

FINAL PROJECT SUMMARY REPORT

PROJECT IDENTIFICATION INFORMATION

1. BUSINESS FIRM AND ADDRESS

Intellisense Systems, Inc.
Emerging Technologies Department
21041 S. Western Ave.
Torrance, CA 90501-1727

2. DOT SBIR PROGRAM: 6913G622QSBIR1 FY 2022, Phase I

Topic 22-PH3: Vibration Sensing System to Monitor for Potential Excavation Damage

3. DOT CONTRACT: 6913G6-22-P-800030

4. PERIOD OF PERFORMANCE: 06/20/2022 to 12/19/2022

5. PROJECT TITLE: Fiber-Optic Excavation Monitoring Sensor (FOCOS) System

SUMMARY OF COMPLETED PROJECT:


To address the DOT's need for a new system to detect excavation damage and notify pipeline operators, Intellisense Systems, Inc. (Intellisense), developed a new **Fiber-Optic Excavation Monitoring Sensor (FOCOS)** system, based on phase-sensitive optical time-domain reflectometry (ϕ -OTDR), machine learning (ML) algorithms, and Internet of Things (IoT) communication. In Phase I, Intellisense proved the feasibility of the FOCOS concept and designed the FOCOS prototype via analytical calculation. We selected and procured optical components as well as control electronic equipment to assemble a Phase I benchtop prototype. Intellisense also investigated ML algorithms and selected candidate ML algorithms, including PatchCore and Anomaly Detection Transformer with Feature Reconstruction (ADTR). The benchtop FOCOS prototype's ability to detect vibration was experimentally demonstrated. We demonstrated spatial resolution of 20 m to locate vibration and detection range of 4 km. We also analyzed the time responses with fast Fourier transformation (FFT) to distinguish the frequency signatures of different vibration signals. We developed the preliminary ML algorithms and verified their capability for classification of vibration sources. In addition, Intellisense identified potential applications for the FOCOS technology and developed a preliminary commercialization plan. The successful Phase I results show that the FOCOS technology can meet the DOT's and PHMSA's current and future needs and requirements for an advanced fiber optic vibration sensing system to monitor for potential excavation damage and, thus, decrease harm to the public and environment.

The data in this final report shall not be released outside the government without permission of the contractor for a period of four years from the completion date (12/19/2022) of this project from which the data was generated.

APPROVAL SIGNATURES

PRINCIPAL INVESTIGATOR


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Chao

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Chung-Yen Chao, Ph.D.
Group Leader, Integrated Systems

PROJECT DIRECTOR



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Adobe Acrobat version: 11.0.20

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