United Nations World Geospatial Information Congress 联合国世界地理信息大会

Intelligent Transportation and Autonomous Vehicles

Introduction to Dr. Fang Shou'en

- Communist Party secretary of **Tongji University**;
- **Doctoral supervisor** in Tongji University;
- **Executive director** of **China Intelligent Transportation Systems Association** (CITSA) and **executive director** of **Road Traffic Safety Association of People's Republic of China**.
- **Research interests**: the theory and method of road planning and design, road traffic safety, etc.

Organizer:

浙江省自然资源厅 测绘与地理信息管理
Department of Natural Resources of ZheJiang Province (Administration of Surveying Mapping And Geoinformation)

同济大学交通运输工程学院
SCHOOL OF TRANSPORTATION ENGINEERING
TONGJI UNIVERSITY

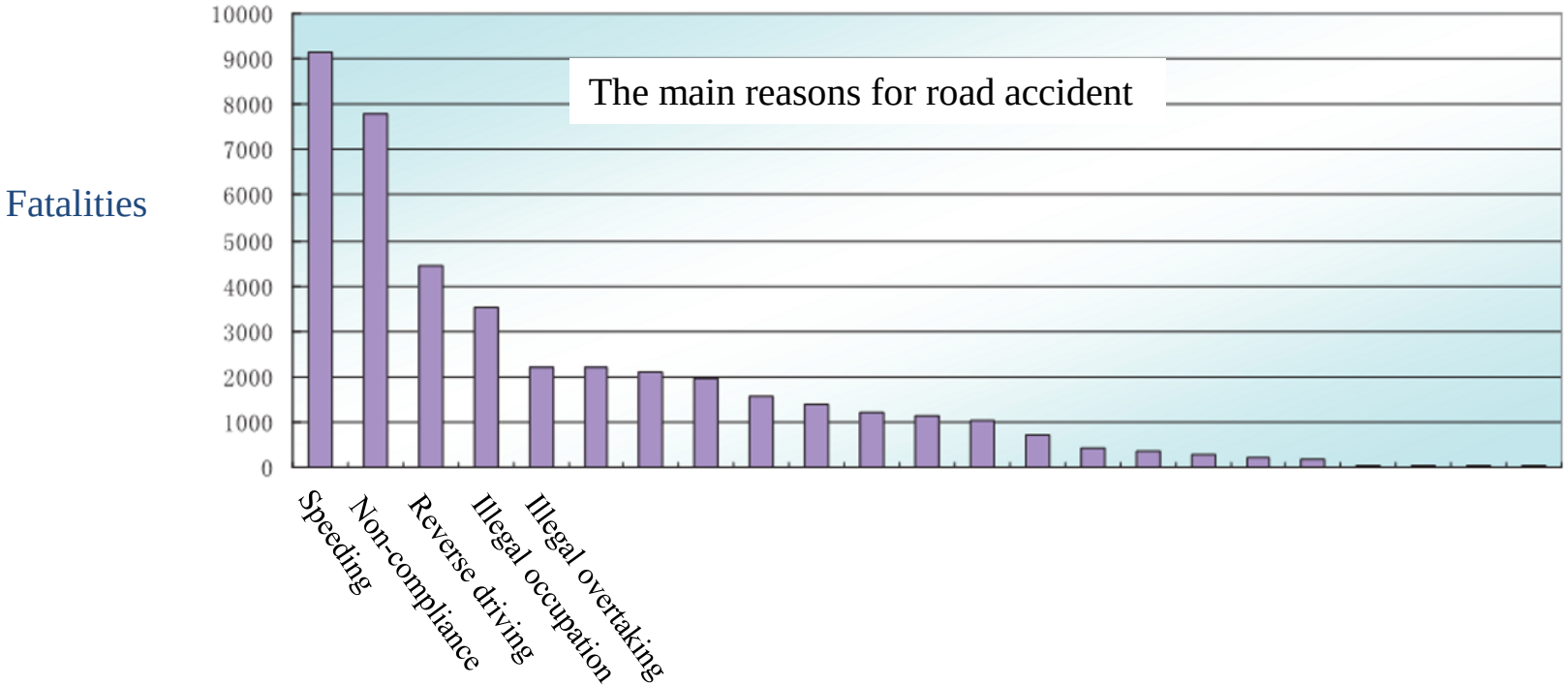
HIGH PRECISION POSITIONING, MAP AND ACTIVE TRAFFIC SAFETY

FANG Shouen

Tongji University

1. BACKGROUND

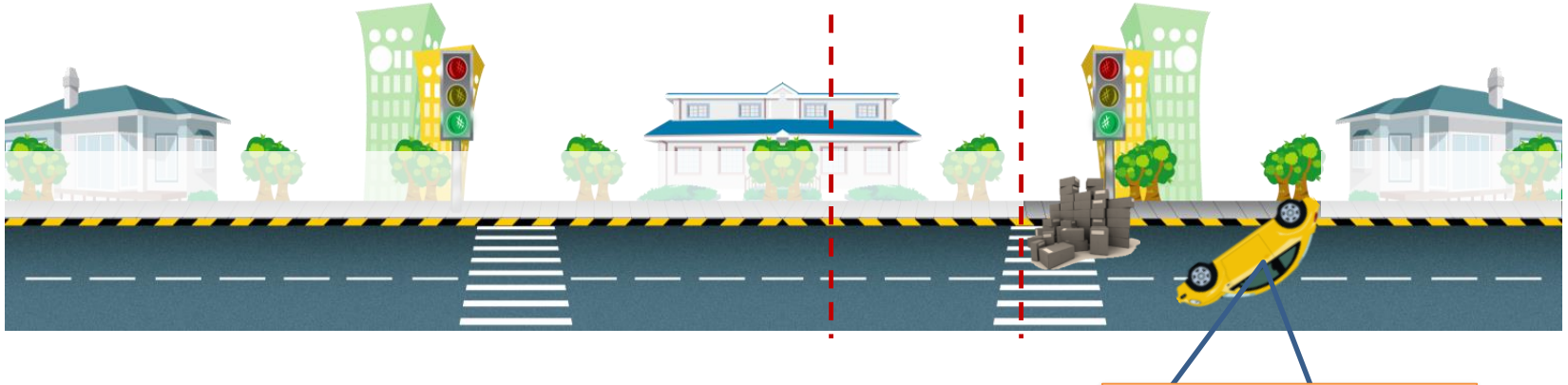
- In China, more than 50% of traffic accidents are caused by overspeed, non-compliance, reverse driving, illegal occupation, and illegal overtaking.



1. BACKGROUND

- Serious accidents causing casualties are concentrated in locations where the traffic environment is complex

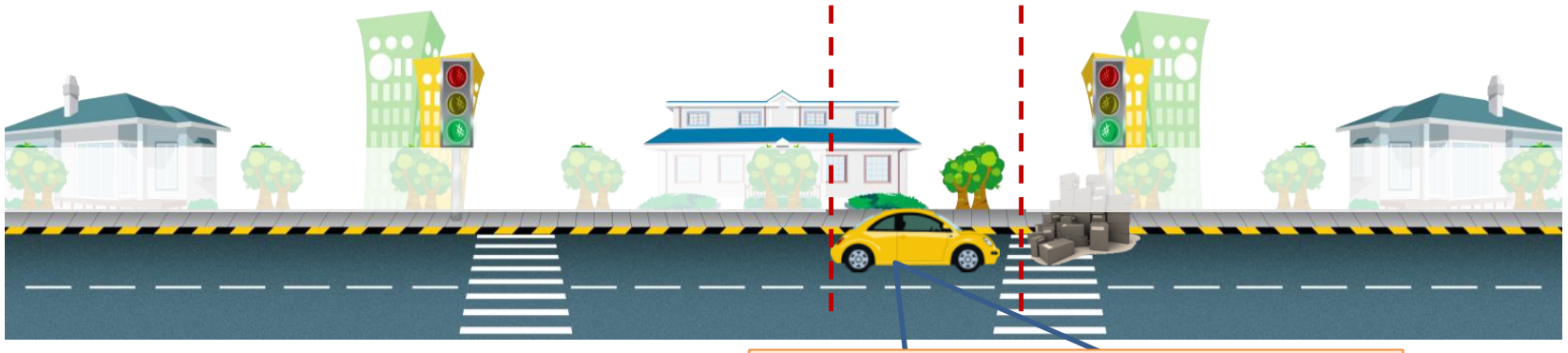
1. BACKGROUND



Post-accident phase

- Pre-tight seat belt
- Whiplash Protection System（WHIPS）
- Vehicle-use child safety seats
- Airbag

