Overview of Pitt Transportation Infrastructure Research

-Brainstorming Session-

Julie Vandenbossche

October 25, 2023

Completed Pitt Research

Bridge

- Steel Bridge Corrosion Prevention and Mitigation Strategies, **Dr. Stephens** PITT|IRISE

- Corrosion Repair Strategies for Steel Girder Ends Using High Performance and Traditional Materials, **Dr. Harries**

- Improving Bridge Assessment Through the Integration of Conventional Visual Inspection, Non-Destructive Evaluation and Structural Health Monitoring Data, **Dr. Alavi** PITT|IRISE

- Data Management, Mining, and Inference for Bridge Monitoring, **Dr. Rizzo**

Pitt Bridge Condition Assessment System
(PittBCAS)

Crack and Spall Evaluation

Delamination Evaluation
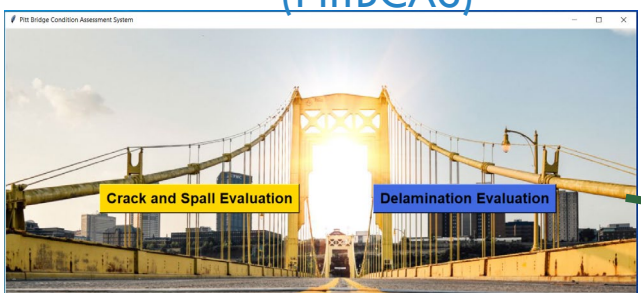
Output delamination area

Output
- Crack region density
- Total crack length
- Crack density
- Spall region density

RUTGERS
Center for Advanced Infrastructure
and Transportation

WJE ENGINEERS
ARCHITECTS
MATERIALS SCIENTISTS
Wiss, Janney, Elstner Associates, Inc.

2

Ongoing Pitt Research

Bridge

- Integrating Additive Manufacturing with Accelerated Bridge Construction Techniques, *Dr. Alavi* PITT|IRISE

- A Novel Methodology for Structural Optimization of Bridge Decks Against Corrosion, *Dr. Brigham* PITT|IRISE
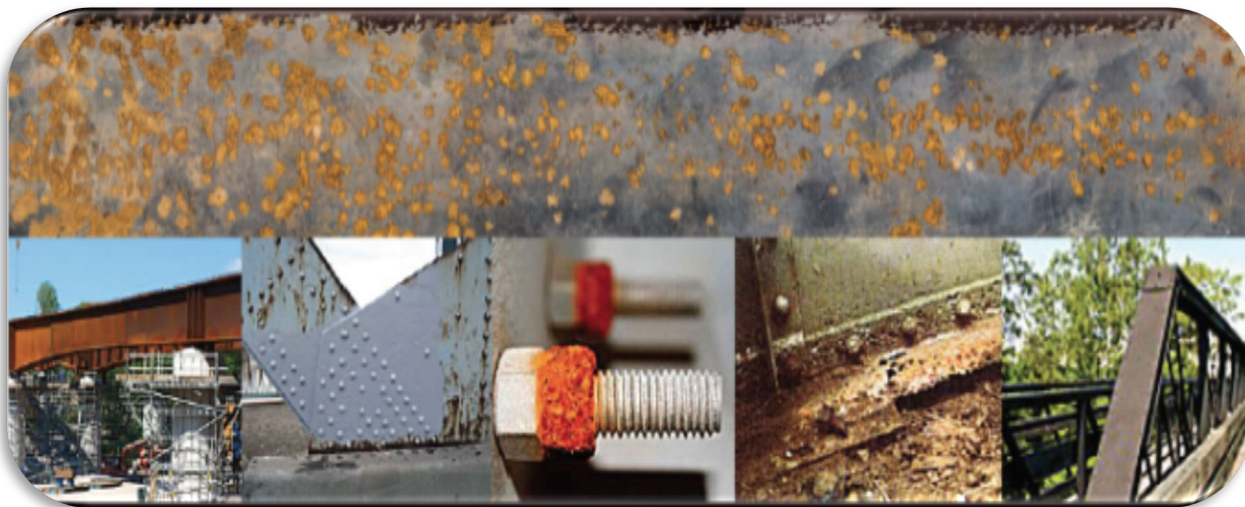
Completed Pitt Research

