Technical Portfolio

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LiDAR Systems | Intelligent Transportation | Data-Driven Engineering

Project Focus	Execution Model	Differentiator
LiDAR-based validation site delivery, from concept through operational use	Remote-first engineering across secure, constrained infrastructure	Custom data pipelines, analytics, and bench validation that reduced cost and risk

1. Overview

This portfolio highlights recent work delivering a LiDAR-based sensing and data validation system from concept through full deployment. The focus is on end-to-end execution, including system design, multi-vendor integration, remote operations, and data-driven performance analysis.

My role emphasized building functional systems in real-world environments, developing automated data pipelines, and extracting actionable insights from large datasets to support engineering decisions and customer validation efforts.

2. Flagship Project: LiDAR Validation Site - Fort Worth, TX

A LiDAR-based sensing system was developed and deployed to evaluate vehicle detection, classification, and trigger performance under live traffic conditions. The objective was to validate system accuracy, assess capture timing, and support downstream imaging and tolling workflows.

Role & Responsibilities

- Led project from initial concept through full operational deployment
- Evaluated and coordinated multiple LiDAR suppliers for system fit and performance
- Authored communications interface specifications for system interoperability
- Coordinated Professional Engineering (PE) review and approval
- Managed electrical subcontractor planning, installation, and field execution
- Designed and implemented the end-to-end data pipeline
- Performed data analysis to identify system performance gaps and anomalies

System Architecture (Conceptual)

Sensor Layer	Edge Processing	Data Ingest	Processing Pipeline	Structured Outputs	Analysis

- Real-time sensor triggers captured at edge compute
- Secure transmission through a constrained network environment
- Automated parsing, pairing, and transformation into structured datasets

- Output to CSV and Excel formats for analysis and reporting

3. Bench Testing, Assembly & Pre-Deployment Validation

The system was bench assembled and validated in a controlled environment before field deployment in order to reduce integration risk and compress the commissioning schedule.

Objective: De-risk field deployment by validating system performance, integration, and data integrity prior to installation.

Approach

- Built and assembled complete sensor and compute configurations in a controlled environment
- Verified communications interfaces and data formats across multiple vendors
- Simulated live data flows to validate ingestion, parsing, and output pipelines
- Identified and resolved integration issues prior to field deployment
- Established repeatable configuration and deployment procedures

Key Outcome

- Eliminated the need for a separate off-site testing phase
- Reduced project cost by approximately $100,000
- Accelerated deployment timeline by shifting validation upstream

Impact

- Enabled smoother field installation with minimal rework
- Reduced dependency on field troubleshooting
- Ensured system readiness prior to installation in a constrained environment

This approach effectively shifted validation from field to lab, reducing cost, risk, and deployment uncertainty.

4. Data Pipeline & Automation

Objective: Enable continuous, automated processing of high-volume sensor data into usable engineering datasets.

Key Components

- Log ingestion and normalization
- Event pairing logic (trigger matching and sequencing)
- Time-bucketed dataset generation
- Automated CSV and Excel output generation
- Archival and processing workflows

Results

- Processed tens of thousands of events per day
- Eliminated manual data handling
- Enabled rapid turnaround from raw data to analysis-ready datasets

5. Data Analysis: Trigger Accuracy & Capture Zone Validation

Problem: Determine whether rear capture triggers align with the intended capture zone for license plate imaging, without access to ground truth imagery.

Methodology

- Focused on passenger vehicle class as the most consistent vehicle type
- Calculated inferred rear capture distance using trigger time delta, reported speed, and assumed average vehicle length
- Built distribution models using 1-foot distance bins
- Compared results against expected capture zone and camera depth-of-field constraints

Key Findings

- Significant variability in inferred capture distances
- Wide distribution exceeding practical camera focus limits
- Discrepancy between expected and actual trigger behavior
- Evidence of inconsistent system timing affecting downstream image capture reliability

Statistical Insights

- Mean vs. median comparison highlighted skew in the trigger distribution
- Standard deviation quantified variability affecting capture reliability
- Concentration bands and outliers were identified and tied to performance impacts

Impact

- Provided engineering justification for system tuning and calibration
- Informed camera focal point strategy and deployment constraints
- Identified root causes of missed or suboptimal captures

6. Custom Tooling & Analytics

Capabilities Developed

- Custom parsing scripts for structured data extraction
- Automated batch processing tools for daily dataset generation
- Event matching logic for trigger pairing and validation
- AI-assisted analysis workflows for anomaly detection and pattern recognition

Outcome

- Reduced analysis time from hours to minutes
- Enabled scalable processing of large datasets
- Improved visibility into system performance trends

7. Remote Deployment & Operations

Environment

- Operated within secure, firewall-restricted infrastructure
- Limited direct physical access to deployed systems

Approach

- Established secure remote connectivity for system access and monitoring
- Performed configuration, testing, and troubleshooting remotely
- Coordinated field installation and validation through structured workflows
- Maintained continuous system operation without on-site dependency

Result

- Successfully delivered full system functionality in a remote-first execution model
- Demonstrated the ability to support complex deployments across constrained environments

8. System Integration & Field Execution

Responsibilities

- Multi-sensor integration and configuration
- Coordination of hardware installation and alignment
- Validation of data capture and system timing
- Real-time troubleshooting during deployment

Key Strength

- Ability to bridge hardware systems, data pipelines, and analytical validation

9. Customer-Focused Engineering Approach

- Translate technical system performance into clear, measurable outcomes
- Support decision-making with data-backed insights
- Rapidly diagnose and resolve issues to maintain project momentum
- Capture and incorporate feedback into system and workflow improvements

10. Summary of Capabilities

- End-to-end system delivery: concept -> deployment -> analysis
- Strong focus on data collection, automation, and AI-assisted analytics
- Proven ability to operate in remote and secure environments
- Experience coordinating multi-vendor systems and field execution
- Ability to convert raw data into actionable engineering insights

11. Closing Statement

This work reflects a practical, results-driven engineering approach focused on delivering functional systems, extracting meaningful insights from data, and supporting real-world deployment challenges. My experience demonstrates the ability to independently execute complex projects while maintaining a strong focus on performance, reliability, and continuous improvement.