Predictive Route Guidance An Interesting ITS Application

Jon Bottom

Charles River Associates

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Provide an overview of predictive route guidance

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- Provide an overview of predictive route guidance
- Give a sense of what's known

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 - recurrent vs. non-recurrent congestion
- By providing better travel information
 - Individuals make better travel decisions (probably)
 - Network conditions improve overall (maybe)

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Before they begin trip ("pre-trip")

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■ To give them trip-related data ...

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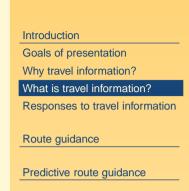
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- Some means of communicating with travelers ...
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 - Here we'll use both interchangeably ("messages")



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- Some means of communicating with travelers ...
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- Based on network conditions

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- Based on network conditions
 - In the past ("historical" guidance)

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 - Feel better knowing what's happening

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 - Image processing; ILD, cell phone signatures
- How processed:
 - Forecast future demand, conditions
 - Generate guidance

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- Data needed:
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 - Some ignore us completely

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- If a significant number of drivers change their decisions in some way

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- If a significant number of drivers change their decisions in some way
- The effects of their decisions on network conditions

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- If a significant number of drivers change their decisions in some way
- The effects of their decisions on network conditions
- Will invalidate our predictions!

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- The effects of their decisions on network conditions
- Will invalidate our predictions!
- The Self-Defeating Prophecy!!

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Example of a self-defeating prophecy

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 - Suppose we predict congestion on one of two parallel routes

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- Example of a self-defeating prophecy
 - Suppose we predict congestion on one of two parallel routes
 - We tell drivers about it
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 - It may congest worse than what we predicted for the original

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- Example of a self-defeating prophecy
 - Suppose we predict congestion on one of two parallel routes
 - We tell drivers about it
 - If enough of them listen to us and shift to the other route
 - It may congest worse than what we predicted for the original
 - And leave the original route free-flowing

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- Another possibility:

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- In all these cases, guidance was based on wrong predictions

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 - Congestion oscillates from one route to the other
- In all these cases, guidance was based on wrong predictions
 - We've probably made network conditions worse

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 - If enough of them listen to us and shift to the other route
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- Another possibility:
 - Congestion oscillates from one route to the other
- In all these cases, guidance was based on wrong predictions
 - We've probably made network conditions worse
 - And people will eventually stop listening to us

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Guidance is "consistent"

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- Guidance is "consistent"
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- Guidance is "consistent"
- When the network condition predictions
- On which our guidance messages are based
- Turn out to be true (within limits of model accuracy)

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- When the network condition predictions
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- Turn out to be true (within limits of model accuracy)
- After drivers receive the messages and react to them

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- Guidance is "consistent"
- When the network condition predictions
- On which our guidance messages are based
- Turn out to be true (within limits of model accuracy)
- After drivers receive the messages and react to them
- How do we compute consistent guidance?

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If only a small fraction of drivers receive predictive guidance

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- If only a small fraction of drivers receive predictive guidance
- Or react to the guidance messages

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- If only a small fraction of drivers receive predictive guidance
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- Their reactions will not affect network conditions –

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- If only a small fraction of drivers receive predictive guidance
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- If only a small fraction of drivers receive predictive guidance
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 - The individual drivers may benefit

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- If only a small fraction of drivers receive predictive guidance
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- Their reactions will not affect network conditions –
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 - The individual drivers may benefit
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- If only a small fraction of drivers receive predictive guidance
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- Difficult to factor driver reponse into extrapolations
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 - Say 1-2 hours into the future

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 - Consider a guidance horizon
 - Say 1-2 hours into the future
- Generate guidance for each guidance interval within guidance horizon
 - Guidance remains fixed over guidance interval

- Rolling horizon approach
 - Consider a guidance horizon
 - Say 1-2 hours into the future
- Generate guidance for each guidance interval within guidance horizon
 - Guidance remains fixed over guidance interval
 - Say 5-10 minutes

- Rolling horizon approach
 - Consider a guidance horizon
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- Network model uses continuously collected data inputs

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- Each update interval guidance is re-computed

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 - Each update, the process is rolled foward by one period

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- If an incident is detected, reset

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These network models assume drivers have perfect information

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 - If this were true, no need for route guidance!

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- Only consider dynamic traffic assignment (DTA) models

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 - All variables are time-dependent

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 - Key variables are:

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- Fixed point definition

for $T: X \mapsto X$, $X \subseteq \Re^n$ (or X more general) find $x^* \in X$ such that $x^* = T(x^*)$

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Fixed point expresses an equilibrium condition

 $S \circ D(T) = T$ $D \circ S(F) = F$

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Fixed point expresses a consistency condition

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