



ESTIMATION OF WINTER ROAD SURFACE CONDITIONS (RSC)

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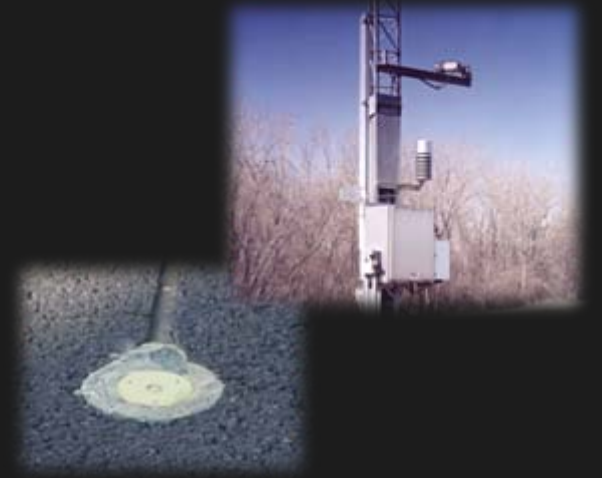
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Max Perchanok

Maintenance Technology
Ministry of Transportation Ontario

RSC Monitoring...

Condition
Time
7:00am.
snow
covered



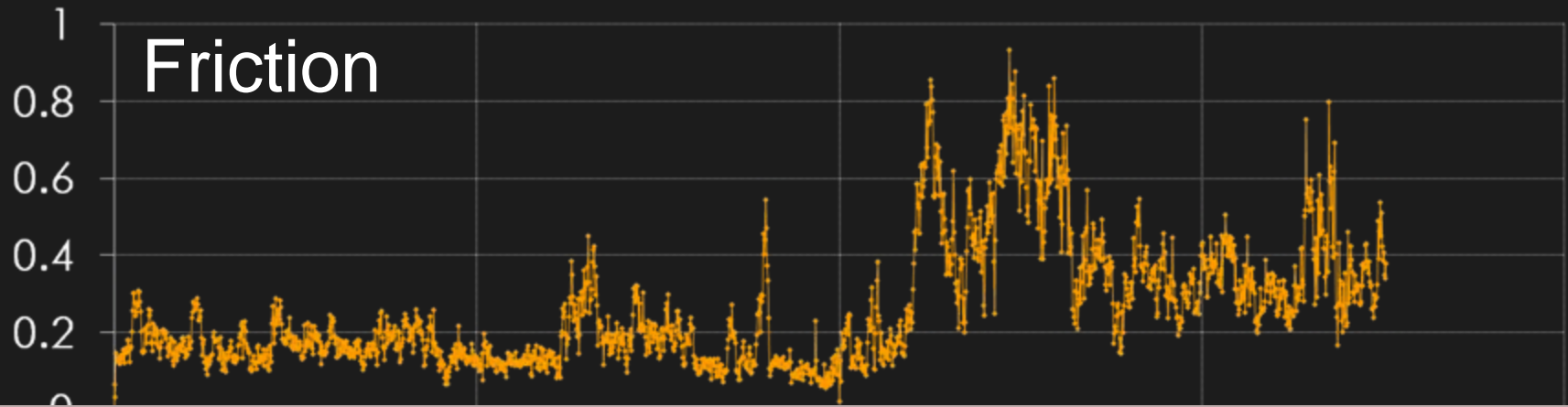
No Monitoring Solution Is Perfect!



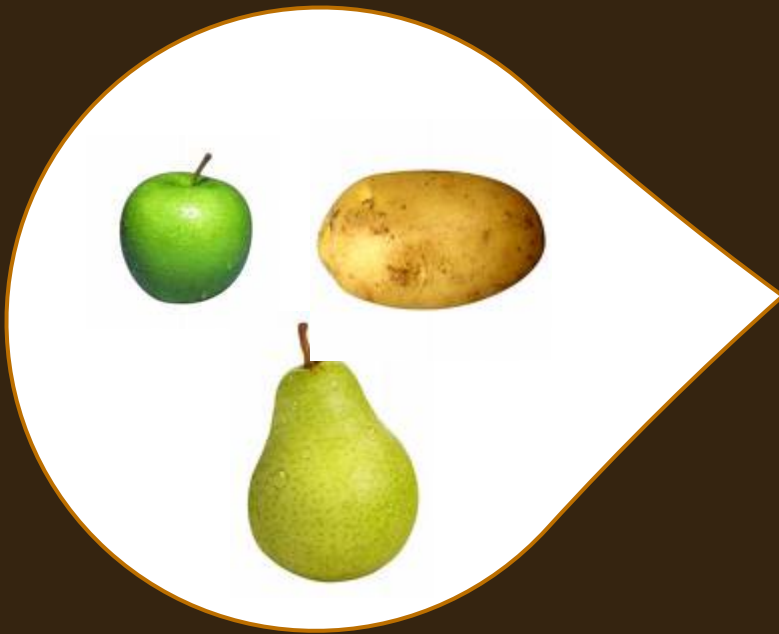
- Spatial coverage
- Temporal coverage
- **Incomplete description**

