
TIP Project Brief - 90038/10H015

Civil Infrastructure

Distributed Fiber-Optic Sensing Technology For Civil Infrastructure Management

Develop a distributed fiber-optic sensing technology to enable real-time monitoring, identifying and locating disturbances and changes over long stretches of pipelines.

Sponsor: Optellios, Inc.

Newtown, PA

- Project Performance Period: 2/1/2010 - 1/31/2013
- Total project (est.): \$3,917 K
- Requested TIP funds: \$1,930 K

Optellios, Inc., is attempting to develop a novel and potentially widely deployable technology for monitoring the status and integrity of water pipelines and other similar structures using fiber-optic cables. Instead of using a large number of individual sensors that would be required to monitor a lengthy stretch of pipelines, the optical fiber would act as a continuous sensor providing real-time data about the location and nature of acoustical and temperature changes in the sensor's surroundings over distances of tens of miles. At present there is no single sensor system that is capable of providing such detailed real-time monitoring capability. Monitoring for thermal and acoustic anomalies along water pipelines will help detect water loss due to leaks, while simultaneously detecting structural changes associated with aging infrastructure by monitoring acoustic emissions. Acoustic monitoring would further enable early detection of third-party interference, particularly accidental and intentional excavations, a constant source of concern for in-ground utility operators. The key innovation, and most difficult challenge, is the use of a complex analysis of how specially tailored light signals, sent down the fiber, are scattered and reflected back from various points along the path. The specific character of the returned light—changing with time depending on how far it traveled—will reflect local conditions of the optical fiber at each point along its run, including both transient effects such as vibrations and more static conditions such as temperature and strain. Although the current research targets the in-ground water infrastructure, including water mains and wastewater systems, potential applications exist across many other critical infrastructure sectors. If such a monitoring system were successfully developed, it is expected to become a valuable tool for infrastructure management, because it could assist the operators in prioritizing maintenance schedules and prevent costly repairs and accidents.

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