InfoSense, Inc
Innovating Acoustic Inspection Technology™

How to choose when to use the SL-RAT, versus a pole (zoom) camera, or robotic CCTV

Comparing the Primary Inspection Technologies in a Collection System Operator's Toolbox

	SL-RAT	Pole (Zoom) Camera	Robotic CCTV
Technology Description	Sound waves passed through pipe segments create an acoustic blockage assessment score from 0 (blocked) to 10 (plenty of flow capacity)	Video or still image camera deployed by stationary camera mount by lowering through manhole – does not pass through pipe segment	Video camera deployed using mobile robots provides visual recording of interior pipeline conditions.
Best Application	Screening tool for small diameter pipes	Screening tool for larger diameter pipes	Detailed interior pipe surface condition inspections
Pipe Diameter	6-18in	6in* or larger[e] *"zoom cameras are known to perform better in larger diameter pipes… can only "see" 100 ft down an 8-in pipe"*[d]	6in or larger[e]
Equipment Setup	Setup Identical for each inspection, no adjustments required	Setup dependent on manhole depth	Setup dependent on pipe location and manhole configuration
Avg Inspection Rate	Less than 3min/segment[c]	12-24 min/manhole[a,b]	30ft/min[c]
Avg Production Rate	9,500-12,000**ft/day[c]	4,600-6,250*ft/day[e]	1,000-2,000 ft/day[c,e]
Cost	$0.02[d]- 0.14/ft[c]	$0.23* - $1.00/ft[b,c]	$1.68 to $2.03(off road)/ft[c]
Assessment Consistency & Operator Training Requirement	Measurement assessment consistent across operators - assessment based on machine learning algorithm	Measurement assessment based on operator visual interpretation with dependency on experience, skill level and training	Measurement Assessment based on operator visual interpretation with dependency on experience, skill level and training (i.e. PACP certification)
Limitations	Does not tell where the issue is or where it is in the pipe; Limited to small diameter pipes	Possible to miss significant defects outside of sight distance or obstructions such as water vapor, pipe misalignment, pipe curves; Highly dependent on operator training/skills; Depth of manholes (extendibility)	Difficulty accessing off-road locations; Expensive to operate; Time intensive; Highly dependent on operator training/skills; Sewer cleaning may be required prior to inspection

Sources: [a]Martel (2011); [b]Martel (2010); [c]Panguluri (2014); [d]Steach(2016); [e]Tuccillo (2010)

*Zoom camera production rate is highly dependent on pipe diameter (sight distance can range from 50 ft for 8-in pipes to 700ft for larger diameter pipes)

**12,000ft/day was the average rate verified by users in the field – based on approximately 100,000 SL-RAT assessments

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Comparison of tradition CCTV with zoom camera and SL-RAT technology in Application

In order to perform their jobs properly, collection system operators need to have various complementary inspection tools available in their "toolbox." The SL-RAT and pole camera provide speed, low cost, and ease of use. They are excellent preliminary screening tools. Robotic CCTV provides tremendous detail, but it comes at a higher cost and much slower speed. When used in combination, the system operator can better allocate resources in a much more cost-effective way.

If a utility with 1,000 miles of sewer were to inspect their entire system using one crew only, the hypothetical table below compares the time and costs between technologies:

Technology	Miles of Pipe in Collection system	Average Cost US$/ft	Projected Funding Requirements (USD)	Avg Production Rate (ft/day/crew)	Time Required (years)*
CCTV	1,000 miles	$ 1.86/ft	$ 9.8 Million	1,500 ft/day	13.5
Zoom Camera**	1,000 miles	$ 0.62/ft	$ 3.3 Million	5,425 ft/day	3.7
SL-RAT	1,000 miles	$ 0.08/ft	$ 0.4 Million	10,750 ft/day	1.9

* Based on 260 work days per year
**Zoom camera production rate is highly dependent on pipe diameter (sight distance can range from 50 ft to 700ft per manhole)

Ultimately, an operator must take into consideration the tradeoffs of utilizing each technology and appropriately select the right tool for the job. The SL-RAT is best for quick and low-cost screening of small diameter pipes – which constitute the majority of pipes in an average collection system. However, the SL-RAT technology should not be applied to pipes larger than 18 inches in diameter. On the other hand, a zoom camera is frequently ineffective in small diameter (6-8 inch) pipe inspection applications, being limited on average to 50ft to 100ft sight distances in 8-in pipes (Martel 2010 & 2011). However, zoom cameras are extremely effective for screening larger diameter storm and sewer lines. And while CCTV technology is a much more expensive and time-intensive method of inspection, neither the SL-RAT nor zoom camera can replace the detailed view of pipe wall conditions that it provides.

References

[a]Martel, K., Feeney,C., and Tuccillo, M. 2011. Field Demonstration of Condition Assessment Technologies for Wastewater Collection Systems. Report Number EPA/600/R-11/078. Office of Research and Development, EPA. Available on the internet at https://nepis.epa.gov/Exe/ZyPDF.cgi/P100C8E0.PDF?Dockey=P100C8E0.PDF

[b]Martel, K., Tuccillo, M., Rowe,R., Hogan, S., DeBlois, G., Thayer, S., Bannon, B., Ross, M., and Enfinger, K. 2010. Innovative Internal Camera Inspection and Data Management for Effective Condition Assessment of Collection Systems. Report Number EPA/600/R-10/082. Office of Research and Development, EPA. Available on the internet at https://www.wef.org/globalassets/assets-wef/3---resources/topics/a-n/collection-systems/technical-resources/epato592010innovativecamerainspection.pdf

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[d]Steach, Kristen, Interview by Cartegraph. 2016. Available on the internet at https://www.cartegraph.com/video/kingsport-tn-modern-infrastructure-management

[e]Tuccillo, M., Jolley, J., Martel, K., and Boyd, G. 2010. Report on Condition Assessment Technology of Wastewater Collection Systems. Report Number EPA/600/R-10/101. Office of Research and Development, EPA. Available on the internet at https://www.wef.org/globalassets/assets-wef/3---resources/topics/a-n/collection-systems/technical-resources/epato592010reportonconditionassesmentofwwcs-1.pdf