TIP Project Brief – 080058/9H9013

Civil Infrastructure
Next Generation SCADA for Prevention and Mitigation of Water System Infrastructure Disaster

Develop a novel monitoring and inspection system for pipes and pipe networks in water and wastewater infrastructure systems using wireless sensor nodes incorporated in an advanced Supervisory Control And Data Acquisition (SCADA) system.

Sponsor: The Regents of the University of California (Irvine)
Office of Research Admin.
300 University Tower
Irvine, CA 92697-7600

- Project Performance Period: 4/1/2009 - 3/31/2012
- Total project (est.): $5,685 K
- Requested TIP funds: $2,800 K

A research team led by the University of California at Irvine and including Earth Mechanics, Inc. (Fountain Valley, Calif.), the Irvine Ranch Water District (Irvine, Calif.), the Orange County Sanitation District (Fountain Valley, Calif.), the Santa Ana Watershed Project Authority (Riverside, Calif.) plans to develop a novel monitoring and inspection system for large water pipe networks. This advanced SCADA (Supervisory Control And Data Acquisition) system will incorporate several novel features to monitor both networks of pressurized pipes, commonly used for water supply, and un-pressurized gravity pipes generally used for wastewater. The former will use noninvasive external sensors to monitor vibrations at the pipe surface, listening for the sharp transient jolts caused by a sudden local change in pressure or other hydraulic conditions. The latter will use highly innovative data fusion techniques that incorporate any sound or vibration in the pipe from a fracture, the vibrations caused by the fracture wave propagating along the pipe and any transient flow induced pipe vibrations. The new system being developed will use the experience from a previously developed advanced wireless network of compact, low-power devices called DuraNodes. This system developed at UCI uses MEMS (micro-electromechanical system) devices to measure a variety of dynamic factors such as acceleration and displacement as well as collecting images and measuring temperature. Development of the wireless control and data integration system will be the third major research area. A particular feature of the proposed system is the ability not only to detect a fracture or failure in a pipeline but also to evaluate in real time the remaining useful life at the original design capacity in the damaged system, enabling more effective and strategic planning of repair operations and maintenance. The project involves several major research challenges that need TIP support, including developing the necessary understanding of the correlation between pressure drops and pipe vibrations, differentiating important vibration data caused by fractures or breaks from background “noise,” and developing techniques to monitor otherwise inaccessible installed pipes by mounting sensors on exposed connecting features such as hydrants or air release valves. The project success will aid in extending the useful life and reliability of the water systems infrastructure.

For project information:
Dr. Masanobu Shinozuka, (949) 824-9379
shino@uci.edu

Active Project Members

- Earth Mechanics, Inc. (Fountain Valley, CA)
  [Original, Active JV Member]
- Irvine Ranch Water District (Irvine, CA)
  [Original, Active JV Member]
- Orange County Sanitation District (Fountain Valley, CA)
  [Original, Active JV Member]
- Santa Ana Watershed Project Authority (Riverside, CA)
  [Original, Active JV Member]
- University of California at Irvine (Irvine, CA)
  [Original, Active JV Member]