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Oak Ridge National Laboratory Transport Security Research

Secure Hijack, Intrusion, and Exploit Layered Detector (SHIELD)

Vehicle Attack Analysis Framework (VAAF)

Continuous Driver Authentication (Go CSU!)

Fault Anomaly Detection

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Problem: Cybersecurity Resilience Varies Wildly by Manufacturer

Best Practice	OEM A	OEM B	OEM C	OEM D
CAN Gateway	✓		✓	
CAN Message Authentication			✓	
Segmented Networks	✓	✓	✓	
Transparent Vulnerability Handing	✓			
Frequent Security Patching			✓	
Whole-Vehicle Security Assessments				

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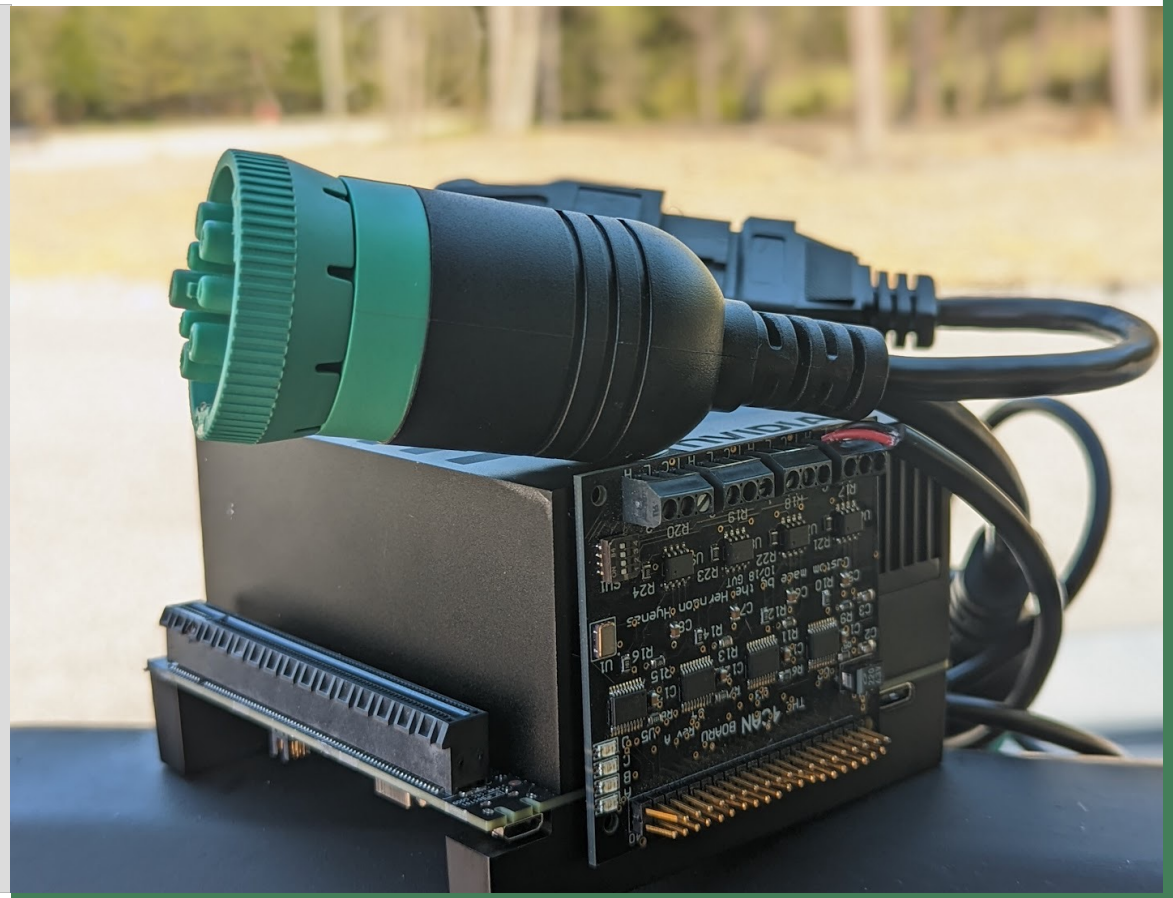
SHIELD: Secure Hijack, Intrusion, and Exploit Layered Detector