Geotechnical

- Subsidence Impact Forecasting: I-70 over Longwall Mine, *Dr. Iannacchione*

- Exploring Approaches to Managing Landslide Risks:

    Workshop Summary Report, *Dr. Iannacchione*

- Landslide Capacity Building Seminars, *Drs. Iannacchione and Bain*

- Depth to Bedrock Seismic Measuring Device, *Dr. Sachs*

- Landslide Best Practices, *Dr. Ciloglu, MBI*
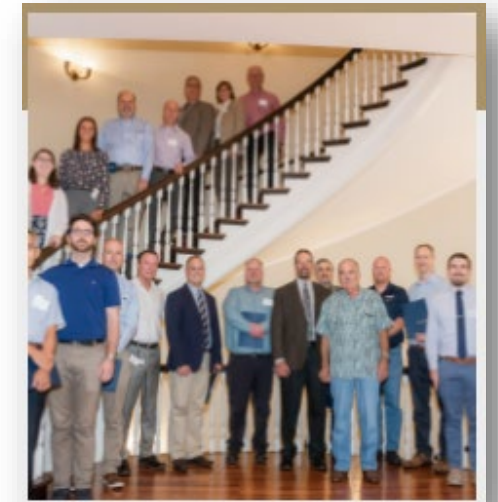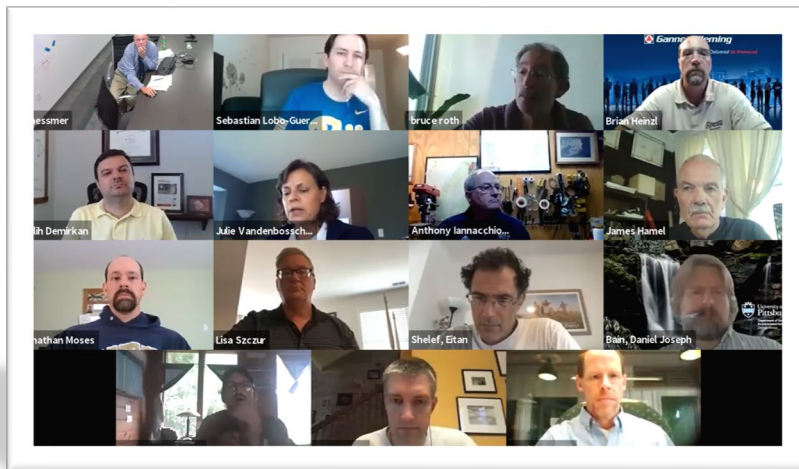
Ongoing Pitt Research

Geotechnical

- Development of a Roadway Landslide Inventory and Analytical Tool for Southwestern Pennsylvania, ***Drs. Bain, Iannacchione and Shelef***

- Development of a Regional Landslide Inventory to Advance Hazard and Risk Estimates for Southwestern Pennsylvania, ***Dr. Bain***

Completed Pitt Research

Pavements

- Faulting Models for JPCP and BOCA, *Drs. Khazanovich (JPCP) Vandenbossche (BCOA)*

- Development of a Simplified Mechanistic-Empirical Design Tool for Rigid Pavements in PA, *Dr. Khazanovich* PITT|IRISE

- Early Opening of Concrete Pavements to Traffic, *Dr. Khazanovich* PITT|IRISE

- Effect of Super Loads on Pavement Life, *Dr. Vandenbossche*

- Preliminary Evaluation of Pavement Surface Distresses Related to Pavement Markings, *Dr. Khazanovich* PITT|IRISE
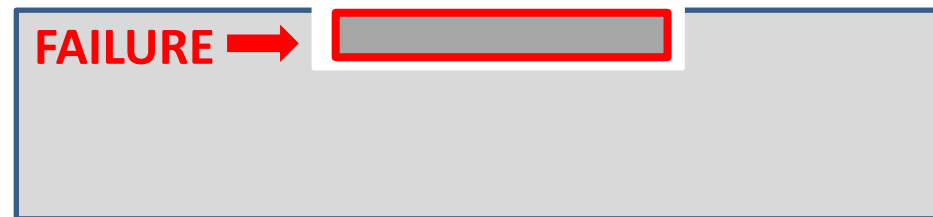
Ongoing Pitt Research