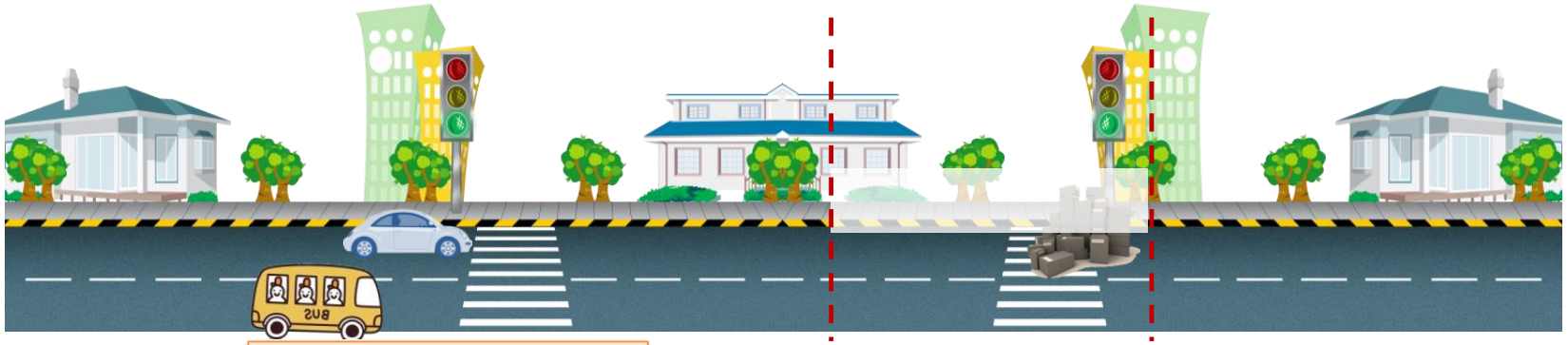
1. BACKGROUND



The upcoming phase of the accident

- Anti-collision warning system(AWS)
- Traction control system
- Electronic Stability Program(ESP)
- Vehicle Stability Assist (VSA)
- Anti-lock Braking System(ABS)
- Electric Brake force Distribution(EBD)
- Lane changing auxiliary system
- Acceleration Slip Regulation(ASR)

1. BACKGROUND



Normal driving stage

How to reduce the probability of accidents during normal driving?

- Obtain the safety information related to driving vehicles on the road
- Provide the normal information intervention and safe services for drivers

1. BACKGROUND

Why the accident occurs?

Whether the velocity vectors of the conflicting vehicles intersect?

How to know the position of the vehicle on the road?

Actively prevent accidents from happening

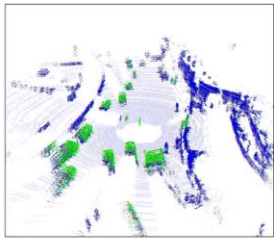
High-precision positioning and reliable spatial data are necessary conditions for proactive prevention of accidents

2. HIGH PRECISION POSITIONING AND MAPPING

- GNSS observation network and wide-area real-time precision positioning system are important infrastructures for realizing urban traffic active safety services, enabling wide-area sub-meter positioning
- Vehicle-borne high-precision positioning terminal

Marking, sign recognizing

V2V,V2R short-range communication



Moving objects detection

2. HIGH PRECISION POSITIONING AND MAPPING

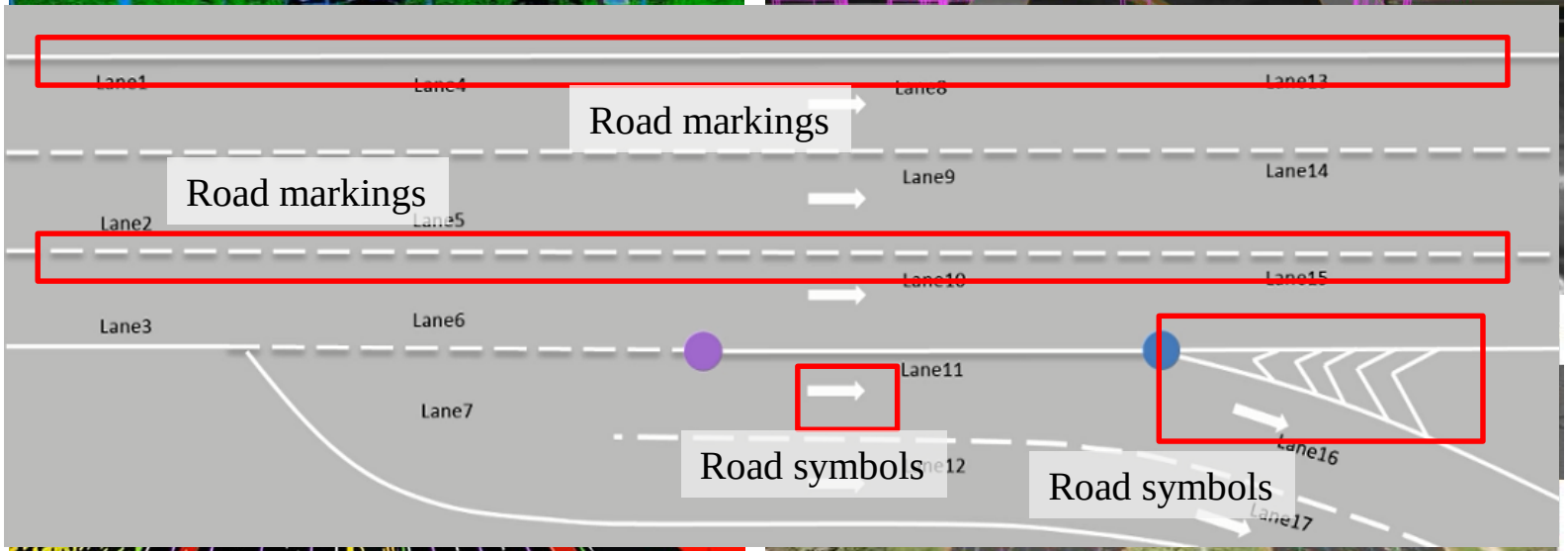
- Vehicle-borne high-precision positioning terminal
  - high-precision lane-level seamless positioning module
  - low-speed CAN bus information acquisition and control
  - V2X workshop-vehicle short-range communication
  - 3G and call communication
  - ACC radar sensing

