Challenges in real-world field experiments:
- Simulation environments are highly controlled but experiments involving real-world traffic infrastructure are subject to uncertainties and situations beyond the control of the researcher.
- Identifying most critical variables affecting performance of ADAS from enormous set of candidate variables and their attribute levels.

Approach Overview
- Definition of performance measures
- Selection of explanatory variables and their levels: geometry, built environment, traffic, etc.

Data Fusion for Trajectory Prediction
- ADAS Performance Metrics:
  - Primary variables:
    - Gradient of approach
    - Horizontal alignment
    - Road width (number of lanes)
  - Why these variables?
    - Line-of-sight vertically affected
    - Line-of-sight horizontally affected
    - Relative positions of vehicles during maneuvers
  - Secondary variables:
    - Traffic control type
    - Blind approach due to situational conditions
    - Blind approach due to foliage/build environment
    - Presence of other vehicles (influencing vs not influencing maneuvers of test vehicles)
    - Presence of the law
    - Presence of pedestrians
    - Protected vs. unprotected left turns
    - Presence of cars side parking
    - Number of approaches
    - Weather conditions

Data Fusion Algorithms
- GPS & IMU Tracking
- Camera, LIDAR, Radar: Labeled multi-target (multi-object) model for multi-object tracking with particle filter

Traffic Scenarios
- Overtaking on a rural highway
  - Maneuvers: Communication equipment (range required)
- Urban Intersection
  - Mix of communication equipment and sensors
  - Large variability
- High pedestrian and bicyclist density zones
  - Maneuvers: Sensors (detailed recognition of environment required)

Urban Intersection Experiment
- Eight different intersections in Austin, TX

Preliminary Results - Need for Redundancy
- Results indicate that V2V alone cannot ensure safety—crucial to have redundancies in communication via infrastructure.

Need for Efficient Experimental Design
- Challenges in real-world field experiments:
  - Simulation environments are highly controlled but experiments involving real-world traffic infrastructure are subject to uncertainties and situations beyond the control of the researcher.
  - Identifying most critical variables affecting performance of ADAS from enormous set of candidate variables and their attribute levels.

Objectives
- Determine optimal configuration of in-vehicle and infrastructural sensors and communication equipment to maximize roadway safety.
- Analyzing and quantifying the impact of different road geometry, built-environment, and traffic variables on the performance of each equipment: single variables & interacting variables.
- Understanding the complementarity between different sensors and communication equipment in varied traffic scenarios.

Motivation - Crashes are Expensive
- Crashes are associated with astronomical economic and social costs.
- Crashes are Expensive
- Crashes are associated with astronomical economic and social costs.

Need for Redundancy
- Results indicate that V2V alone cannot ensure safety—crucial to have redundancies in communication via infrastructure.

Incorporating road side DSRC and mmWave in equipment suite and accuracy with different configuration of equipment.

Field Testing
- Travis Ht. & Harwood Pl. (Austin, TX)
- V2V DSRC signal reception poor due to large building & environment.
- Cedar & 34th Street (Austin, TX)
- V2V DSRC signal reception poor due to thick foliage.

Travis Ht. & 27th Street (Austin, TX)
- V2V DSRC signal reception poor due to large building & environment.

Ongoing and Future Work
- Trajectory prediction models using data collected and comparison of accuracy with different configuration of equipment.
- Incorporating road side DSRC and mmWave in equipment suite and analyzing gain in ADAS performance through V2I.
- Extending experiments to high speed passing maneuvers on rural roads and areas with high density of pedestrians and bicyclists.

University of Texas at Austin