MIUN.SE
DISCOVER YOUR OPPORTUNITIES

ID: 0022

DECISION SUPPORT SYSTEM
FOR VARIABLE SPEED REGULATION

Patrik Jonsson
patrik.jonsson@miun.se

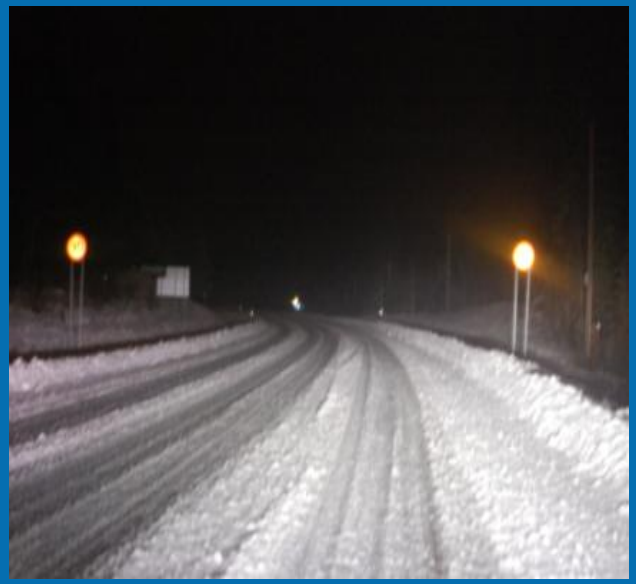
Mittuniversitetet
MID SWEDEN UNIVERSITY

VARIABLE SPEED REGULATION

Installed in Sweden at 20 roads

Results are:

- Less accidents
- Lower speeds
- Improved accessibility



VARIABLE SPEED REGULATION IN SWEDEN

Traffic situations addressed are:

- Intersections
- Dense traffic and cue's
- Unprotected Traficant's
- **Dangerous road conditions**

VARIABLE SPEED REGULATION RESULTS

- Traficant's have better compliance of variable speed limits compared to fixed speed limits
- Low variable speed limits are well accepted
- 70% to 90 % states that the system is reliable
- 80% states that they are more observant of road conditions when variable speed limits are in use

Swedish transport administration publication **2008:14**

WHY THE NEED OF IMPROVED VARIABLE SPEED LIMIT SYSTEMS

MIUN.SE
DISCOVER YOUR OPPORTUNITIES

Current systems:

- Implements a road weather model, that uses neighboring monitoring stations

Proposed system:

- Utilize probability functions for certain events

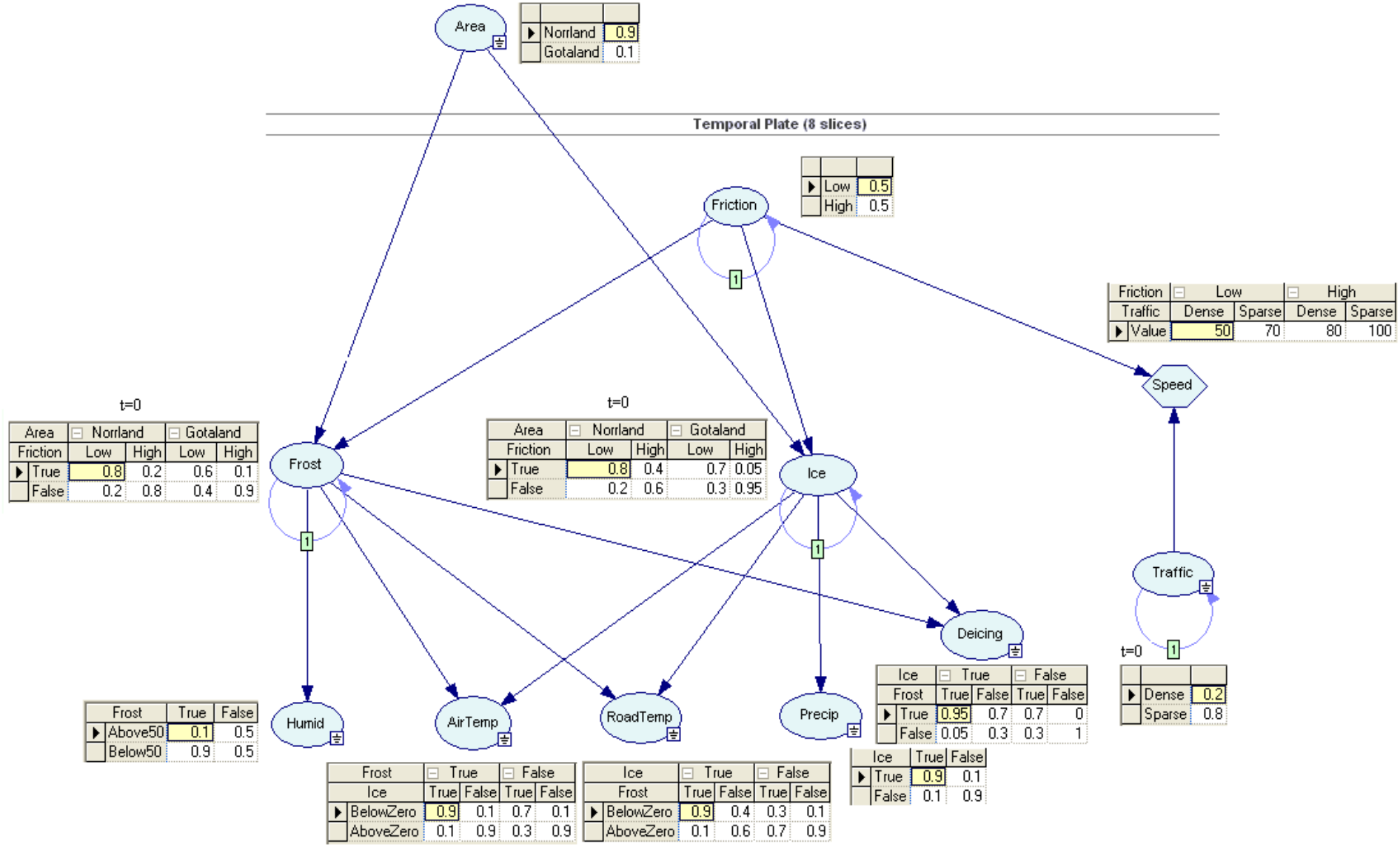
Advantages:

