Intelligent Video Analysis by Paul Gagliardo, MPH, P.E.

The centralized sanitation infrastructure in the United States consists of 1.2 million miles of sewers, including both sanitary sewers and combined sewers. EPA estimates that there are at least 16,000 Publically Owned Treatment Works (POTWs) serving 230 million people. When sanitary sewer systems are not maintained properly, sanitary sewer overflows (SSOs), or discharges of raw sewage, can occur. Possible causes of SSOs include blockages, line breaks and sewer defects. Such releases regularly contaminate our nation's waters and expose humans to pathogens and viruses. EPA estimates there are 40,000 separate SSOs per year, contributing 2 billion gallons of untreated sewage into the environment every day. Only 20% of the sanitary sewer systems are inspected in any one year. Most of that survey is performed by CCTV video inspection with manual readings to identify defects.

Artificial Intelligence (AI) is an umbrella term for computer software that mimics human cognition in order to perform complex tasks and learn from them. Machine learning (ML) is a subfield of AI that uses algorithms trained on data to produce adaptable models that can perform a variety of complex tasks. AI systems work by ingesting large amounts of labeled training data, analyzing the data for correlations and patterns, and using these patterns to make predictions about future states. Deep learning is a class of machine learning algorithms that uses multiple layers to progressively extract higher-level features from the raw input. In image processing, lower layers may identify edges, while higher layers may identify the concepts relevant to a human such as faces. In the past few years video analytics has attracted increasing interest from industry. The main goal of video analytics is to automatically recognize temporal and spatial events in videos. This technology has led to advances in self driving autos, a smartphone application that can detect autism in children, algorithms to track retail customers' journey through stores, and, crowd management. AI also has a darker side where it is being used to create deep fake songs through voice cloning, composing written content with text generators and manipulating social media trends by amplifying divisive content.

The use of intelligent video analysis to review CCTV images and identify defects has many benefits. It can increase the productivity of the CCTV operator by a factor of two times. The model is more precise in detecting NASSCO graded defects than the human eye. Therefore, more critical defects that can cause infiltration or exfiltration are identified. The technology enables utilities to inspect more pipelines, at higher efficiencies and lower costs, providing more protection to the environment and public health.

The value to the utility that performs inspections with internal crews and its own trucks is significantly lower costs on a per mile basis, or, allows them to inspect more pipes for the same investment. Contractors who perform the work can achieve increased margins while at the same time allowing them to bid projects at a lower cost per mile. This technology increases the likelihood of finding critical defects that can cause sewer exfiltration and thus adding value to the environment by reducing contamination.

This is one case where implementing an automated AI solution provides benefits to many stakeholders and does not negatively impact society by creating deep fakes or the labor force by replacing humans with a computer program.