Main board and appearance of the terminal

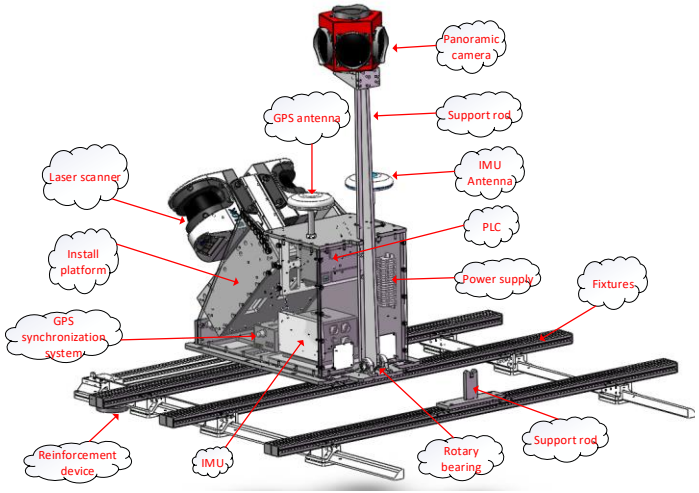
Android operating system embedded with high-precision positioning module

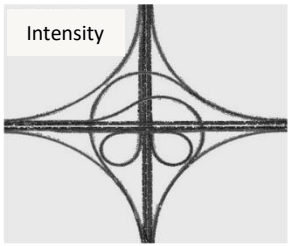
2. HIGH PRECISION POSITIONING AND MAPPING

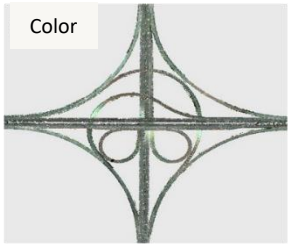
- High-precision, high-resolution spatial data, especially the road maps, are the basic conditions for active traffic safety services.