- Uncertainties are taken into consideration
- Smooth speed update

Mittuniversitetet
MID SWEDEN UNIVERSITY

A Dynamic Bayesian Network for variable speed limits

MIUN.SE
DISCOVER YOUR OPPORTUNITIES



MIUN.SE
DISCOVER YOUR OPPORTUNITIES

INITIAL CONDITIONS

Initial probabilities at t=1 for intermediate nodes

Frost at t=1

Area	Norrland				Gotaland			
Friction	Low		High		Low		High	
(Self) [t...	True	False	True	False	True	False	True	False
True	0.8	0.3	0.6	0.2	0.6	0.2	0.6	0.1
False	0.2	0.7	0.4	0.8	0.4	0.8	0.4	0.9

Ice at t=1

Area	Norrland				Gotaland			
Friction	Low		High		Low		High	
(Self) [t...	True	False	True	False	True	False	True	False
True	0.9	0.4	0.6	0.2	0.9	0.1	0.4	0.05
False	0.1	0.6	0.4	0.8	0.1	0.9	0.6	0.95

Traffic at t=1

(Self) [t-1]	Dense	Sparse
Dense	0.4	0.2
Sparse	0.6	0.8

Mittuniversitetet
MID SWEDEN UNIVERSITY

Evidence nodes

Figure 6. Evidence for the road temperature sensor node *RoadTemp*.

Figure 7. Evidence for the traffic intensity observation node Traffic.

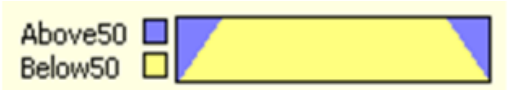


Figure 4. Evidence for the humidity sensor node *Humid*.

Figure 5. Evidence for the precipitation sensor node *Precip*.

Figure 2. Evidence for the air temperature sensor node *AirTemp*.

Figure 3. Evidence for the de-icing observation node *Deicing*.

Intermediate nodes

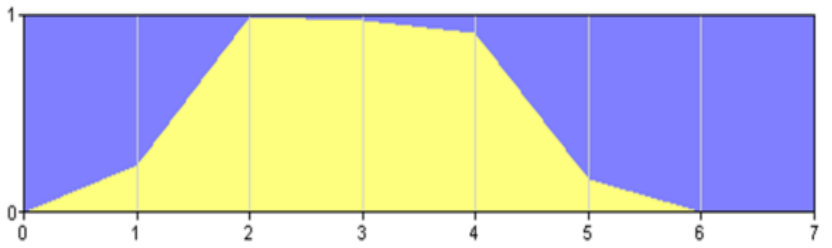


Figure 8. Intermediate probability trajectories from the chance node *Frost*.

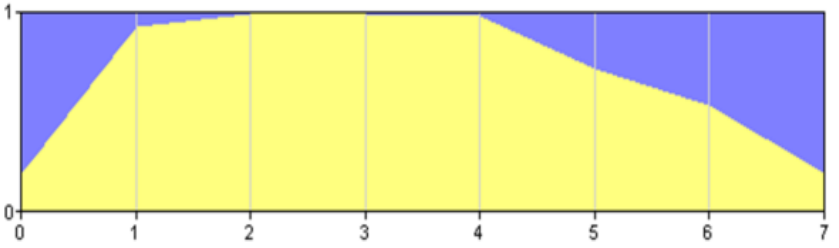


Figure 9. Intermediate probability trajectories from the chance node *Ice*.

