TIP Project Brief – 090060/10H016

Civil Infrastructure
Robotic Rehabilitation of Aging Water Pipelines

Develop a prototype robot to apply carbon fiber reinforcement inside water transmission pipes, allowing trenchless repair and rehabilitation, even in smaller pipes, as much as eleven times faster than human crews.

Sponsor: Fibrwrap Construction, Inc.
Ontario, CA

- Project Performance Period: 2/1/2010 - 1/31/2015
- Total project (est.): $17,582 K
- Requested TIP funds: $8,462 K

This joint research venture led by Fibrwrap Construction is working to design and build a prototype robot to repair and retrofit aging water mains by applying a tough, carbon fiber reinforcement material to the insides of the pipes without the need for costly excavation or replacement. Other members of the joint venture include Fyfe Company, a pioneer in the development of fiber-reinforced polymer composites, and the University of California, Irvine. The United States is served by a sophisticated water infrastructure consisting of two million miles of water transmission pipelines, most of which, unfortunately, are aging and in some cases failing prematurely. Recent catastrophic breaks of water pipes highlight the urgent needs for cost-effective solutions to address this societal challenge. At present, broken or failing pipes must be dug up, segment by segment, to repair or replace them, which is costly. This project aims to construct a prototype robot able to apply high-strength, high-stiffness, low-cost carbon fiber internally to strengthen underground pipelines and prevent their bursting and collapsing. Simple robots have been used for some time to crawl through pipes for inspection, but the task of evenly and thoroughly applying a carbon fiber coating to the insides of old pipes with unpredictable flaws, imperfect shapes and uneven surfaces is a far bigger technical challenge. The proposed robot would employ advanced sensor systems to monitor the contact pressure against the pipe wall and synchronize the application process with the motion of the robot. Able to lay carbon fiber eleven times faster than human crews, the pipe-repair robot will be able to adapt to variable sized pipes and conditions. The multidisciplinary research team includes Fibrwrap Construction, a pioneer in automated trenchless carbon fiber installation systems; Fyfe Company, a world leader in developing and applying fiber-reinforced polymers for civil infrastructure rehabilitation; the University of California, Irvine, with extensive knowledge and experience in advanced robotics, pipeline modeling and analysis, sensing and non-destructive evaluation of pipelines. In additional to formal members of the joint venture, the project is supported by the East Bay Municipal Utility District; the San Diego County Water Authority; the District of Columbia Water and Sewer Authority; and construction engineers Simpson, Gumpertz & Heger. If successful, the project will develop and commercialize the robotic system which potentially could save the U.S. economy an estimated $245 billion in lost benefits and give the nation a lead in a growing world market for water infrastructure technology.

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Active Project Members

- Fibrwrap Construction, Inc. (Ontario, CA)
  [Original, Active JV Member]
- Fyfe Company, LLC (San Diego, CA)
  [Original, Active JV Member]
- The Regents of University of California, (UCI) (Irvine, CA)
  [Original, Active JV Member]