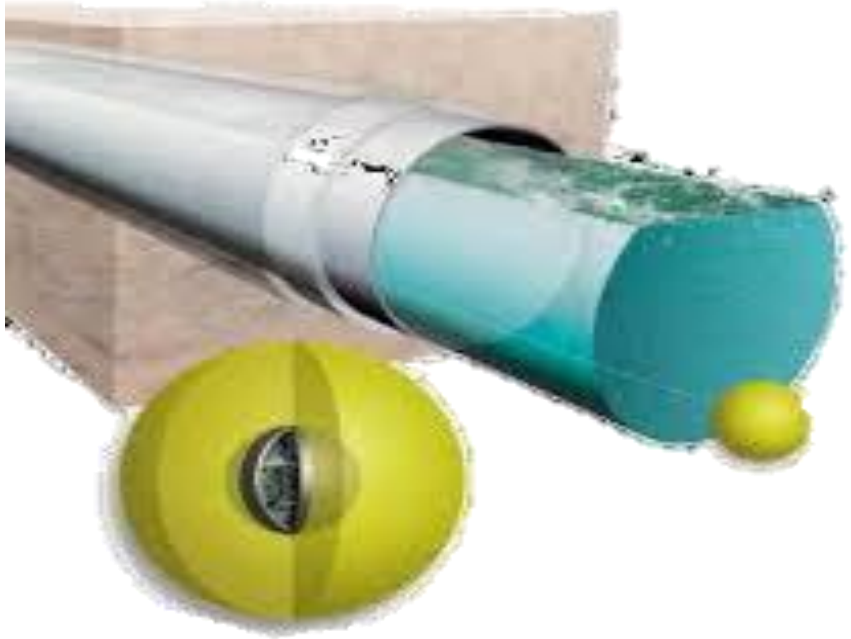
- Suitable for a wide variety of metallic & nonmetallic pipe
- Does not disrupt flow or service
- Some applications can assess pipe wall thickness
- Leak detection performed simultaneously
- Above ground access at valves & appurtenances
- Sensors can be placed at variable intervals
- Long lengths can be rapidly inspected



Pressure Pipeline Inspection System Examples

Internal Leak Detection & Multi-Sensor Systems

- Multi-Sensor Inspection System for Pressure Pipes
  - Laser, SONAR, electromagnetic inspection in partially or fully depressurized forcemains (typically 18”+)
  - Can be used in a variety pipe materials including PCCP, depending on system
- Tethered Leak Detection
  - Leak & gas pocket detection for pressure pipes (4”+)
- Free-Swimming Leak/Gas Pocket Detection
  - Acoustic leak detection capabilities
  - Used in live, operational pipelines
  - Inserted through valves or hydrants