Research Problem:

Inferring Road Surface State



It is a Classification Problem!



Identify the features...

color (X_1)
shape (X_2)
taste (X_3) ...



Build the mapping ...

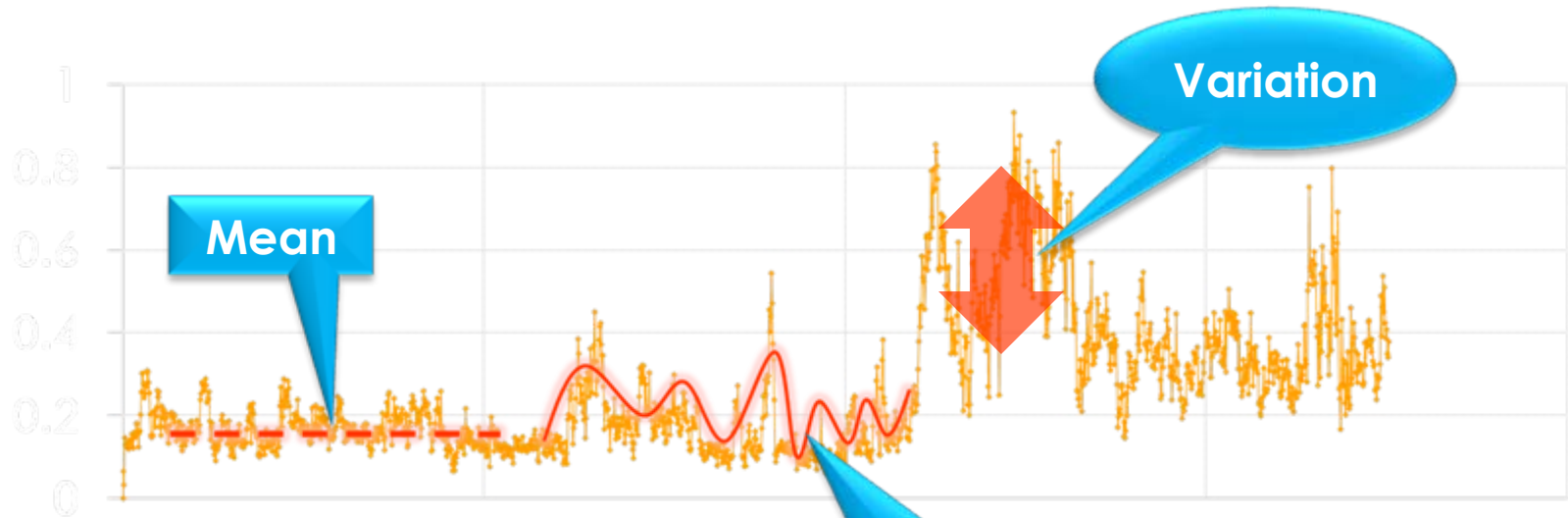
$f(X_1, X_2, \dots)$



Classification Modeling – Step 1:



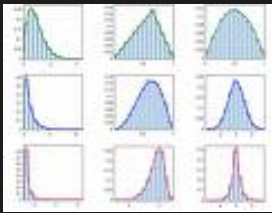
Feature Extraction ...



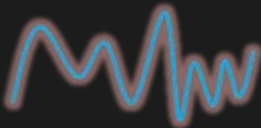
**Cyclic Variation Patterns:
Spectral Analysis**

Model Calibration ...

Features



- *F*
- *Std*
- *Skew*
- *Freq*
- *Temp*
- ...



