Can A.I. Take Over Winter Road Condition Reporting?

2018 National Rural ITS Conference
October 24, 2018
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Why?
No. Really. Why?
Iowa DOT Maintenance

- 101 garages
- 900 snow plows
- 1,000 permanent drivers
- 462 seasonal part-time drivers
- 9,480 centerline miles
- 24,200 total lane miles
- Report winter road conditions as conditions change
Can it be done?

We’re gonna try!
Project Overview

- Research project with SAS
- Started in February 2018
- Develop an approach for modeling winter road conditions
  - Build analytic foundation to spatially predict conditions
  - Leverage historical data (2016-17 and 2017-18)
  - Concentrate on I-80 corridor
Project Overview

- Produce a user interface (UI) for consuming model results that the field maintenance staff can verify or reject the model predictions.
- Results updated at 15 minute intervals
Ingest historical data sources

Develop data model and analytic data data mart
Data Sources

- DOT Rd Cond.
- RWIS Data
- AWOS Data

NWS
511 Events
INRIX

RWIS Data Attributes:
- Barometric pressure
- Dew point
- Humidity
- Precipitation rates
- Surface temperature
- Wind direction

Modeled Road Conditions
Model Review - Spatial Analysis

Expand RWIS & AWOS sensor station data to cover I-80 corridor and beyond through variogram analysis and kriging technique. (standard spatial analysis techniques)
Developing the Model

Model Building Methodologies Assessed
- Decision Tree
- Regression
- Neural Networks

The champion model was the decision tree, based on the number of correctly predicted road conditions and that there are simpler and less variables without sacrificing accuracy.
Preliminary Results

- Out of ~242,000 road condition observations:
  - ~237,000 were correctly classified
  - 97.8% Model Accuracy

<table>
<thead>
<tr>
<th>Actual Road Conditions</th>
<th>Modeled Road Conditions</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Completely Covered</td>
<td>Partially Covered</td>
<td>Seasonal</td>
<td>Total</td>
<td>Accuracy</td>
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<tr>
<td>Completely Covered</td>
<td>6,829</td>
<td>354</td>
<td>498</td>
<td>7,681</td>
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<td>Partially Covered</td>
<td>420</td>
<td>32,007</td>
<td>2,066</td>
<td>34,493</td>
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<tr>
<td>Seasonal</td>
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<td>1,685</td>
<td>197,789</td>
<td>199,709</td>
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<td>Total</td>
<td>7,484</td>
<td>34,046</td>
<td>200,353</td>
<td>241,883</td>
<td>97.8%</td>
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Winter Storm #14
February 9-10, 2018

http://mesonet.agron.iastate.edu/onsite/features/cat.php?day=2018-02-10

88.5% (3,821) road segment observations from 511 Road Conditions accurately predicted

### '17-'18 Winter Storm #14

**Posted:** 10 Feb 2018 07:31 PM

The snow producing winter storms are coming fast and furious with the most recent storm dumping its heaviest totals over southern Iowa. The featured map displays the combination of NWS COOP, Local Storm Reports, and CoCoRaHS reports for the event. Areas north of Ottumwa reported the heaviest totals over six inches. The next round of snowfall is already here this Saturday evening with the heaviest totals expected over southern Iowa again.

**Voting:**
- Good = 5
- Bad = 0

**Tags:** winter1718

<table>
<thead>
<tr>
<th>TARGET_Road_condition(ROAD_COND)</th>
<th>Modeled_Road_condition</th>
<th>Frequency</th>
<th>Completely Covered</th>
<th>Partially Covered</th>
<th>Seasonal</th>
<th>Total</th>
<th>Accuracy</th>
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<tbody>
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<td>427</td>
<td>748</td>
<td>3141</td>
<td>4316</td>
<td>88.5%</td>
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</table>
Model Trained, Now What?

Produce a user interface (UI) for consuming model results

- Results updated at 15 minute intervals from historical data.
- Research & Testing Team for UI
  - 9 Maintenance field staff from around the state
  - 5 Central Office project team members
  - 2 Staff from Iowa State/CTRE
- User Acceptance Testing Started 9/27/18
User Interface
Map – Overview

REJECTED
HOUSTON
WE HAVE A PROBLEM....
User Acceptance Testing

- Almost immediately, it was apparent something wasn’t right with the data.
  - Screenshots of winter storms I had weren’t matching up with what was showing in the UI.
  - Snow plow images for a 10am view in the UI were showing a nighttime view image.
- After digging deeper, we found that Iowa DOT had given SAS some bad data related to time stamps.
Up until this point, we had never really used winter road condition data fused with other data sources.

Found it needed to be cleansed and the event time stamps needed to be standardized.

Iowa DOT has a lot of data

We believe we have everything corrected and SAS has started re-running the model.

Hoping to restart UAT on 10/29/18.
User Interface
Map – Precipitation Layer
User Interface

Snow Plow Cam
User Interface
Modeled Road Segment

I-80: IA 14 to Speedway Dr

Road Condition: Partially Covered

Modeled Road Condition: Seasonal

Route: I-80
Segment Length: 4.6 Miles

Precipitation (in/Hr)

- Over 30
- 20 to 30
- 15 to 20
- 10 to 15
- 8 to 10
- 6 to 8
- 4 to 6
- 3 to 4
- 2 to 3
- 1.5 to 2
- 1 to 1.5
- 0.5 to 1
- 0.25 to 0.5
- 0.1 to 0.25
- 0.01 to 0.1

Last 24 Hours of Modeled Road Conditions

Target Road Condition | Modeled Road Condition
Next Steps

- Review the historical winter storms
- Review the Mis-Matches
  - Reported Condition vs Modeled Condition
- Determine Correct Condition
  - Reported vs Model vs Either
- Fix any User Interface bugs and ease of use
- Process Live Data Starting October 15th (already started)
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Jury is still out.
Questions?

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