Pavements

- Faulting Models for JPCP and BOCA, **Drs. Khazanovich** *(JPCP)* **Vandenbossche** *(BCOA)*

- Three-dimensional Micro-mechanical Characterization of the Effect of Vibration and Compaction in Concrete Pavements, **Drs. Fascetti and Vandenbossche** PITT|IRISE

- Joint Performance Optimization for JPCP, **Dr. Vandenbossche** PITT|IRISE

- Prediction of Dowel Corrosion and Effect on Performance of Concrete Pavements, **Dr. Vandenbossche** PITT|IRISE

- Design and Construction of Two-lift Concrete Pavements for Pennsylvania, **Dr. Khazanovich** PITT|IRISE
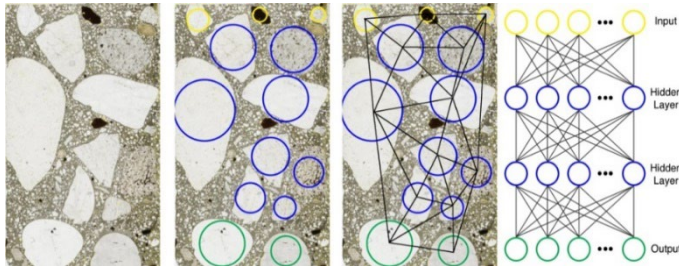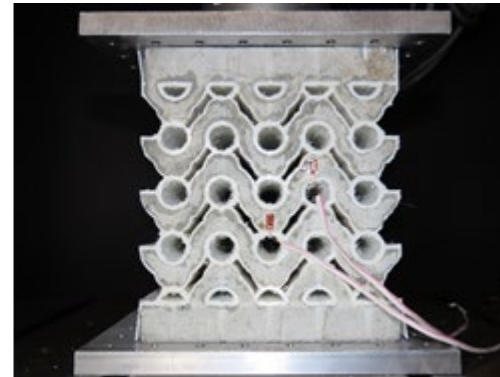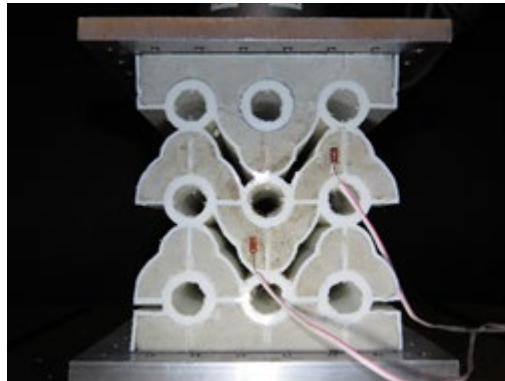
Completed Pitt Research

Materials

- Microbial Concrete Sealer for RC, ***Drs Sachs and Haig***

- Carbon Nanotube Additives for Structural and Highway Concrete, ***Drs Sachs and Gilbertson***

- Material Compatible Repairs for Concrete Pavements and Bridge Decks, ***Drs. Sachs and Vandenbossche***

FAILURE ➡

Ongoing Pitt Research

Materials

- Material Compatible Repairs Evaluation, *Drs. Sachs, Khazanovich and Vandenbossche*

- Carbon Nanotube Additives for Structural and Highway Concrete (*Continuation*)**, Drs. Sachs and Gilbertson**

- Microbial Concrete Sealer (*Continuation*)**, Drs. Sachs and Haig**

- Developing Light-Weight and High-Performance Metamaterial Concrete, **Dr. Alavi**

Completed Pitt Research

Workers Safety

- Investigating New Underground Utility Location Technologies and Novel Methods to Improve the Safety and Efficiency of Highway Construction, **Drs. Khazanovich**