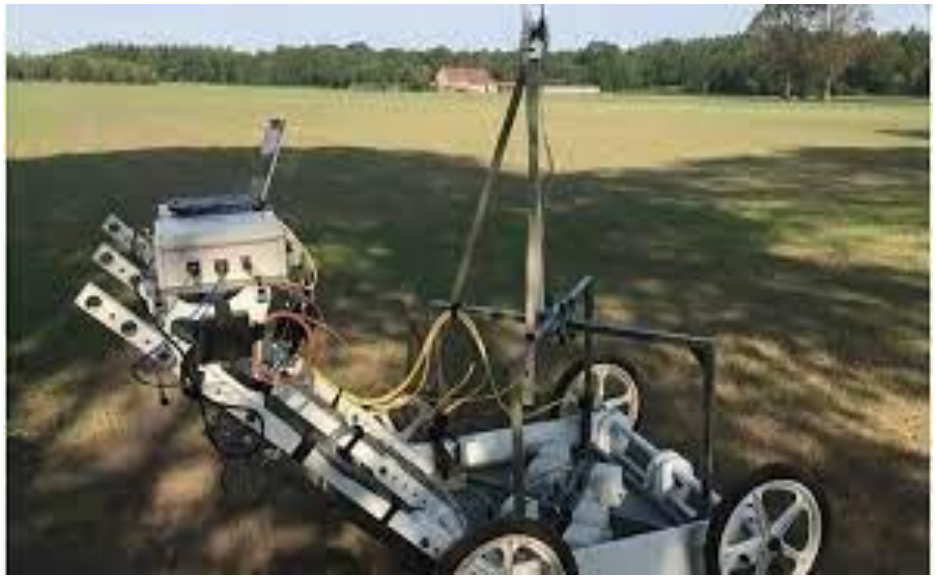


Advanced Pipeline Mapping Technologies

- State-of-the-art X,Y,Z coordinate mapping systems are now available
- Provides very accurate 3D vertical & horizontal location information
- Internal mapping probe technology compatible with GIS systems
- Detects pipe sags, misaligned joints, horizontal and vertical design issues
- Long length deployments possible
- Stand-alone or integrated systems
- Potential to integrate with CCTV visual inspection

Emerging Pipeline Mapping Technologies

- Above-ground 3D electromagnetic/ GPR locating and mapping technology
- Originally developed to detect and identify unexploded ordinance
- Dept of Defense technology transfer into pipeline/ infrastructure applications
- Being refined to detect & characterize various types of pipes and their locations



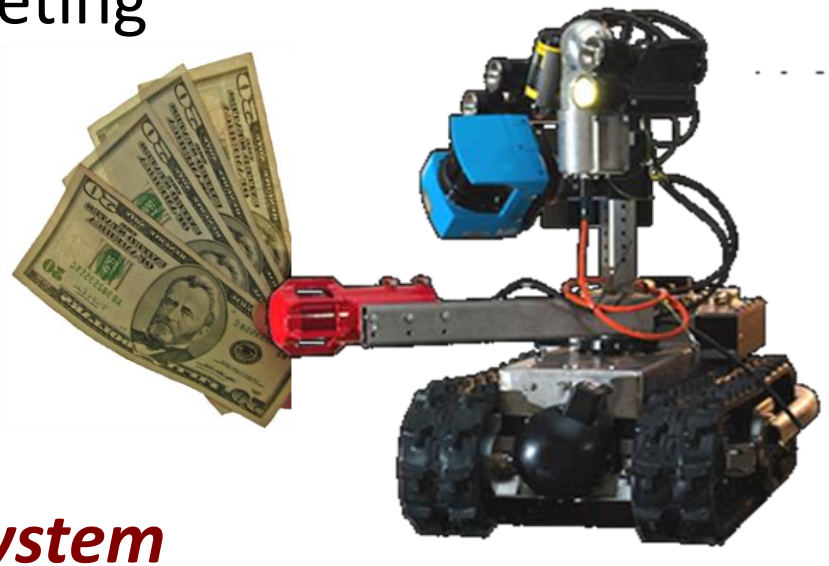
What inspection system should I use?

- There is no one-size-fits-all advanced pipeline condition assessment or mapping system – each application is unique
- Depends on pipe material, diameter, deployment
- Are there gravity, pressurized or submerged conditions?
- What information are you looking for?
  - Extents of corrosion
  - Pipe location
  - Wall thickness -remaining life in the pipe
  - Debris quantification
  - Underwater condition assessment
  - Voids and corrosion behind the pipe
  - Rebar condition
  - Leakage

- **Importance of an experienced, knowledgeable consultant**

Benefits of using advanced pipeline condition assessment & mapping technology

- **Quantifiable** inspection information
- Rapid, accurate inspection and location capabilities
- Better information = Better decision making
- Allows for better capital project planning & budgeting
- Larger upfront cost is offset
  by project planning savings
- Less costly surprises
- More effective asset management



Know what is in the ground to understand your system

A Look Into the Future…

- Advanced pipeline condition assessment and mapping technologies will continue to rapidly progress and evolve
- Artificial Intelligence and machine learning will be integrated into a variety of inspection systems
- Seamless integration into asset management programs can be expected
- Most impactful advancements will be in the potable water sector
- Technologies will become more readily available and more cost effective
- Advanced multi-sensor technologies represent the future in pipe condition assessment.

Questions?

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