Autonomous Winter Road Maintenance Decision-Making using Artificial Intelligence (AI)

FHWA Project 693JJ320C000022

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App tutorial

www.smartmdss.org
How can you help us to improve the app?

We can add special points on the map for you!
We can suggest winter road maintenance operations based on your budget, equipment, and resources!
If you have online surveillance cameras, we can connect your cameras to our app
If you have an online weather stations, we can use your data for decision-making
If you need a weather station in your area, we can provide a cost-effective weather station for you and add it to our decision-making system

How we can help more...

FILL OUT OUR REGISTRATION SHEET

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Project Scope

**Project Title:**
Autonomous Winter Road Maintenance Decision Making Enabled by Boosting Existing Transportation Data Infrastructure with Deep and Reinforcement Learning

This project aims to boost the current model-based winter maintenance with an Artificial-Intelligence (AI)-enhanced framework, in which

1. data can be analyzed in real-time for autonomous decision making

and

2. such decision-making ability can be improved continuously as more data is obtained.
1. Road Condition Predictions using AI (RNN model)

Architecture (a) and working mechanisms (b) of RNN

2. Sense Dynamic Road Conditions

Level 1- Image classification

- Wet with 99.62% confidence
- Heavy Snow with 92.28% confidence

Level 2- Snow/Road Detection

- 37% snow-road overlap

Level 3- Use of deep learning for road condition assessment
Innovations

3. Autonomous Decision Making Employing DRL

VIRTUAL ENVIRONMENT

- Environment: sky with pipes
- Environment: road system
- Agent: bird
- Agent: maintenance crew
- State: position, road condition
- Action: fly or not, operation
- Reward: distance to death, safety & saving

(a) RL conceptual model in winter maintenance

Overview of the Proposed Work

- WP1: Integrated Web-Based MDSS
  - RWIS & AVL: Concentration, Pavement Temp., Snow Coverage, Moisture, Friction
  - Weather: Air Temp., Cloud Coverage, Precipitation, Wind, Humidity

- WP2: RNN for Road Condition Predictions
- WP3: RNN for Correlating Intervention and Road Conditions

- Decision Making
  - WP 4 & 6 Deep RL for Decision Making in Virtual & Real Environments
  - WP6: Trained with Historical data
  - WP5: Training & Tech Transfer to Move from Virtual to Real

- Intervention
  - WP7: Use CNN to Sense Real World
  - WP8: IRL with Users’ Experience

- Feedback
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