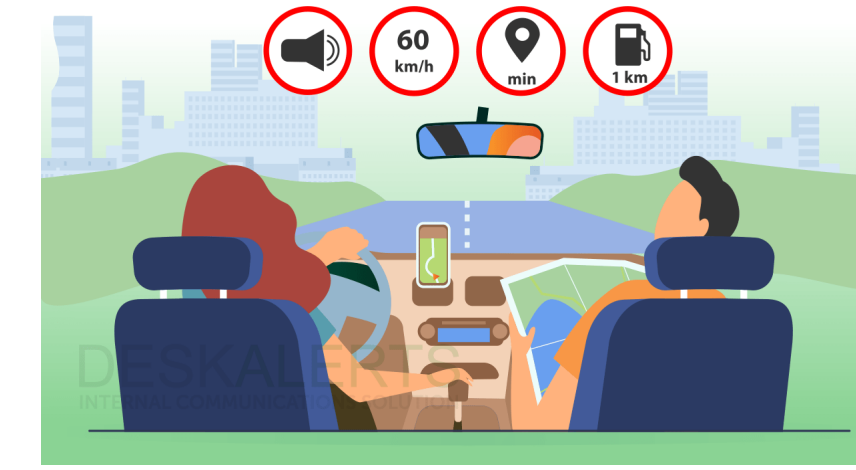


Background

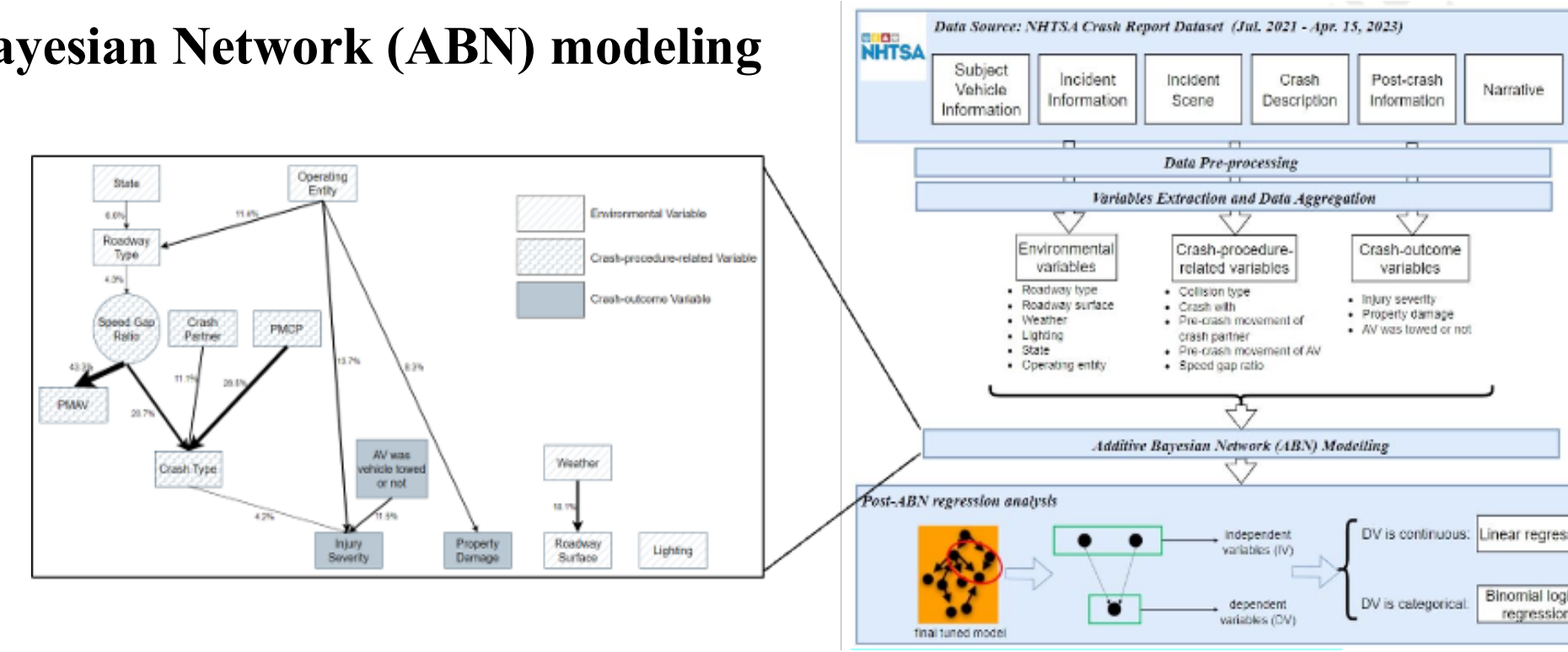
- Traffic accidents claim thousands of lives daily, with over 94% linked to human error.
- Driving automation (ADAS) may enhance traffic safety and efficiency, yet its effectiveness depends on drivers' understanding of these systems.
- To fully exploit the benefits of driving automation, it is essential to understand how drivers use these technologies and guide their behaviors.