- Identifying Major Causes of Construction Accidents for the Paving Industry in Pennsylvania, **Dr. Khazanovich**
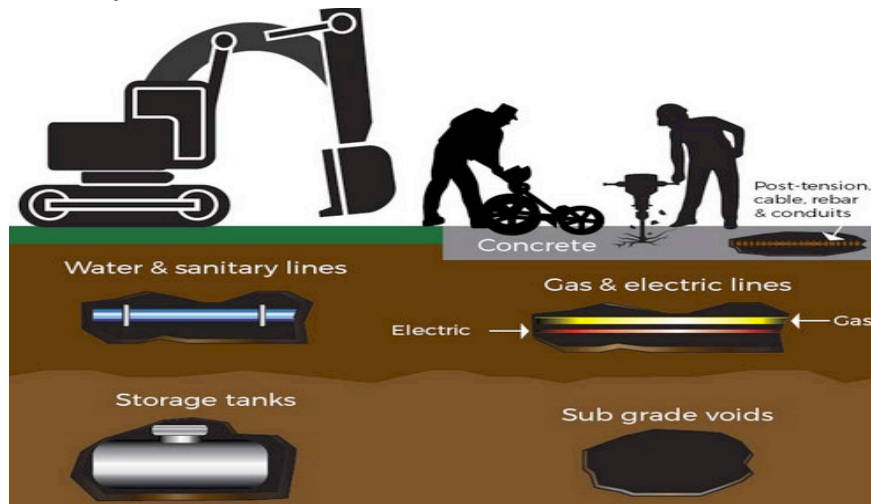
Ongoing Pitt Research

Workers Safety

- Identifying Major Causes of Construction Accidents for the Paving Industry in Pennsylvania, *Dr. Khazanovich* PITT|IRISE

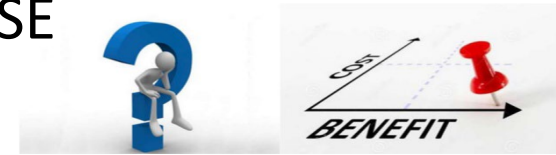- Novel Immersive VR Platform for H&S Training of Construction Workers, *Dr. Fascetti* PITT|IRISE

11
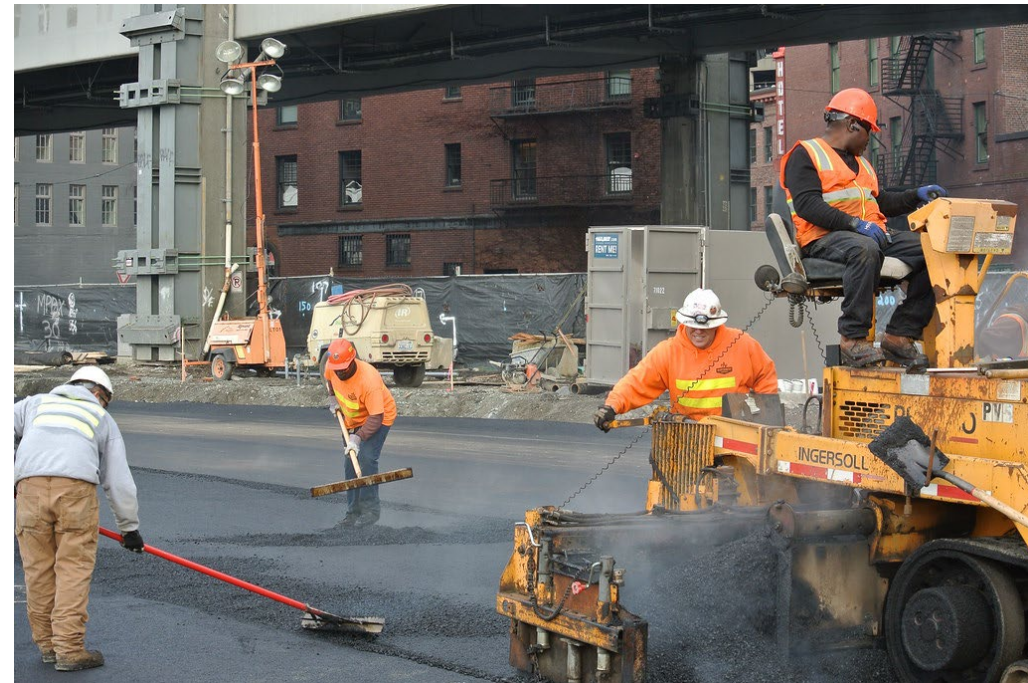
Ongoing Pitt Research

Other

- Developing Methodologies to Predict and Quantify the Benefits of IRISE Research, *Dr. Magalotti* PITT|IRISE