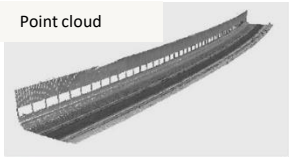


2. HIGH PRECISION POSITIONING AND MAPPING



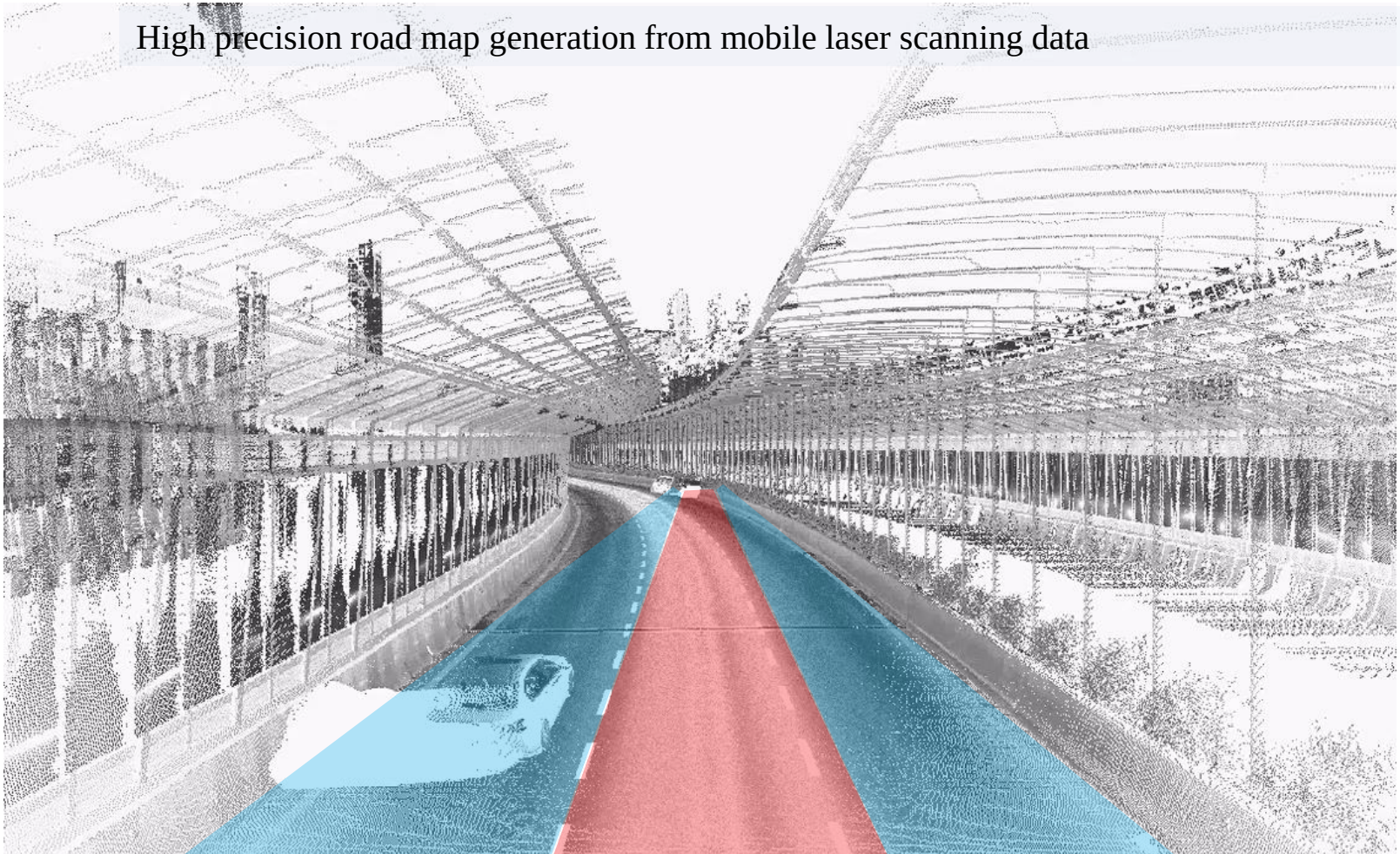




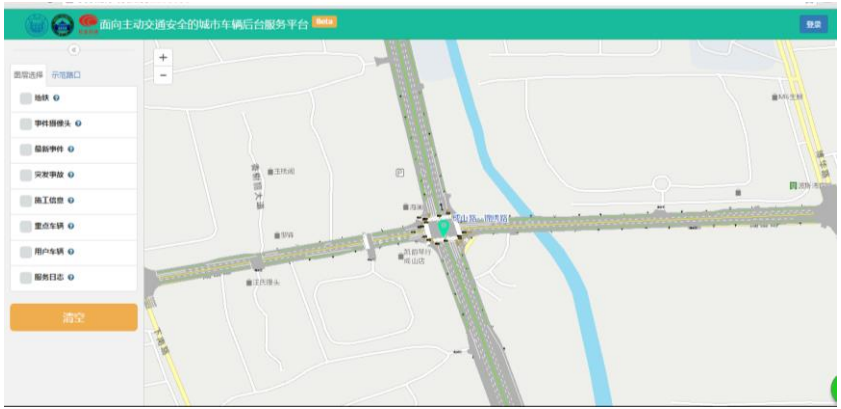


2. HIGH PRECISION POSITIONING AND MAPPING

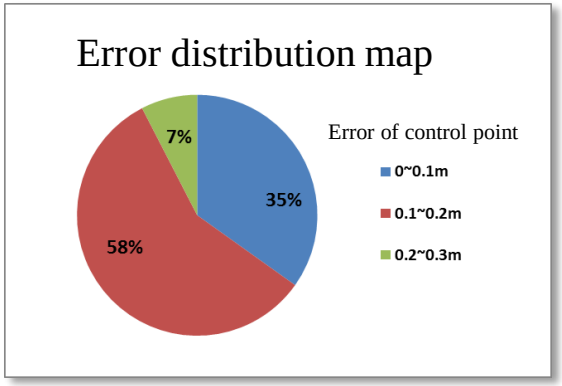
High precision road map generation from mobile laser scanning data