Why ADAS/ADS- involved crashes still happen?

- **Dataset:** NHTSA crash report
- **Method:** Additive Bayesian Network (ABN) & crash sequence analysis
 - Crash progression is influenced by dynamic factors, such as vehicle speed, and speed limits.
 - Crash outcomes are determined by static factors, such as road type, and time of incident.
 - Rear-end collisions account for the majority of driving automation-involved incidents

Additive Bayesian Network (ABN) modeling



Code	Description	Code	Description
A1	v1 accelerate/misread	M2	v2 merge left/right
A2	v2 accelerate/misread	R1	v1 turn right
B2	v2 back up	S1	v1 stop
D1	v1 decelerate	S2	v2 stop
E1	v2 entering traffic	TD	v1 driver takes over the driving task
E2	v2 entering traffic	DF	v1 driver distraction - using operation
L1	v1 lane left	F	v1 diverging / misdirection
L2	v2 lane right	V1	v1 violate the rule
M1	v1 merge left/right	V2	v2 violate the rule

Example:
The customer was driving straight on a highway at approximately 66 miles per hour when the wheels allegedly locked up, causing the customer to lose control and hit the concrete barrier.

Crash sequence encoding

Sequence 1: A1 T0 V2 R1 X13
Sequence 2: A1 T0 V2 X12

Distance = 0+1+0+1+2 = 4

Legend: match (green), gap (red), mismatch (blue)

Sequence alignment & clustering

Crash sequence analysis

Static Factors

- Automation Level
- Model Year
- Incident Year
- Incident Time
- Weather
- Speed Limit
- SV Speed
- Roadway Surface
- Roadway Type

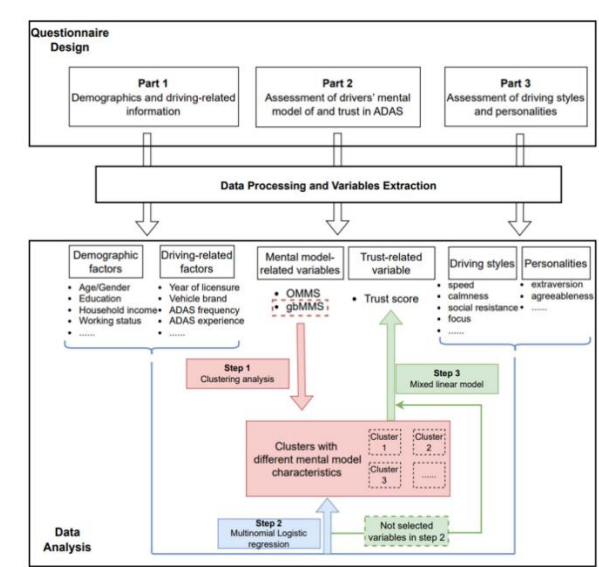
Crash Progression

- Crash Pattern (model 1)
- Crash outcome
 - SV Contact Area (model 2)
 - Highest Injury Severity (model 3)

Logistic regression

How are Drivers informed of ADAS?

- **Method:** Survey study with 287 drivers & interview study with 18 salespersons
 - Most drivers still had limited knowledge of ADAS.
 - Inaccurate depiction of ADAS functionalities, limitations & capabilities during salesperson–customer interactions.