- Tactical Urbanism/Demonstration Projects Guide, *Dr. Stevanovic*

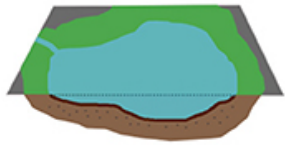- A Seminar Series on Innovative and Comprehensive Stormwater Management, **Dr. Bain** PITT|IRISE

Mon Fayette Expressway Test Bed

- Absorptive Sound Walls: **Dr. Alavi**

- Digital Twin Technology: **Dr. Fascetti**

- Electrified Roadway Strategic Plan: **Dr. Alavi**

- Energy Harvesting: **Dr. Alavi**
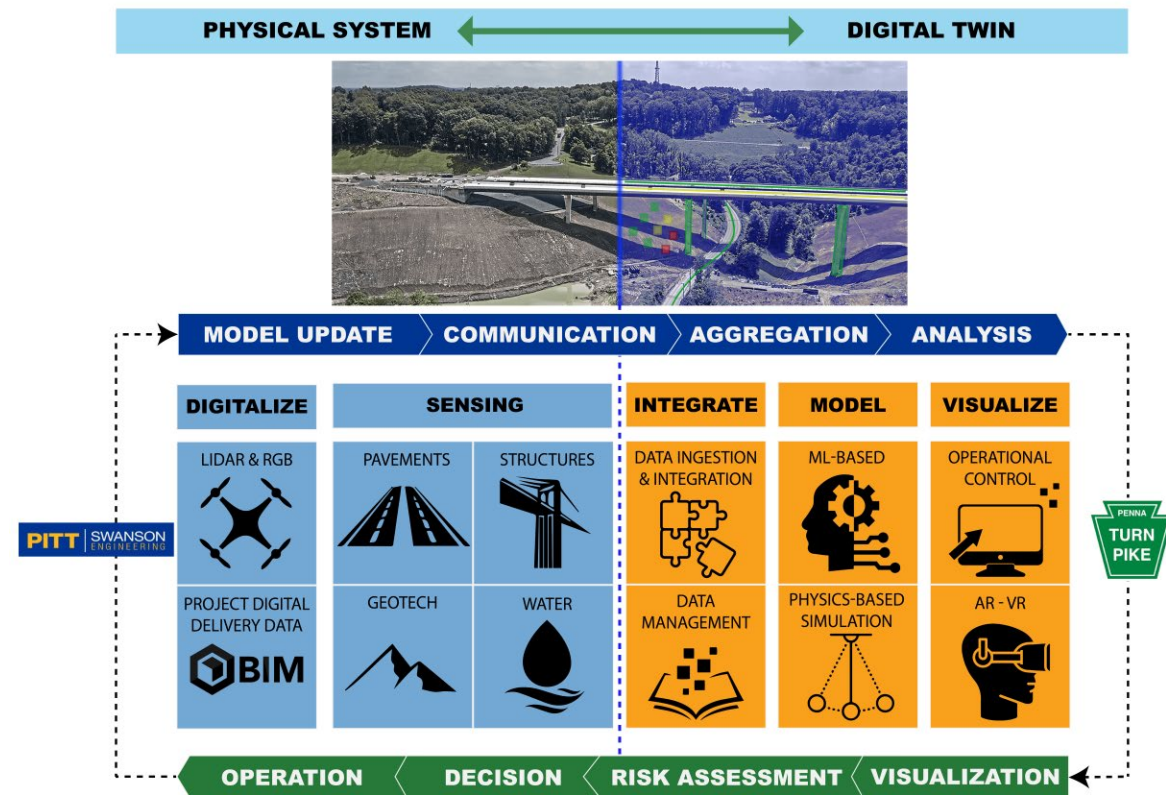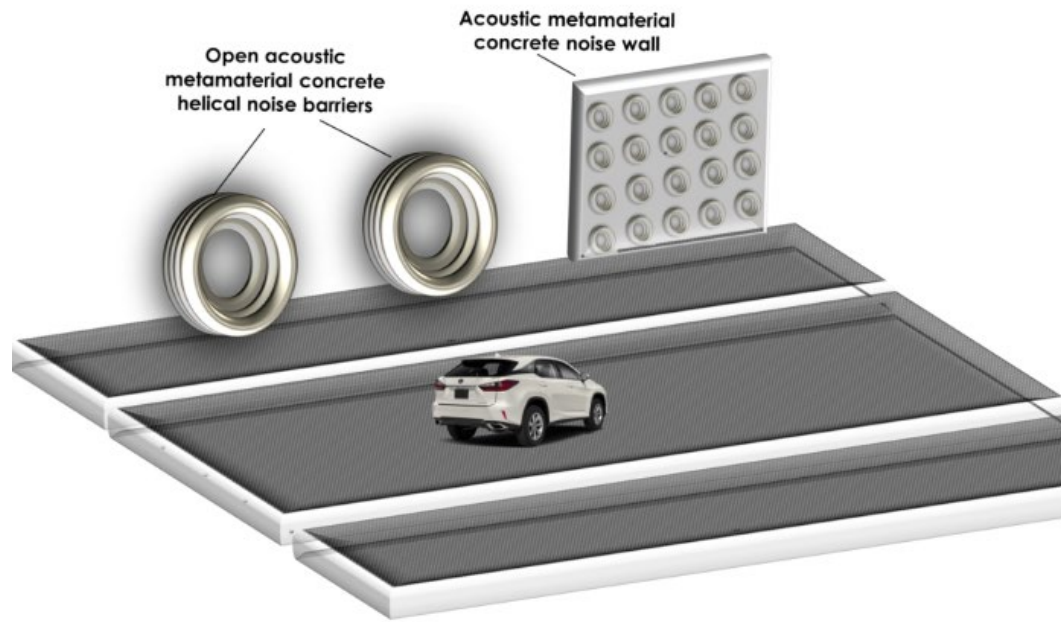
IRISE Year 6 Projects Being Initiated