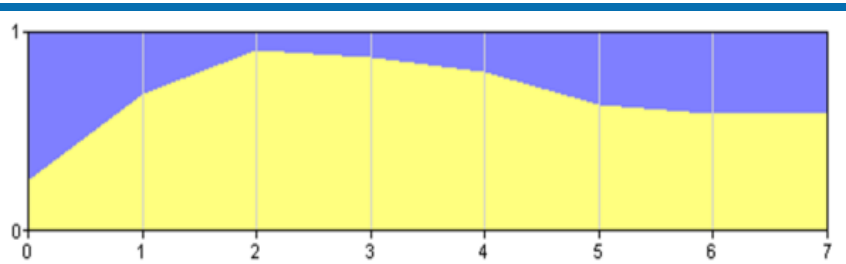
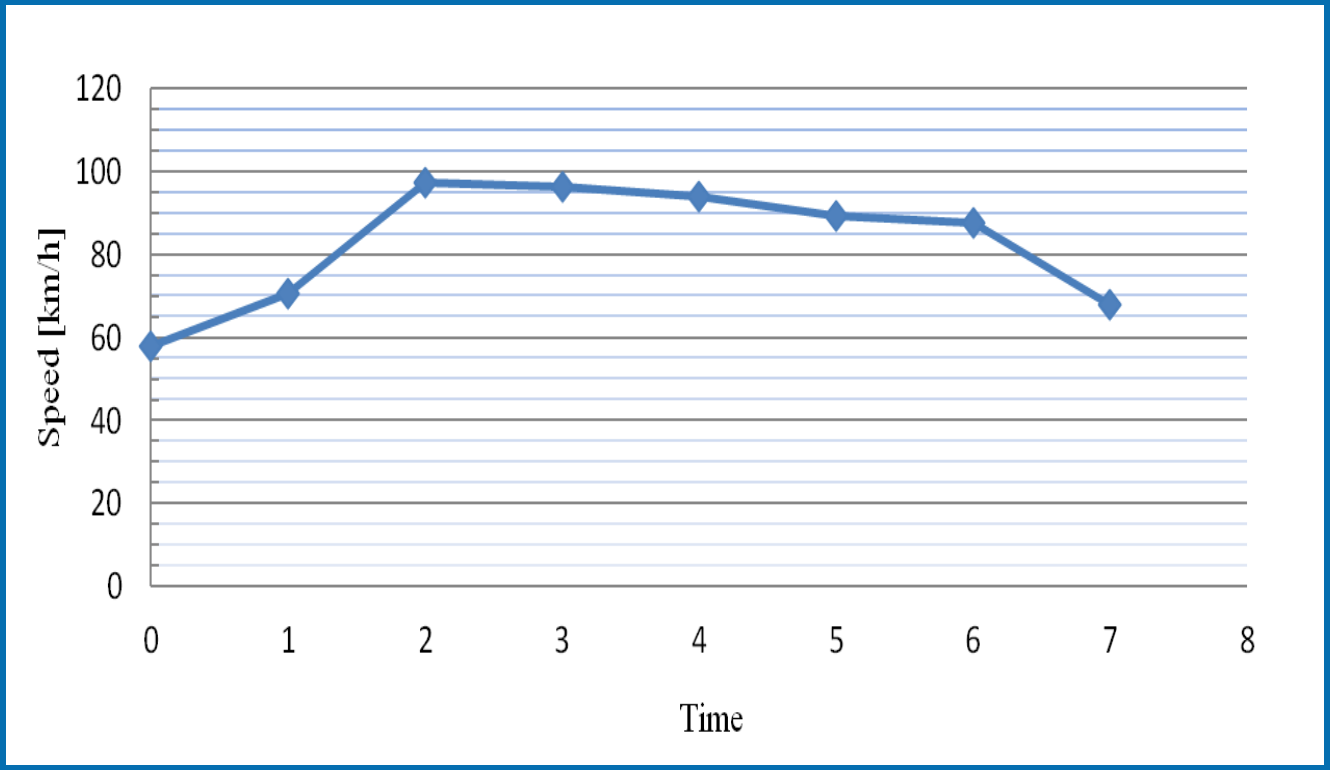


Figure 10. Intermediate probability trajectories from the chance node *Friction*.

MIUN.SE
DISCOVER YOUR OPPORTUNITIES

Mittuniversitetet
MID SWEDEN UNIVERSITY

RESULTING SPEED LIMIT RECOMMENDATION



A smooth speed regulation recommendation

Uncertainties are taken in consideration

MIUN.SE
DISCOVER YOUR OPPORTUNITIES

FUTURE WORK

- Use weather models and forecasts in Dynamic Bayesian Network
- Integrate DBN in existing weather controlled models
- Perform field tests
- Evaluate DBN influence of performance increase in variable speed limit systems

Mittuniversitetet
MID SWEDEN UNIVERSITY

THANK YOU FOR YOUR ATTENTION

Patrik Jonsson
patrik.jonsson@miun.se

This research is financed by Combitech AB