

From Mapping the Underworld of Buried Utilities to Intelligent Excavation Assistant

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Zoom Link:

<https://purdue-edu.zoom.us/j/95828821113?pwd=YmcwdGkxNG5Rd0RqRWFhWithMXVNOT09>

Abstract

In the U.S. alone, a mechanic excavator hits an underground pipe averagely every 60 seconds – known as utility strikes, causing hundreds of fatalities, thousands of injuries, and billions of financial losses. There are ***two root causes*** for recurring excavation accidents: 1) lack of accurate and complete records of underground pipes, and 2) lack of an effective communication mechanism (e.g., visual scenes, voice messages, sounds) to assist operators to develop holistic situational awareness of the dynamic excavation operation in cluttered, unstructured workspaces in real time. Towards covering these two gaps, we have developed new algorithms to overcome the limitations on ground penetrating radar (GPR) in urban settings attributed to the complexity of the underworld and its reflection on the GPR signals and image signatures. We have also created new methods to more accurately determine the location and dimension of underground pipes by fusing data from utility specifications and regulations and contextual cues, termed as “virtual sensors”, and GPR scans. In addition, we have also enabled geospatial-aware AR to visualize and communicate the digging implementation to operator in real-time. Leveraging our findings, we are currently working on two directions: autonomous robotic system with the capacity of adapting to complex spatial configurations of underground networks to generate accurate, geospatial 3D pipe models; intelligent excavation assistant for safe urban trenching.

Bio

Dr. Hubo Cai is a Professor of Civil and Construction Engineering at Purdue University. He is the founding director of the Laboratory of Computer-Integrated Infrastructure Informatics (LCIII) and the co-director of the Discrete Event Simulation (DES) Laboratory. After obtaining his B.S. in Construction Management Engineering from Tongji University, he received his M.S. and Ph.D. degrees in Civil Engineering from North Carolina State University (NCSU). Before joining Purdue University in 2009, Dr. Cai worked at North Carolina Department of Transportation (NCDOT), URS Corporation (now part of AE.COM), and Western Michigan University. Dr. Cai’s research is multi-pronged with research expertise in infrastructure informatics including multimode sensing, advanced computational algorithms and data analytics, and human-machine collaboration. Dr. Cai has over 90 publications. He has been serving as an Associate Editor for ASCE’s Journal of Computing in Civil Engineering (JCCE) since 2003, and he is currently serving on its editorial board. Dr. Cai is also serving as the Chair of ASCE’s Data Sensing and Analysis (DSA) Committee. He has received many best paper and poster awards.