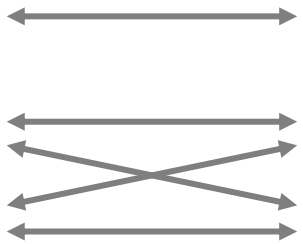
- Ensemble intrusion detection system for in-vehicle Controller Area Networks



CAN Intrusion Detection Overview

Attack type

- CAN frame injection
- Single-signal manipulation
- Multiple signals manipulated



Detector Type

- Message timing anomaly
- Single-signal anomaly
- Inter-signal relationships broken or changed

Detector	Single Frame Injection	Multiple Frame Injection	Denial of Service	Suspension	Masquerade	Diagnostic	Other?
Timing / Frequency	✓	✓	✓	✓	✗	✗	?
Arb. ID Inspection	✗	✗	✗	✗	✗	✓	?
Payload Inspection	✓	✓	✓	✗	✓	✗	?

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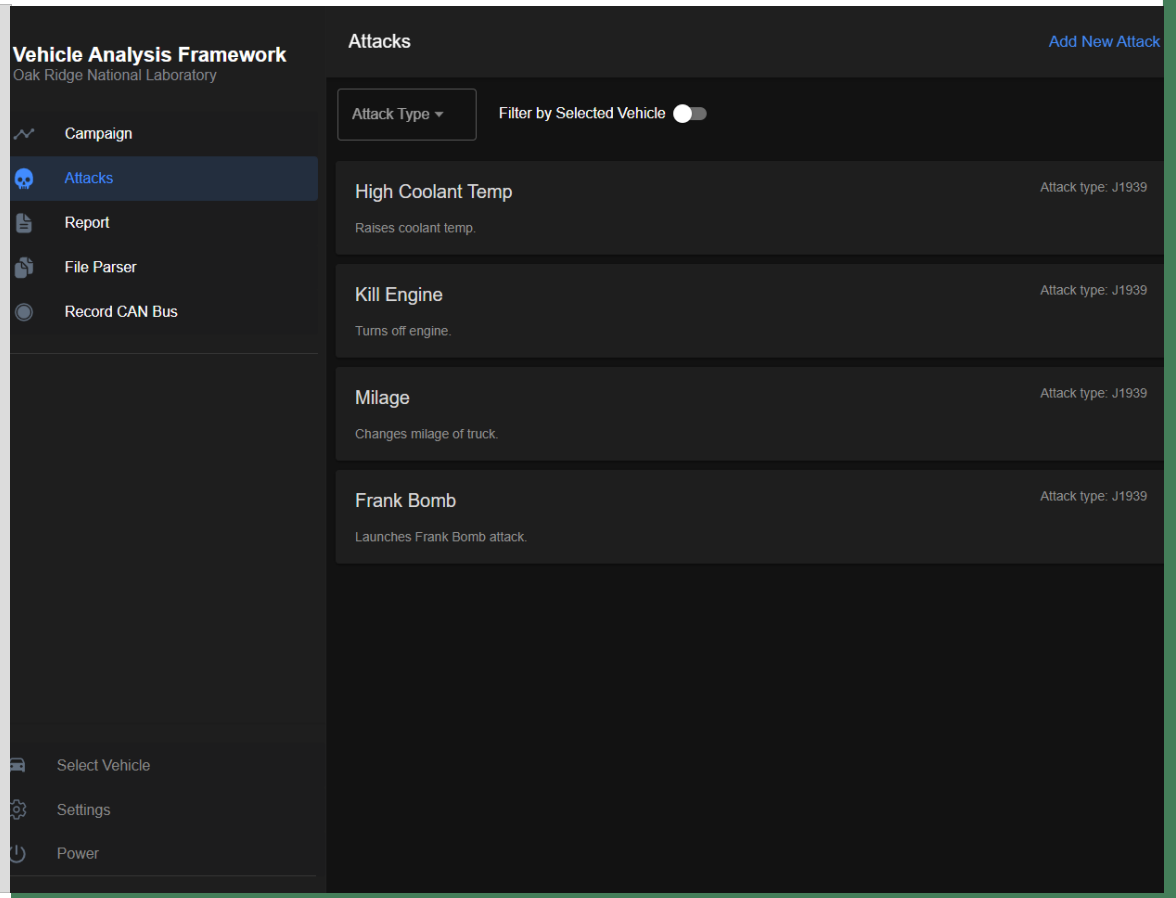
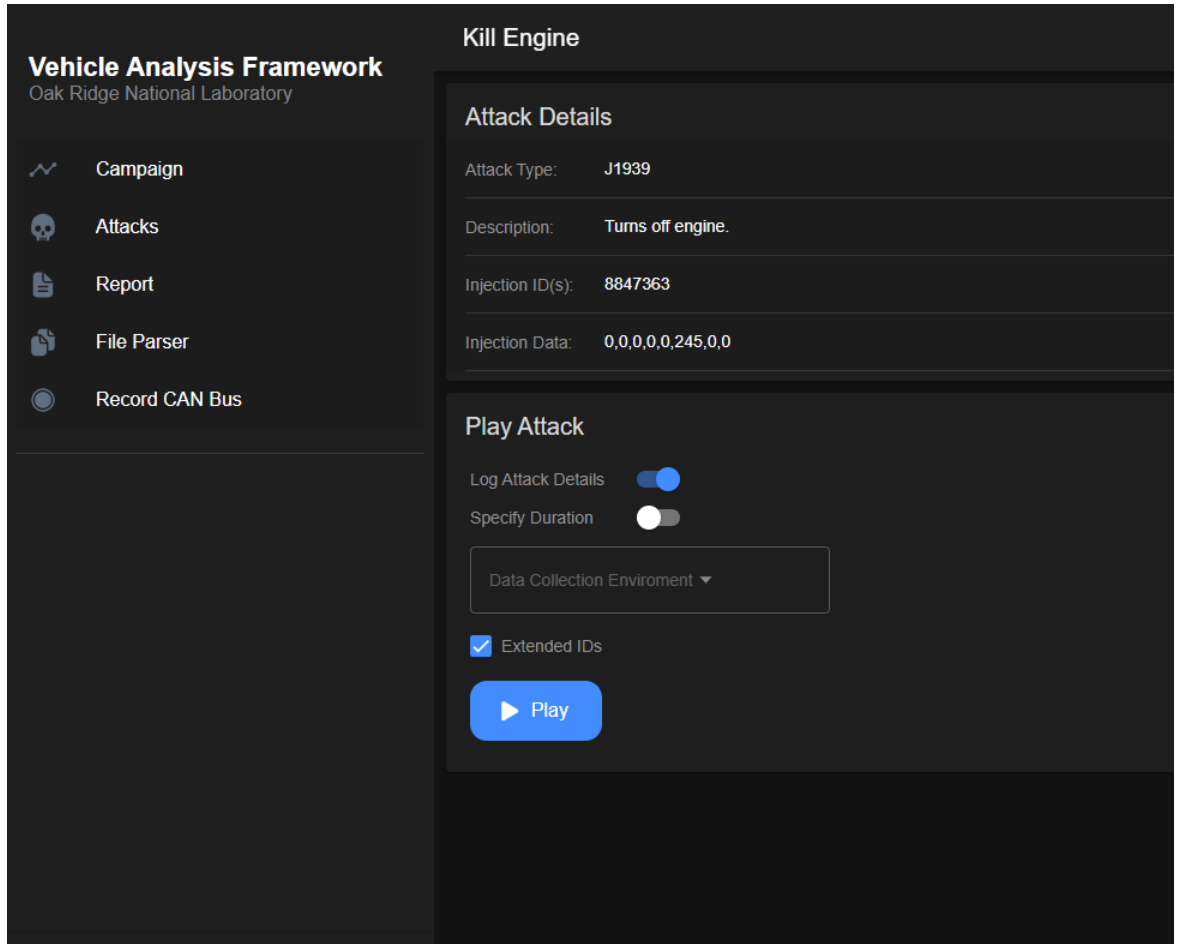
VAAF: Vehicle Attack Analysis Framework

