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Research Background

In Vermont, there are 14,291 public road miles. **14%** of them are in **poor condition**. Among 2,731 Vermont bridges, **30%** are considered **structurally deficient**, and 643 or **23.6%** are considered **functionally obsolete**. A deficient or obsolete road or bridge, when left open to traffic, requires significant maintenance and repair to remain in service and eventual rehabilitation or replacement, which necessitates a huge amount of capital investments. Early and accurate detection, localization and assessment of damages or defect in pavement and bridge deck are of great values for scheduling maintenance and rehabilitation activities, and can significantly reduce the damage progression and maintenance costs.



Figure 1. Illustration of structural defects of bridges and roadways

Nondestructive Subsurface Structure Evaluation with GPR

- The varying permittivity of subsurface medias/structure has different effects on electromagnetic (EM) wave propagation. GPR utilizes such effects to radiate and receive EM waves to image the subsurface structures.
- Advantages: Non-destructive, easy deployment and high efficiency.



Figure 2. GPR operating principle and developed GPR systems

Research Accomplishments

Develop a systematic methodology of employing ground penetrating radar (GPR), including dual band GPR instruments, subsequent data processing and interpretation methods that can be regularly used as part of a roadway pavement and bridge evaluation program. Field tests are conducted to evaluate the sensing effectiveness.

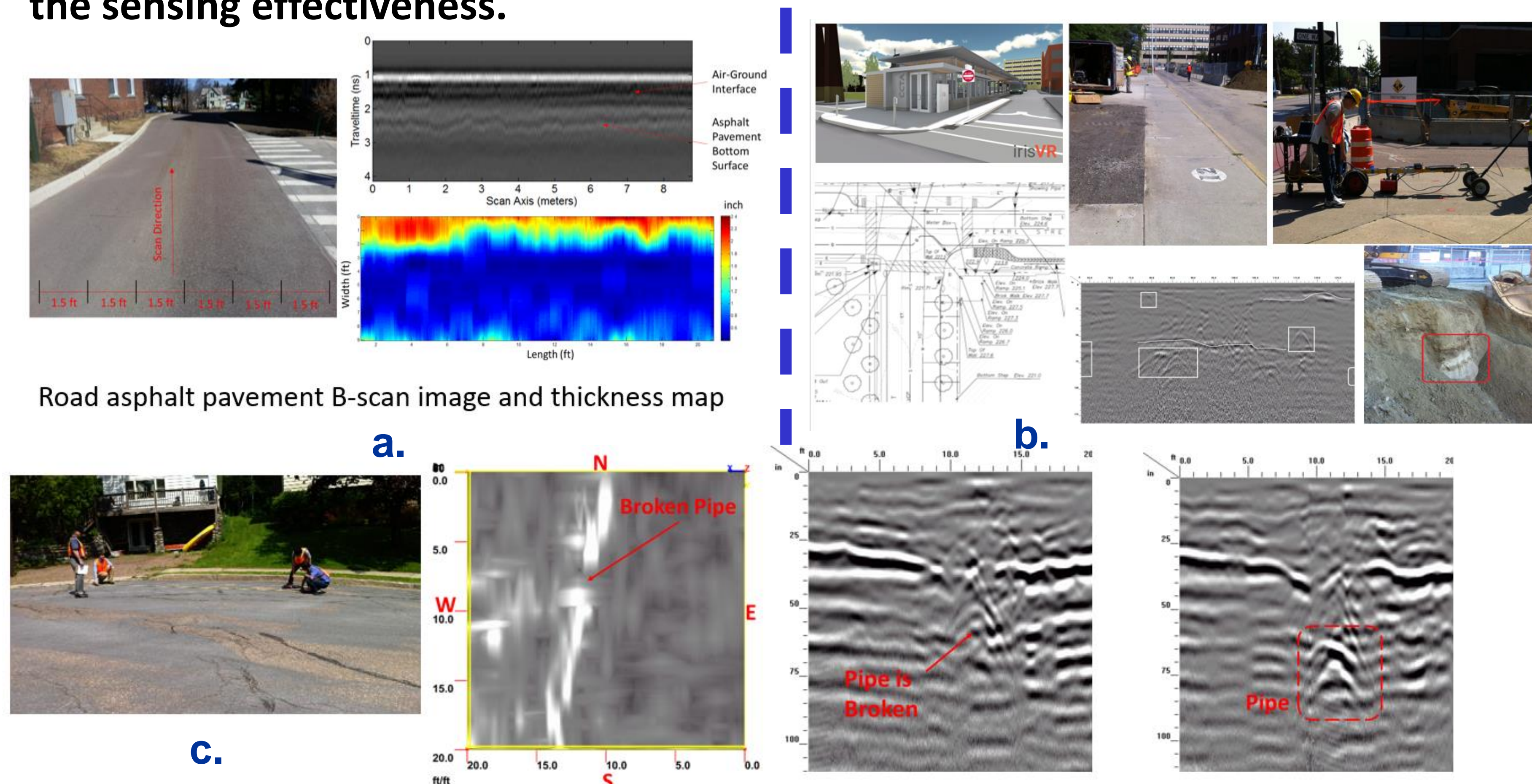


Figure 3. Field test: a). Road pavement test on campus; b). Road foundation structure survey – St. Paul Street, Burlington; c). Underground water pipe leakage detection - Winooski

Conclusions

This study has fulfilled the overarching research objective by developing the systematic methodology of employing GPR. It has deepened our understandings of GPR sensing capabilities, and improved our skills of operating GPR systems and processing GPR data for underground structure sensing. We have a good confidence and strong wiliness to further our collaborations with VTrans to employ GPR to facilitate transportation infrastructure survey, maintenance, repair and rehabilitation in Vermont and beyond.

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