1. *Bridge*: Bridge Load Ratings, **Dr. Rizzo**
2. *Geotechnical*: Why do they keep sliding? Analysis of Reoccurring Landslides in SWPA to Advance Hazard and Risk Estimates, **Dr. Bain**
3. *Pavement*: Adaptation of a Large Language Model for Facilitating Pavement-Related Information Retrieval and Knowledge Discovery, **Dr. Khazanovich**
4. *Materials*: Self-Heating Concrete Pavement Systems with Surface-Mounted Heating Elements, **Dr. Alavi**
5. *Other*: Supervised Learning for Classification of High-Resolution LiDAR Point Clouds, **Dr. Fascetti**
6. *Other:* Developing and Applying Methodologies to Quantify the Benefits of IRISE Projects*, **Dr. Mark Magalotti and Matt Macey, PE**

Bridge **Bridge Load Ratings**

Problem: Need to improve load rating analysis methods as the current approach results in an elevated number of bridges being deemed unsafe due to rising load demands

Approach:

➢Bridge Selection and Digital Twin Creation

➢Load Bridge Rating Analysis and Comparison

➢Software Tool Development

Dr. Rizzo

Duration: 17-months
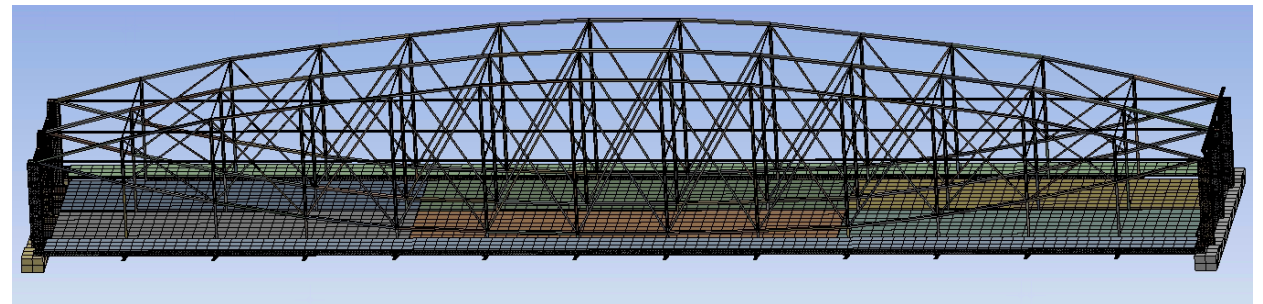