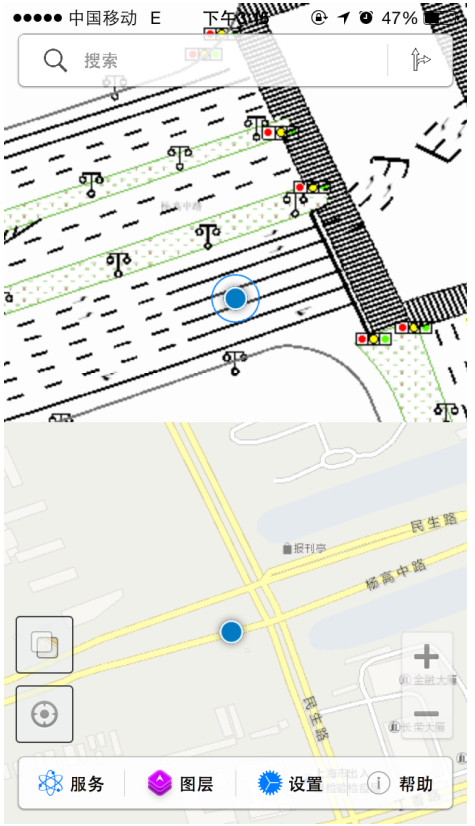
2. HIGH PRECISION POSITIONING AND MAPPING



Overlay of the multi-level navigation electronic map



Accuracy evulation of lane level road maps

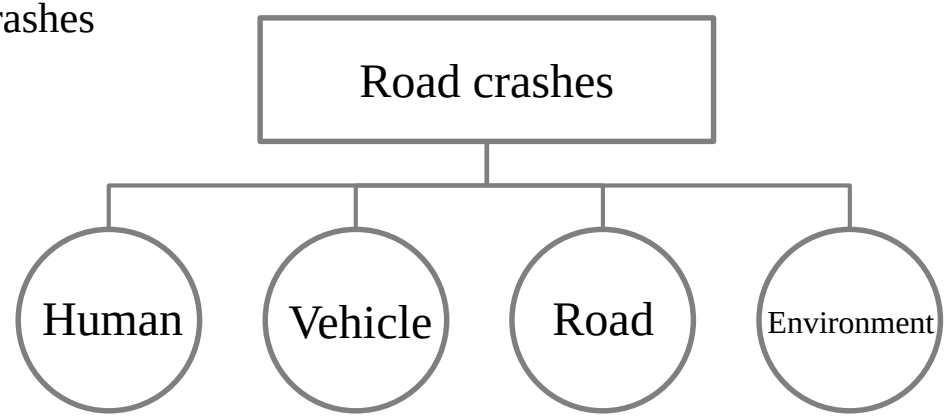


Application of lane level navigation map

3. ACTIVE TRAFFIC SAFETY MODELS

(1) The coulping of crash factors and driving status

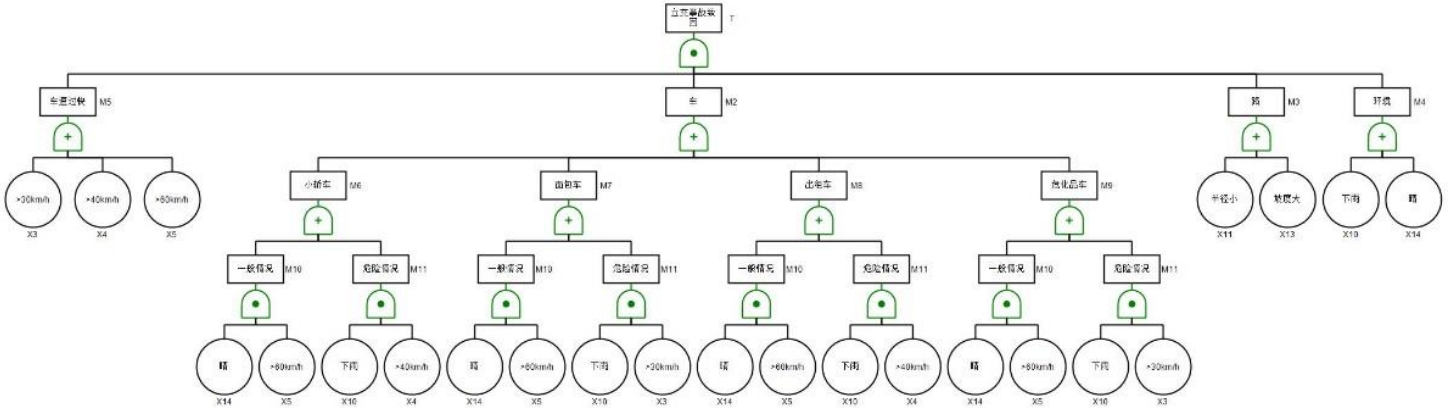
- Crash factor analysis
- The relationship within driving behavior and road alignment & environment
- The effect of driving state on crashes



