How to Prepare Roadways Better for CAV in China: Opportunities and Challenges for Signs and Markings

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260,000 annual road fatalities
26% cities in congestion
44,725,000 tons carbon dioxide

Chinese government is eager to promote CAV as potential solutions to roadway crashes, congestion, energy consumption and emissions.

Strategic Vision of CAV Development in China
China released a draft of the Innovative Development Strategy of Intelligent Vehicles in January, 2018, laying out the three-phase vision.

2020
- 50% new vehicles are intelligent
- LTE-V2X covers 90% of highways in big cities

2025
- most new vehicles are intelligent
- 5G-V2X supports CAV on a large scale

2035
- China becomes a powerhouse of intelligent vehicles

Signs and Markings in China
Signs and markings in China cannot simply bypass the problems and leapfrog to a non-physical-TCD stage.

Summary of main issues of signs and markings in China
- major issue of complying with the existing standards
- no maintained visibility (retroreflectivity) requirements
- ambiguous/contradicting message delivered
- inconsistent or non-uniform applications and practices
- no consideration of older drivers’ visual needs

What to Do Next?
- Meet human drivers’ needs
  - enforce the compliance with standards
  - set up quality control and maintenance guidance
  - keep sign and marking applications consistent
  - update standards based on older drivers’ needs

- Improve machine vision
  - update guidance/standard based on sensor visual capability
  - unify sign and marking applications at workzones
  - guide variable road conditions, such as smart lane
  - standardize the unconventional signs and markings

- Develop digit and virtual signs and markings
  - add the inventory of signs and markings to HD Live map
  - encourage developing innovative digit TCDs
  - build asset management system for signs and markings
  - improve cybersecurity

How Does AV Perceive Signs and Markings?
- Image (from camera or LiDAR) based
- Computer vision
- Deep learning

Does AV Need Signs and Markings?
- Yes, at least in the near term.
- The dependency of AV on signs and markings relies on the development phase of automation and CAV market penetration.

Current issues of signs and markings
- absent signs 33%
- complying signs 40%
- noncomplying signs 27%

Proposed plan for sign and marking development in China
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