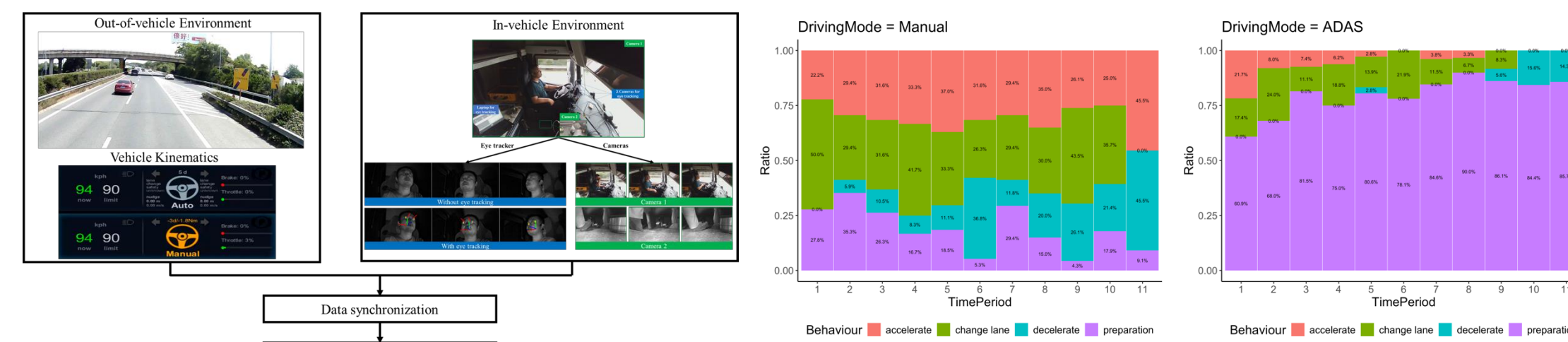
Questionnaire survey



Salesperson interview

How ADAS affect driver behaviors?

- **Method:** Naturalistic driving study among truck drivers, with over 120 hours of highway data.
 - ADAS helps reduce truck driver fatigue during long-haul driving

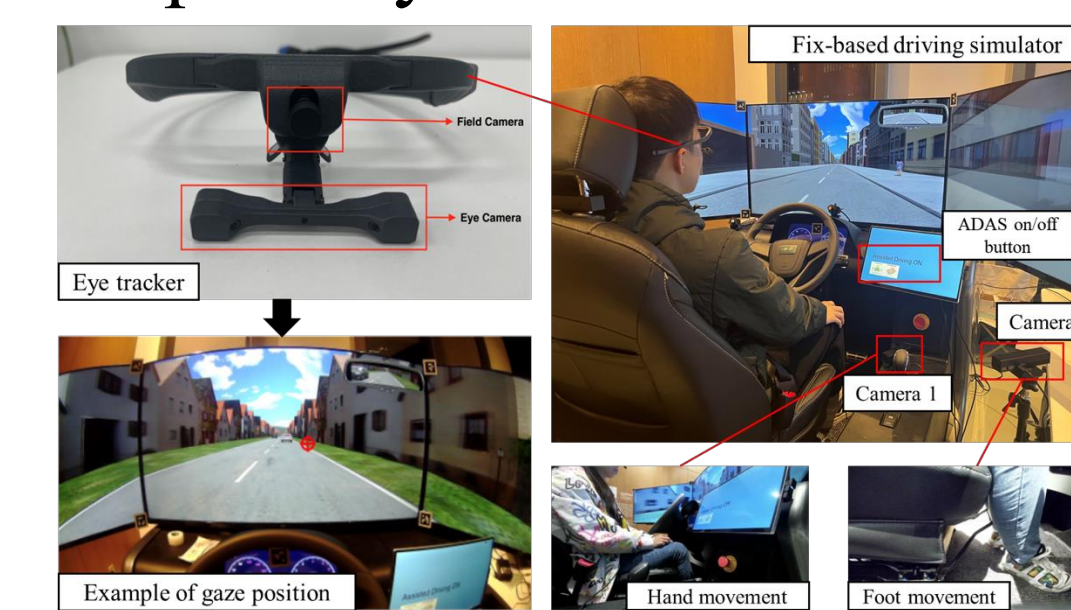


Naturalistic driving experiment

Defensive driving behavior

What can we do? – Driver training & HMI design

- **Method:** Video simulation & driving simulator experiment
 - ADAS users need to be trained in two aspects, ADAS knowledge & hazard perception skills.
 - Human-machine interfaces (HMIs) providing beyond-visual-range and ADAS transparency information can enhance driving safety.



Driver training experiment



HMI for chain-braking scenarios