->Driving status data acquisition

- High-precision devices: location / speed / 3-Dimension acceleration

3. ACTIVE TRAFFIC SAFETY MODELS

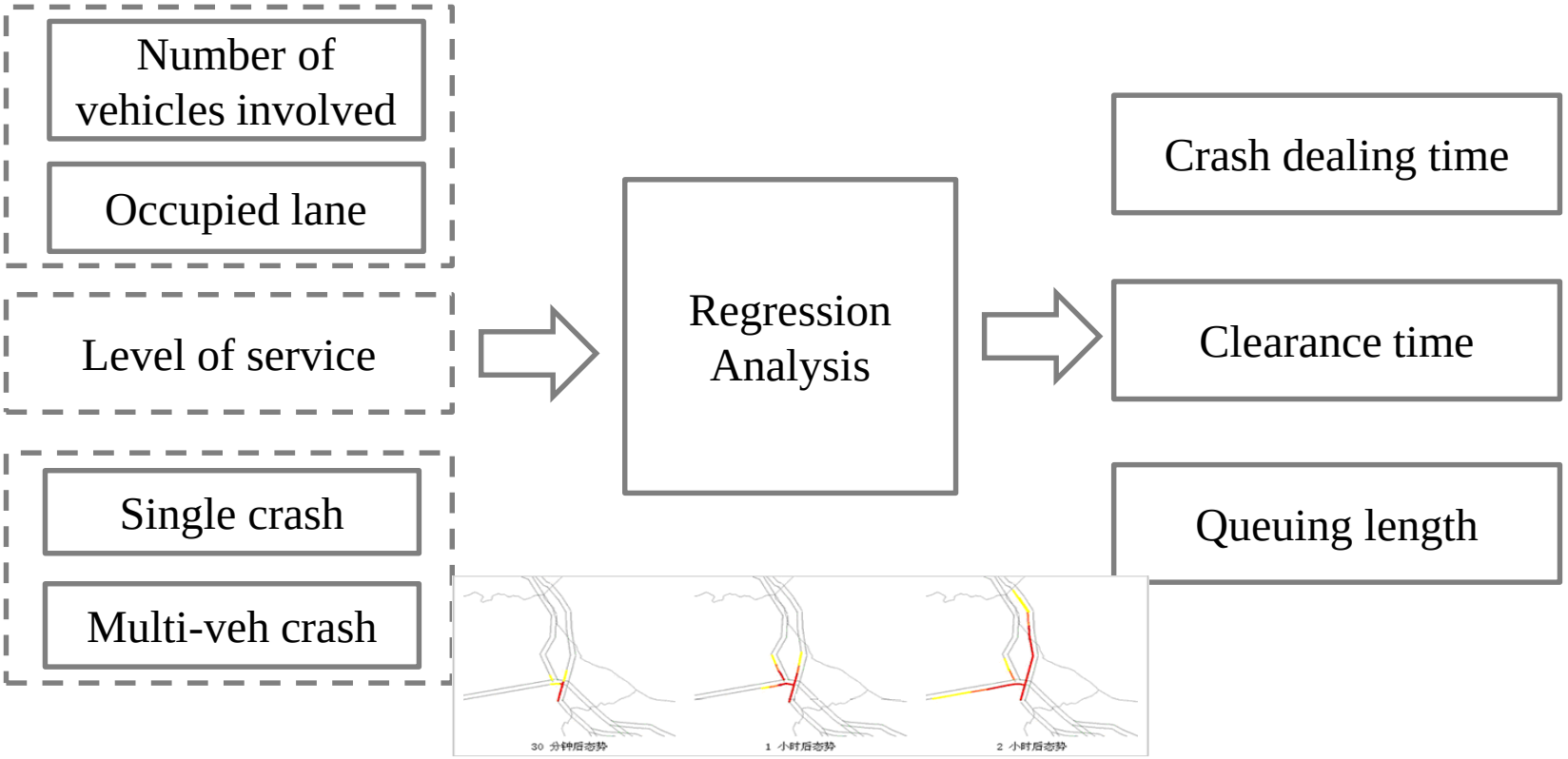


Pre-warning premises

- *Chemical vehicles / micro vans + Raining + >30km/h*
- *Other vehicles + Raining + >40km/h*
- *All vehicles + Sunny + >60km/h*