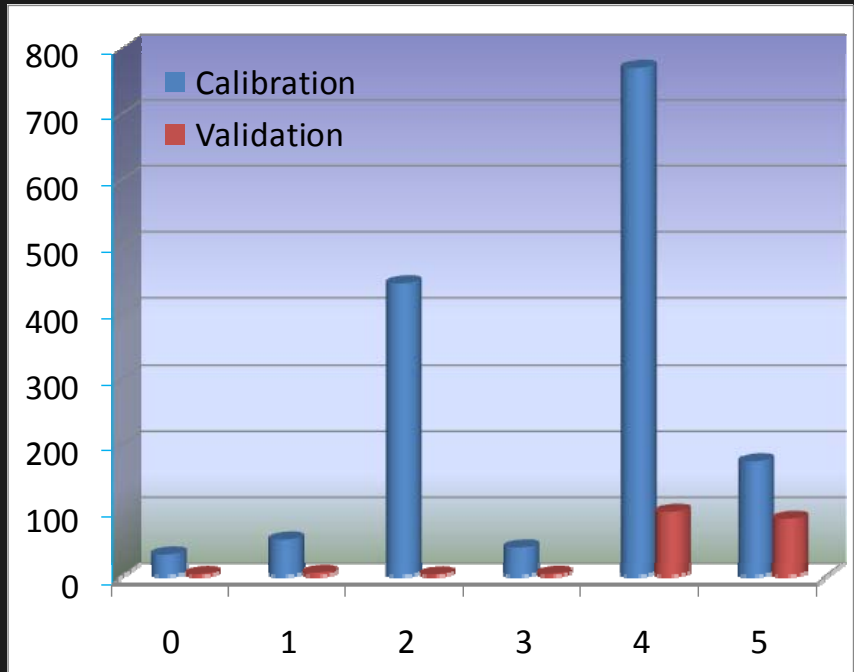
- ✓ Naïve Bayes
- ✓ Logistic regression
- ✓ Artificial neural networks
- ✓ Decision tree

...

Hierarchical Logistic Regression Models

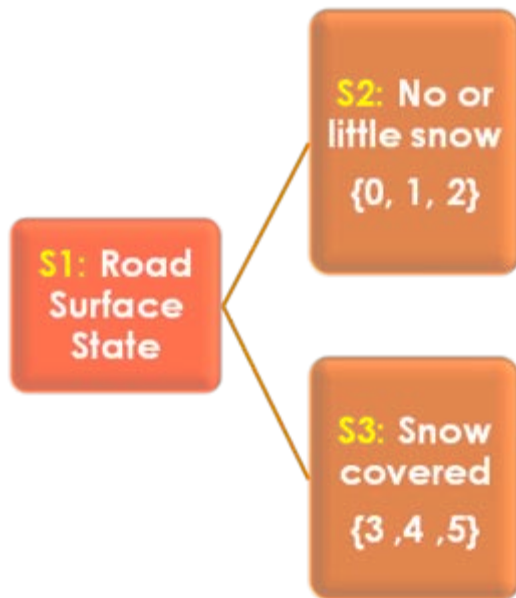


Study Site and Data

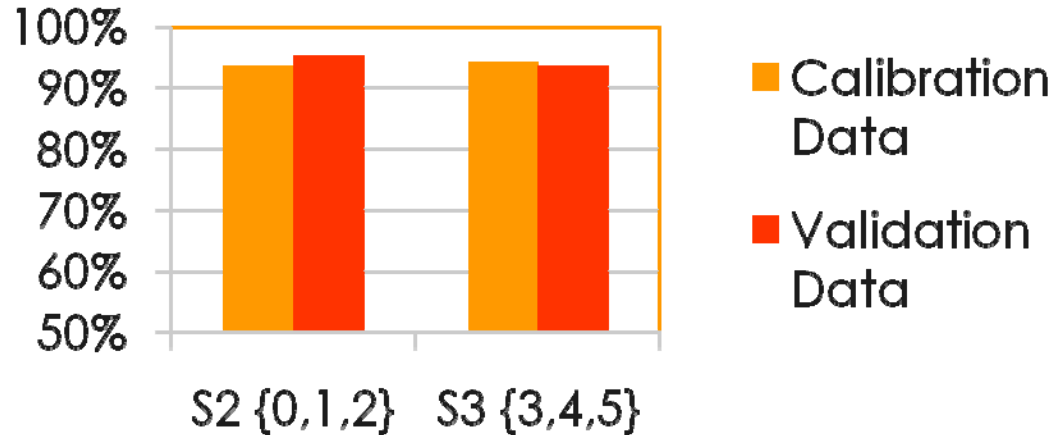


Results: Model

$$\text{Prob}(S3) = f(16.33 - 27.75 F - 6.44 \text{ Std} \\ - 81.38 \text{ Skew} + 209.29 \text{ LowFreq} \\ + 105.52 F * \text{Std})$$