Geotechnical **Why do they keep sliding? Analysis of Reoccurring Landslides in SWPA to Advance Hazard and Risk Estimates**

Problem: Need to investigate the factors leading to the recurrent landslides in Southwestern Pennsylvania

Approach:

➢ Conduct Spatial Analysis

➢ Develop Mechanistic Models

➢ Comparative Multivariate Analysis

Drs. Bain, Shelef and Iannacchione

Duration: 12-months

Pavements

Problem: There is a need for an AI language model tailored to pavement engineering, capable of answering technical questions, providing training, and facilitating knowledge discovery within this specialized domain.

Approach:

➤ AI Model development

➤ Task-specific fine-tuning

➤ User-focused capabilities

Dr. Khazanovich

Duration: 12-months

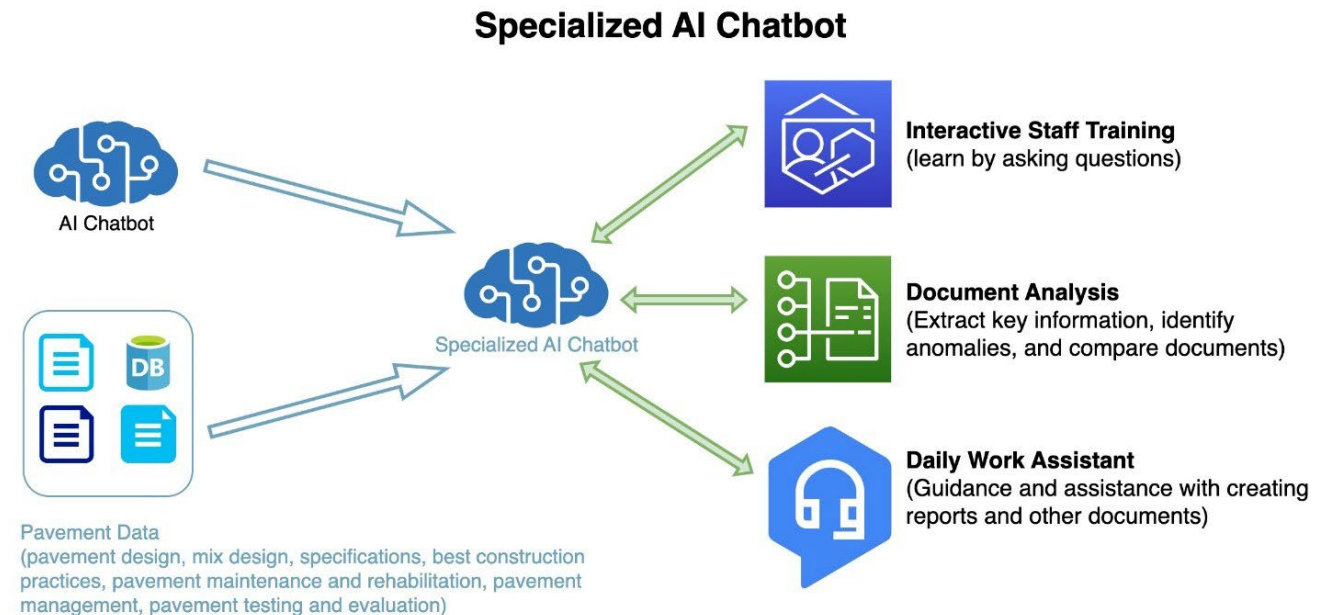**Chat for Facilitating Pavement-Related Information Retrieval and Knowledge Discovery**

Pavements

Self-Heating Concrete Pavement Systems with Surface-Mounted Heating Elements

Problem: There is a need to find a sustainable and efficient solution for snow and ice removal from roadways to reduce the environmental impact of deicing chemicals and the disruptions caused by conventional methods.