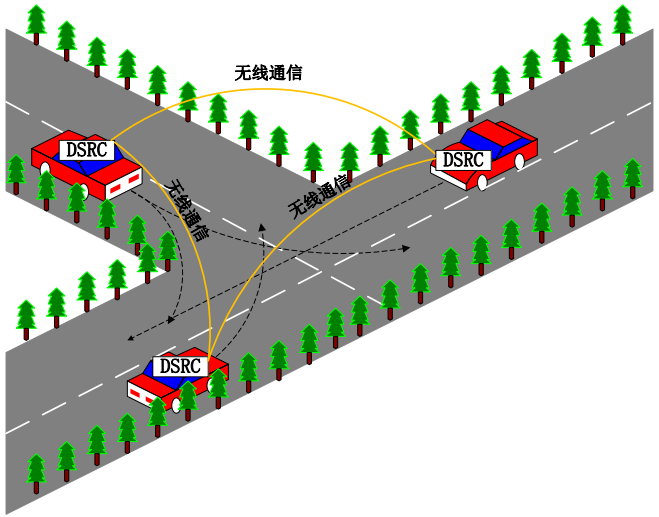
3. ACTIVE TRAFFIC SAFETY MODELS

(2) Risk alerting based on spatial-temporal impact analysis of incidents



3. ACTIVE TRAFFIC SAFETY MODELS

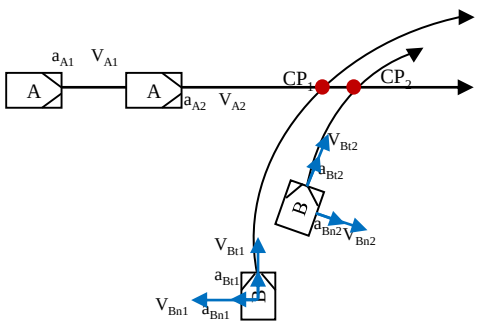
(3) Conflicts alerting in the intersections based on high-precision positioning techniques and DSRC



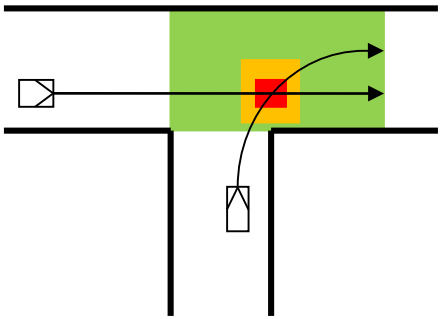
- V2V– DSRC+ meter-level positioning
- Real-time online analysis and alerting

3. ACTIVE TRAFFIC SAFETY MODELS

(3) Conflicts alerting within the intersections based on high-precision positioning techniques and DSRC



Vehicle trajectory



Conflict level

Alerting conditions

- Modeling method:
  - Three stages: into curve, in curve, leave curve
  - Log-linear model, to estimate duration time of the three stages
  - Conflicts classification within the turning duration

3. ACTIVE TRAFFIC SAFETY MODELS

(4) Enhancing visual sense under low-visibility weather conditions

- Modeling method: *Spatial information technology + VR*
  - Spatial point cloud of infrastructure by laser scanning and UAV
  - 3D digital restructure
  - High-precision data acquisition by on-board devices
  - Perspectives generating from driver's viewpoint
  - Scenes generating by on-board devices

4 APPLICATION

5 CONCLUSIONS

(1)High precision positioning+ safety can help to improve safety by

+mapping technique

+safety model

+ VR technique

+…..

(2) Key technique of Autonomous Vehicle and Connect Vehicle: High precision + Communication

(3) Our role: Know where you are and let other vehicle know where you are

THANKS

- **FANG Shouen**
- **Tongji University**
- **fangsek@tongji.edu.cn**

同济大学交通运输工程学院
SCHOOL OF TRANSPORTATION ENGINEERING
TONGJI UNIVERSITY