- Allows researchers with no vehicle cyberattack experience to perform attacks and collect data
- Combines numerous test scripts into one framework
- Ability to parse CAN logs into formatted data



Attack Example

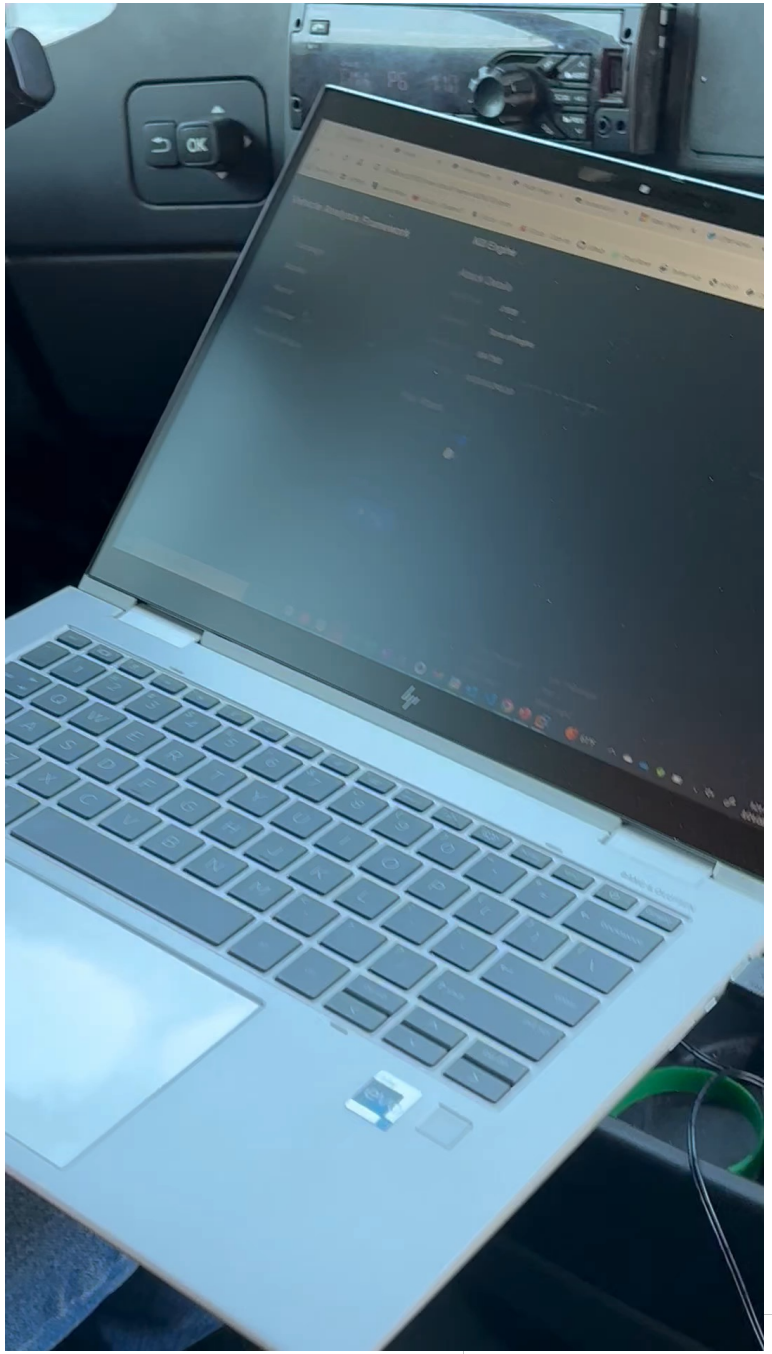


User can:

- View attack details
- Toggle logging
- Specify vehicle environment
- Play for a specific duration or play and stop as desired

VAAF Demo

- Attack – Kill Engine
- Disable engine with a single click
- Injecting “Electric Ignition Off” message

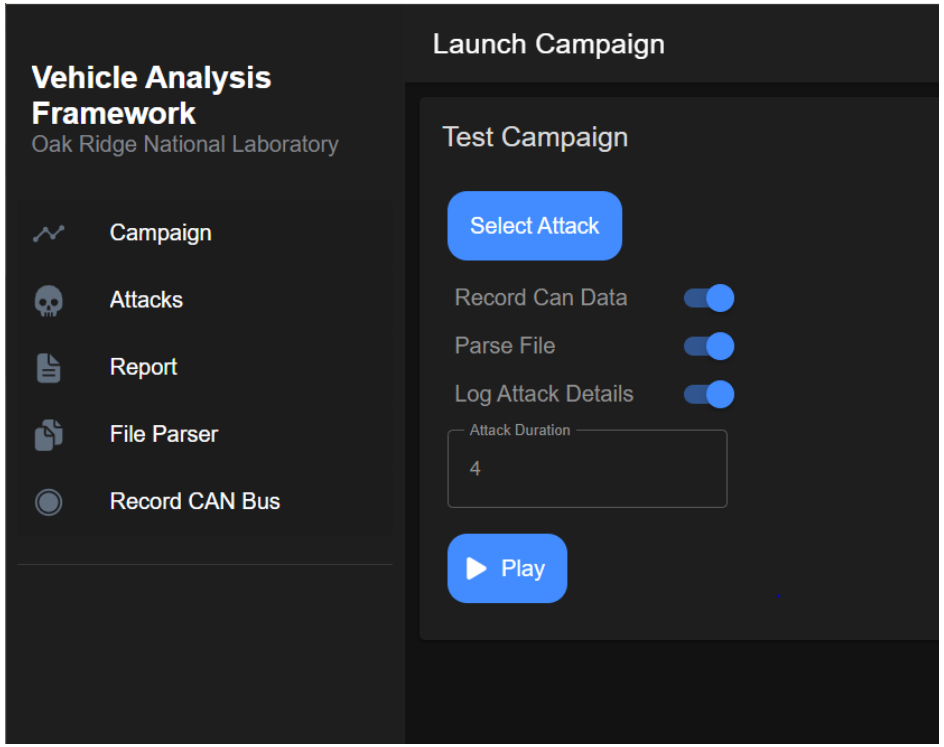


Current VAAF Functionality

- Easy to use WebUI and API
- Launch Attacks
- Record CAN traffic
- Build research reports
- Parse CAN data

VAAF Looking Forward

- Campaigns
  - Create custom attack sequences
  - Record CAN through session
  - Formatted report generation of session
- Vehicle Grading
  - Test multiple categories of attacks
  - Give an overall vehicle security score



Continuous Driver Authentication (DriverID)

1. Continuous driver authentication from vehicle sensor data in heavy-duty commercial vehicles
2. Detection of high-risk driving states and behaviors from vehicle sensor data and/or physiological sensor data

Key Takeaway

Everyone has a unique style of driving, and modern vehicles capture enough data to identify us while we're driving based on that driving style.

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Colorado State University

The **DriverID dataset** is being collected in partnership with a research team at CSU.

Study Design

- 50 drivers
- Controlled and ‘in-the-wild’ driving segments
  - During controlled segment, cyber attacks are launched on the truck to induce driver stress
- Primary deliverables:
  - J1939 logs
  - VBOX logs
    - GPS
    - IMU (pitch, yaw, roll)
- Additional Data Sources:
  - Heart Rate Monitor
  - Stress and Anxiety Questionnaires

2014 Class 6 Kenworth T270

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Separating Faults from Foes

- Segregating legitimate faults from cyberattack

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Collecting Intermittent Fault Data

Raspberry Pi with 4-Channel Relay

Fuel Injector Connected to Relay

Experiment Example

Acknowledgements

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Questions?

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