Approach:

➢ Review of the State-of-the-Art of Self-heating Pavement Research

➢ Characterization and Optimization of the Heating Performance of the Conductive Elements

➢ Design and Fabrication of Self-heating Concrete Slabs with Surface-Mounted Heating Elements and Field Demonstration

Drs. Alavi and Khazanovich
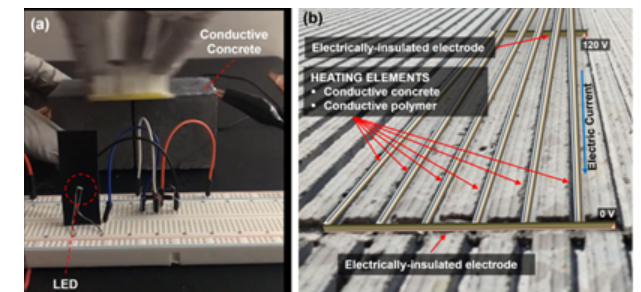
Duration: 24-months

Fig. 2. (a) Conductive concrete developed at Pitt powers an LED [14]. (b) Vision for self-heating concrete pavement with surface-mounted heating elements partially filling the grooves.

Other

Supervised Learning for Classification of High-Resolution LiDAR Point Clouds

Problem: Critical need to streamline the extraction of valuable information from high-resolution LiDAR point clouds in civil infrastructure projects, as current manual classification methods are labor-intensive and inefficient.

Approach: Develop innovative classification tools using supervised learning for the segmentation of 3D point clouds.

> ➢ Review of current practices in point cloud segmentation
>
> ➢ Dual Approach: 3D Scene and 2D Camera-Based Classification
>
> ➢ Development of Segmentation Algorithms

Dr. Fascetti

Duration: 24-months
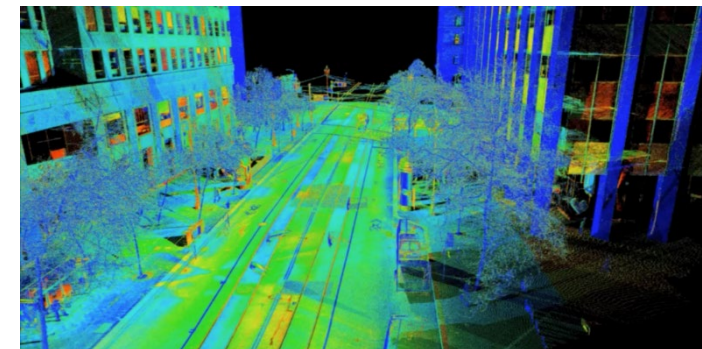
Other Developing and Applying Methodologies to Quantify the Benefits of IRISE Projects

Problem: There is a need to develop and apply methodologies to quantitatively measure the benefits of completed or ongoing IRISE research projects that enhance transportation infrastructure, reduce life cycle costs, and inform the decision-making of transportation agencies.

Approach:

➤ Identification and Selection of IRISE projects

➤ Methodology development and Benefit Analysis

➤ Evaluations and Recommendation

Dr. Mark Magalotti and Matt Macey, PE CDR Maguire

Duration: 12-months

COST BENEFIT ANALYSIS

COST

BENEFIT

Other Activities

- Student involvement
- Workshops/seminars
- Demonstration projects
- Tech days
- Presentations to help tech deployment
- Other ideas ????

Three Sisters Bridges – Allegheny Cnty

https://www.engineering.pitt.edu/irise

Thank You!

PITT|IRISE - Denotes Founding Members