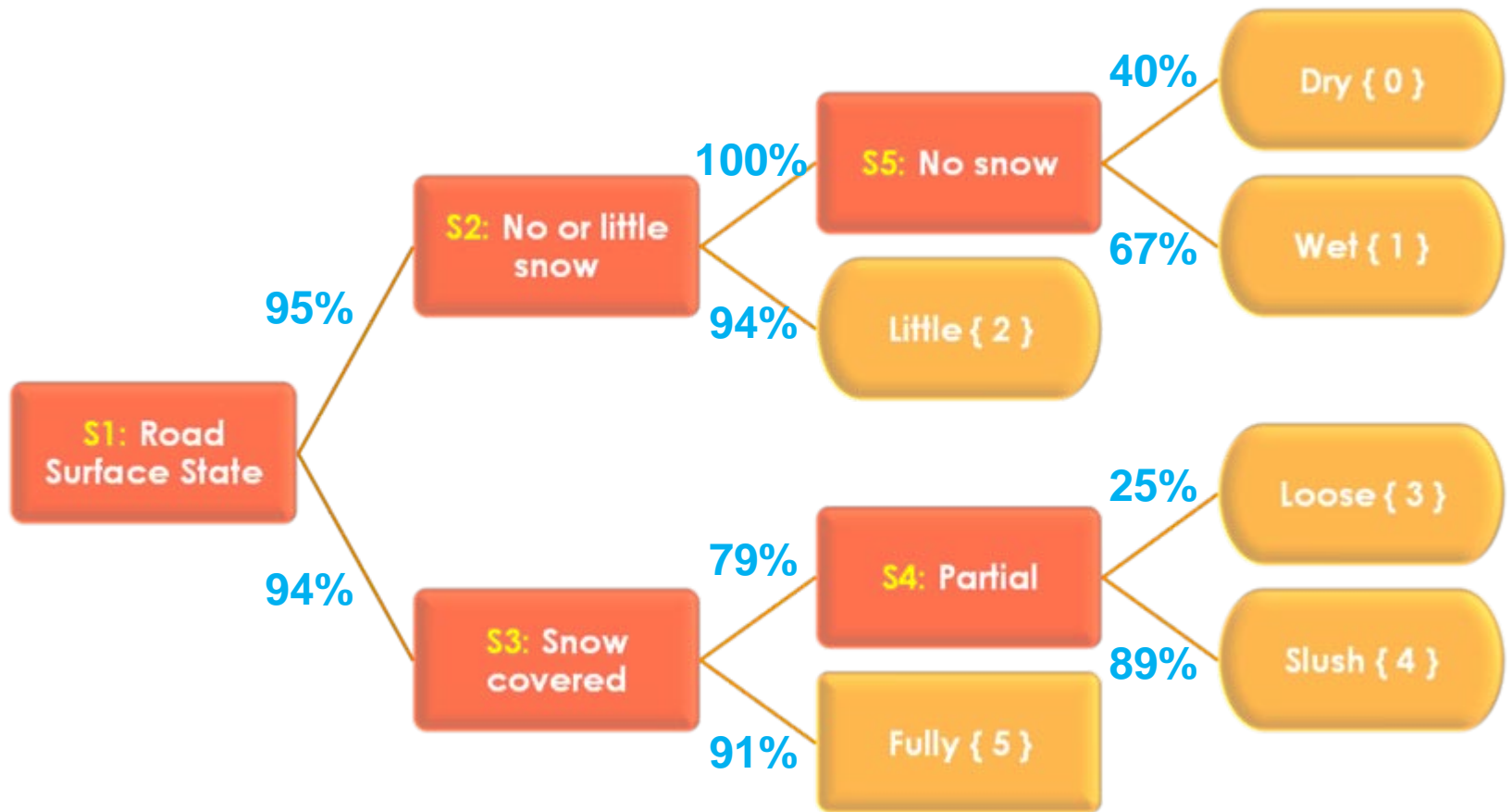


Model Performance: Hit Rate



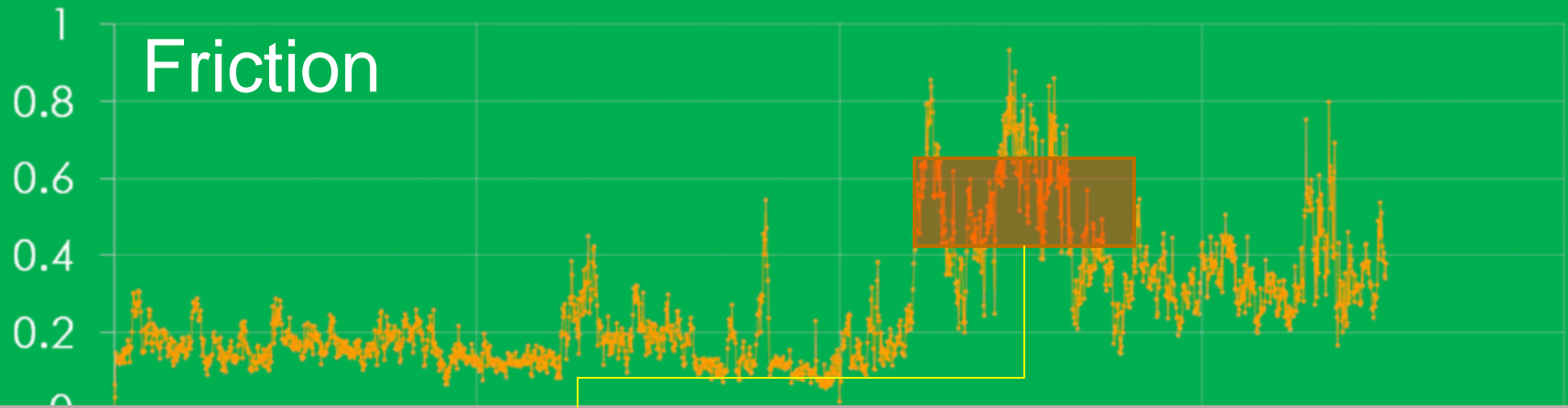
Results:

Accuracy

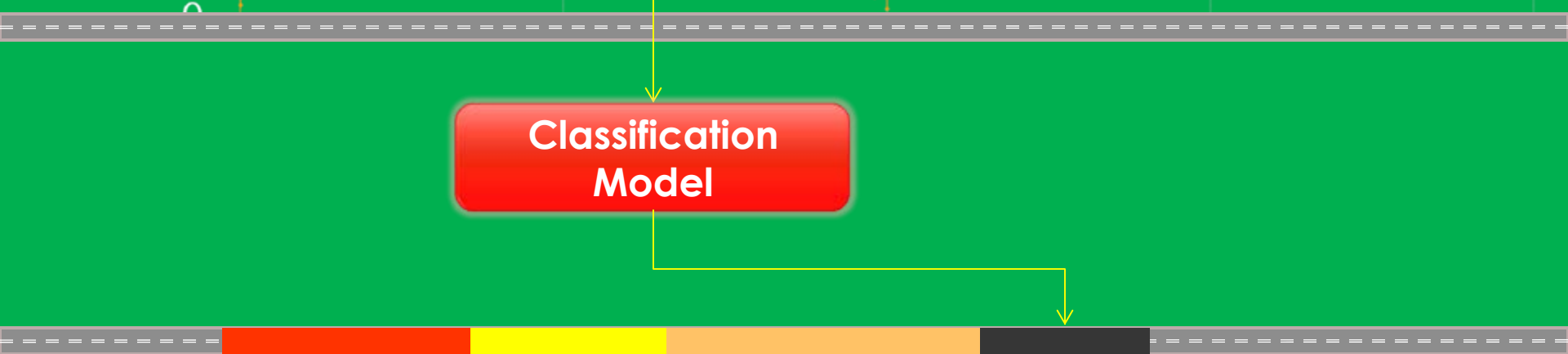


Application:

Model Implementation



Classification
Model





What's Next?

- Validate and refine the models
- Develop RSC forecasting models
- Develop low cost condition monitoring technologies

THIS RESEARCH IS PART OF ...

I

Condition
Monitoring

II

Treatment
Effect

III

Benefit
Analysis

IV

Maintenance
Optimization

V

Traffic
Management

Thanks
to
MTO/NSERC
for
Financial Support !