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Smart Sewer Assessment Systems

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EMERGING CONSTRUCTION TECHNOLOGIES

Civil - Trenchless Technologies

SMART SEWER ASSESSMENT SYSTEMS

THE NEED

The need for accurate preventive assessment of sewer conditions is increasing world wide. Problems encountered with faulty conditions that arise in old sewer lines are numerous. Examples of these problems are dramatic collapses of pipelines from groundwater infiltration, and exfiltration of sewage into the groundwater and the surrounding soil causing dramatic environmental pollution. In fact, Germany pays an estimated 100 billion DM in restoration of failed sewer lines. As a result, the German government has increased the requirements on sewerage facilities by enacting relevant laws (Kuntze et al., 1995).

FIGURE 1 KARO SYSTEM

These problems are further magnified by the lack of proper and error proof inspection techniques that would detect faulty conditions before sudden failure occurs. Contemporary electronic inspection through CCTV (a remotely controlled camera-based system that goes through the pipe and transfers images to a monitor) is not precise and error prone due to the subjectivity and difficulty of an exact evaluation by the operator.

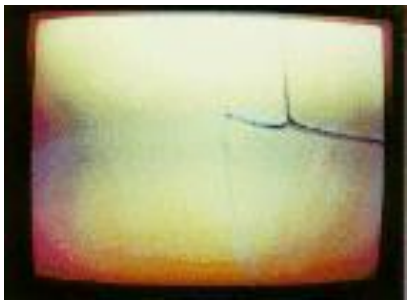

FIGURE 2 OPTIMESS TRISCAN SYSTEM

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THE TECHNOLOGY

The new method utilizes qualified inspection systems that are automated and that utilize artificial intelligence to assess whether or not a crack in the surface of the pipe exists. The KARO system is one example. Developed by the German Federal Ministry of Education, Science, Research, and Technology (BMBF) and four partners from both industry and research institutions. This system is composed of a mobile control and surveillance station, and a mobile robot.

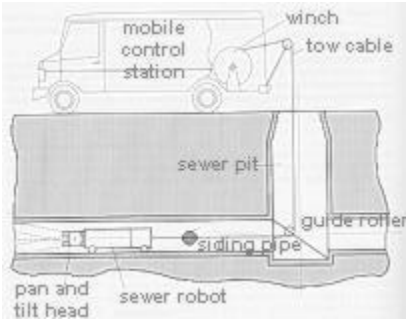

FIGURE 3 KARO SYSTEM CONCEPT

The robot is of high maneuverability and carries intelligent multisensorics that are based on a 3-D optical sensor, ultrasonic sensors for inside pipe inspection, as well as a microwave sensor for the inspection of the soil surrounding the pipe wall (Kuntze et al., 1995). Defects are detected by means of sensor signals which are 'intelligently' connected to each other. They are evaluated by means of fuzzy mathematical methods.

Another example of a pipe condition assessment method is the PIRAT System. Developed by CSIRO (Australia's research agency). This system consists of an in-pipe vehicle which carries scanners and associated instruments that monitor the sewer and a mobile control room which houses data analysis and controls. A laser scanner is used for a drained pipe and a sonar scanner is used for flooded pipes (Campbell et al., 1995). The laser scanner operates by analyzing reflected light using a video camera. And the sonar scanner works by analyzing echoes that represent the features of the pipe. Finally, the interpretation system implements artificial intelligence to automatically classify and rate pipe defects.

Finally, OPTIMESS GmbH a German company offers TriScan. A TV-inspection system for sewage water drains, process pipes and long distance pipelines. The camera is equipped with a special laser distance sensor. It works with high resolution among 50 and 250 mm supplying exact spatial coordinates, so it is possible to separate and classify objects by its dimensions, shape, and profile. The measuring system is able to verify and determinate: pipe diameter, pipe deformations, pipe wall thickness, cross-sectional profile, crack length and width, and degree of pipe corrosion. It can be used for leakage localization in drinking water supply networks and inspection of long-distance pipelines up to a length of 10 kilometers.

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FIGURE 4 OPTIMESS DKM TOOL

THE BENEFITS

The development of such systems allows objective and reliable evaluation of the obtained data for assessment of the existing pipe conditions (damage location, type, and volume). Compared with most TV-based systems, these systems have the extra benefit of employing intelligent multisensorics, and/or neural network training. According to Campbell, the assessment of expert asset managers reveals that on concrete and VC pipes, these systems exceed the performance of good CCTV operators. Moreover, these systems have the potential of predicting or forecasting future system deterioration.

STATUS

The KARO System is currently being applied in Germany and in respect to the PIRAT System it has been used for the inspection of 5 kilometers of sewers in Melbourne.

BARRIERS

There is still no information on the cost associated with such systems. Some disadvantages lie in the slower inspection speeds required for examination of finer defects. Also, the systems do not suggest an optimal repair method when cracks are detected.

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References

1. Campbell, G., Rogers, K., and Gilbert, J. 'PIRAT - A system for quantitative sewer assessment', International No-Dig '95 Conference Documentation, Dresden, September 1995.
2. Kuntze, H.B., Schmidt, D., Haffner, H., Loh, M. 'KARO - A flexible robot for smart sensor-based sewer inspection', International No-Dig '95 Conference Documentation, Dresden, September 1995.
3. OPTIMESS TriScan product information

Reviewers

Peer reviewed as an emerging construction technology

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