Crash-course Vehicle-to-Vehicle Communication

and

Enabling Congestion Assistance with Over-the-Horizon Awareness
Need for Communication

Many ITS applications rely on information from the environment

- first hand: on-board sensors sense the environment

- cooperative: V2V communication enables vehicles to pass on info
Range of instruments

On-board sensors - range limited, line of sight, finds $d, \Delta v$

Radio comm - (comparable to W-LAN) - limited by transmission range, but not line of sight. Can carry diverse info
Range of instruments (cont’d)

Multi-hop Radio comm - range virtually unlimited

![Diagram]

- A
  - tx range
  - I'm here
  - k thnx

- B
  - He's there
  - tx range
  - k thnx

- C
  - I'm here
  - tx range
Range of instruments (cont’d)

Multi-hop Radio comm - range virtually unlimited
Types of V2V comms

Roughly three types:

- Beacon Messages
- Flooding
- Routing
Beacon Messages

Every node periodically broadcasts a beacon (i.e. every 100ms)
Flooding

Information is passed on to all or subset of nodes (geocast, multicast)

A

B

C

D

caution: accident on right lane

k thnx

k thnx

k thnx

Need for Communication  Range of instruments  Types of V2V comms  Challenges of V2V  Over-the-Horizon Awareness

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Routing

also called “unicast”

- Message “finds” route
- Message targeted at specific destination
- Finding route may be costly (w.r.t. delay, medium utilisation)
Challenges of V2V

- Radio signal propagation: dealing with interference, fading, reflections, etc -> UNCERTAINTY.
- Mobility:
  - (potentially) short contact moments
  - requirements on latency (think Collision Avoidance)
  - network topology subject to change (continuously)
- Dealing with vehicles *without* communication means
- Safety-of-life situations - stakes can be high
Over-the-Horizon Awareness

- Congestion Assistant needs view several km ahead
- Vehicles *there* pass observations upstream to *here*
- Cope with V2V challenges: several tricks (read my thesis:-)
- Goal: find traffic jams ahead
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![Diagram showing traffic conditions](image)
Questions?
Backup Slides
propagation of flood j  
gap  
propagation of flood i
(a,b) Dahui et al., Hysteresis phenomena of the intelligent driver model for traffic flow, 2007

(c,d) Own IDM implementation

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Shiny time-position-speed plot of the IDM at work: