

# Enhancing Road Safety with Advanced Wrong-Way Driving Detection Systems

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## The Wrong Way Problem



- Wrong-way driving (WWD) presents a serious threat.
  - 500 DEATHS annually in the US

- High fatality risk in rural areas.
  - Higher frequency of head on collisions at higher speeds
  - One study found fatality rates to be 27x the normal rate



https://abc13.com/wrong-way-crash-wrong-way-driver-fatalities-deadly/10559213/

## The Wrong Way Problem



- Challenges:
  - Do I have a problem?
    - Are crashes the only metric I currently have?
  - Late detection
    - Do I have automated detection? How fast does it recognize and alert? How reliable is it?
  - Limited reaction time
    - •Once I know, how fast can I do something about it?

## The Wrong Way Problem



- Challenges:
  - Sparse infrastructure.

• How can I tell anyone about the driver?

- How much infrastructure can I afford to put on the roadway for detection?
  - •What are the tradeoffs on the different types?

### Kansas Advanced Traffic Management System (KAITS)



- Statewide traffic management platform deployed in 2020
- Covers urban and rural environments across the state
- Integrates device management, incident management, detection, alerting, and automated response





## **Detection Technologies in KAITS**

- Video-based detection
- Radar detection systems
- Mixed detection scenarios (Video + Radar)
- RSU detection
- 8 Vendor Based protocols
- 1 Generic Protocol (public, any vendor can use)



#### Video-Based Detection



Factor	Assessment
Deployment Cost	Moderate — uses existing CCTV infrastructure if available; new installation can be expensive. Servers (or service) to process video
Maintenance Cost	Low — Unless new cameras are deployed, maintenance is usually already covered. Server/Service maintenance costs
Detection Latency	Low to Moderate — processing video streams can introduce some delay, especially if the system uses centralized processing.
Reliability of Detection	Moderate — weather (fog, rain), lighting (nighttime glare), and obstructions (dust, debris) can reduce detection accuracy.
Overall Cost	Moderate to High — initial costs manageable if infrastructure exists, but continuing server/service costs.

#### **Radar-Based Detection**



Factor	Assessment
Deployment Cost	High — radar devices themselves are expensive. Possible to reduce the cost if radars are already deployed
Maintenance Cost	Low — radars are durable and weather-resistant.
Detection Latency	Low — instant radar signal reflection and processing.
Reliability of Detection	Moderate — consistent in all weather and lighting conditions however potentially prone to non-vehicle triggers.
Overall Cost	Varies — Can be expensive up front to deploy, but low operating costs.

## Mixed Radar and Video Detection



Factor	Assessment
Deployment Cost	Very High — two system types plus integration cost.
Maintenance Cost	Moderate — still needs camera upkeep, but radar provides backup.
Detection Latency	Very Low — radar provides instant detection, video supports quick confirmation
Reliability of Detection	Very High — combines radar's weather-proof performance with video's visual validation to reduce both false positives and false negatives.
Overall Cost	High — best cost-benefit ratio in critical areas when safety is paramount.

### **RSU** Detection



Factor	Assessment
Deployment Cost	High — RSU purchase can be expensive and deployment
Maintenance Cost	Low to Moderate — long term maintenance of the device
Detection Latency	Very Low — BSM at 10Hz provides instant detection. Edge Processing
Reliability of Detection	Moderate to High— Based on GPS reliability. Can depend on the lane configuration and spacing.
Overall Cost	Moderate to High — large deployments would be costly. Would also support other CV applications.

### **Real-Time Detection and Response**



 KAITS delivers real time alerts with live video and images to the operator for immediate reaction to the WWD event.



### **Real-Time Detection and Response**



 Emails and DMS messages can be automatically posted or posted with operator approval

😳 Response Plan: Event 10588					
Activate Terminate Plan Plan Actions Plan Actions Plan Litem Plan Plan Plan Plan Actions	Associated Accept Load Get New Predefined Suggestion TAM Dist: 3 Suggestions				
Current Plan Suggestions					
Device Details	Activation Action	Response Plan Message Details	Active Response Plan Message [	Details	Currently Active Message Details
511 ATIS		This location is flagged not to be published by FL-ATIS.			
	Publish	Incident in Sumner county going Northbound on I-35 at E Pawnee Street Last updated 4/28/2025 12:19:27 PM			
DMS I-35 NB S George Washington [(Local) KDOT]	No Action	WRONG WAY Driver Ahead Use Caution	WRONG WAY Driver Ahead Use Caution		WRONG WAY Driver Ahead Use caution
Active		Until Canceled	I Until Canceled	Displayed	1 Until Canceled 1
DMS I-35 NB S Southeast Blvd [(Local) KDOT]	No Action	WRONG WAY Driver Ahead Use Caution	WRONG WAY Driver Ahead Use caution		WRONG WAY Driver Ahead Use caution
Active		Until Canceled	I Until Canceled	Displayed	1 Until Canceled 1
DMS K-15 NB & MIXING YARD (55th Street) [(Local) KDOT]	No Action	WRONG WAY Driver Ahead Use caution	WRONG WAY Driver Ahead Use Caution		WRONG WAY Driver Ahead Use caution
Active		Until Canceled	I Until Canceled	Displayed	1 Until Canceled <u>1</u>

#### How Reliable are these devices?





Florida, District 6 2023-2024

#### But what is a False Alarm?





False Alarm Types

## Alternate Radar Detection Mechanism Sur

• KAITS has a large amount of radars already deployed on the mainlines, collecting data on speed, occupancy, and volume.

 By collecting directional data, the system can also be used to identify wrong way drivers



### Alternate Radar Use



Factor	Assessment
Deployment Cost	None – No new deployment
Maintenance Cost	None – Uses existing infrastructure
Detection Latency	High – Radars are still polled so will only alert on the poll cycle
Reliability of Detection	Moderate – Can work with multiple consecutive detectors for grater accuracy at the loss of latency
Overall Cost	Low – Ideal of data gathering, understanding of the problem, and response. Should not be used in real time, safety critical situations due to latency.

### Alternate Radar Detection Mechanism



- If latency is high, why use this at all?
  - Cost Would allow some form of detection if you already had the existing devices
  - Information You don't know what you don't know
  - Reaction The information gathered may offer opportunities for additional funding or potentially other deterrents (signage, pavement markings, flashers)

### Conclusions



- WWD remains a major road safety challenge.
  - Its not going away and is actually getting worse.
- The need is HIGH for cheap (deploy and maintain) WWD solutions.
  - Ramps
  - Mainline
  - Rural/Urban
- Not a "one solution" type of problem
  - Your specific need will determine which tradeoffs work for you.



#### **QUESTIONS?**

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