PERFORMANCE VALIDATION OF MULTI-OBJECT TRACKING ALGORITHM WITH RADAR SENSOR

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Background & Motivation

Modern driver-assistance systems rely on radar to detect and track objects around vehicles. However, validating radar performance is time-consuming. Existing tools often struggle with processing large real-world datasets, keeping radar and video recordings in sync, and adapting to different customer requirements. These issues slow down development and reduce confidence in test results.

Our project was initiated to address these gaps by improving the validation framework used for HELLA's 77 GHz radar sensors. By increasing processing efficiency, synchronization accuracy, and adaptability, the project supports HELLA in delivering more reliable radar technology for the next generation of advanced driver-assistance systems.

Key Features

- Optimized processing time by approximately 25%, improving the tool's efficiency when handling large datasets.
- Enhance visualization output, fixed video time synchronization by using Unix timestamp. (no delay between radar and camera feed).
- Support for specific configurations from Car Manufacturers, providing a more robust, flexible and scalable solution for tracking validation. Car Manufacturers' have their own mounting position and use cases for radar setups, support for this enable a more versatile system/tool to handle specific client needs.
- Research advanced evaluation metrics tailored to radar field, ensuring a more accurate analysis applying in different real-scenarios

Methodology

Data layer

Input: Raw radar data + vehicle data (speed, yaw rate, etc...)
Process: Pre-processed and converted into a standardized internal format.
Purpose: Enables consistent simulation and analysis

Simulation layer

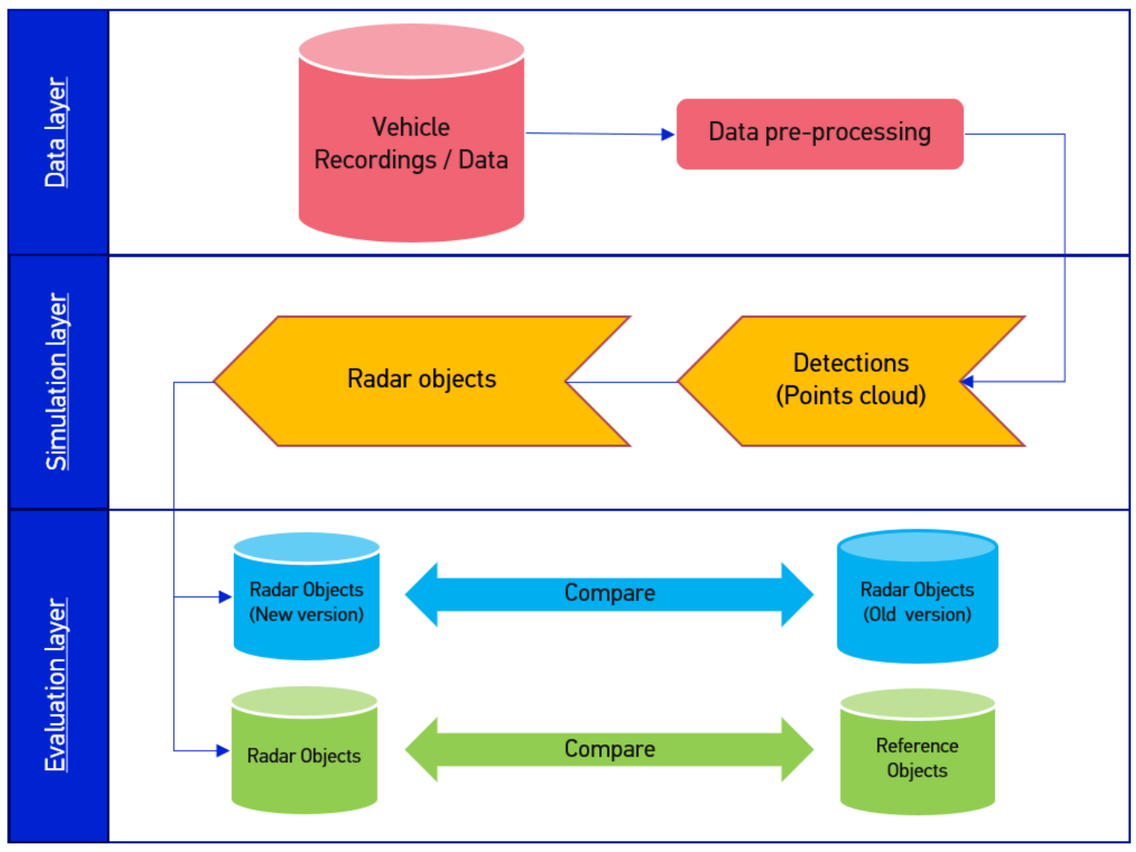
Goal: Optimize processing efficiency
Visualization: Radar detections as Point Cloud, fused with camera data

Evaluation layer

Output: Video + chart-based visualization of detection results
Comparison: New vs. previous software versions
Reference: Camera & radar feeds used for validation
Evaluate tracking metrics using camera as ground truth such as:

- ✅ True Positives (TP)
- ❌ False Positives (FP)
- ❌ False Negatives (FN)
- Multi-object tracking precision (MOTP)
- Multi-object tracking accuracy (MOTA)
- High-order tracking accuracy (HOTA)

Scope of work

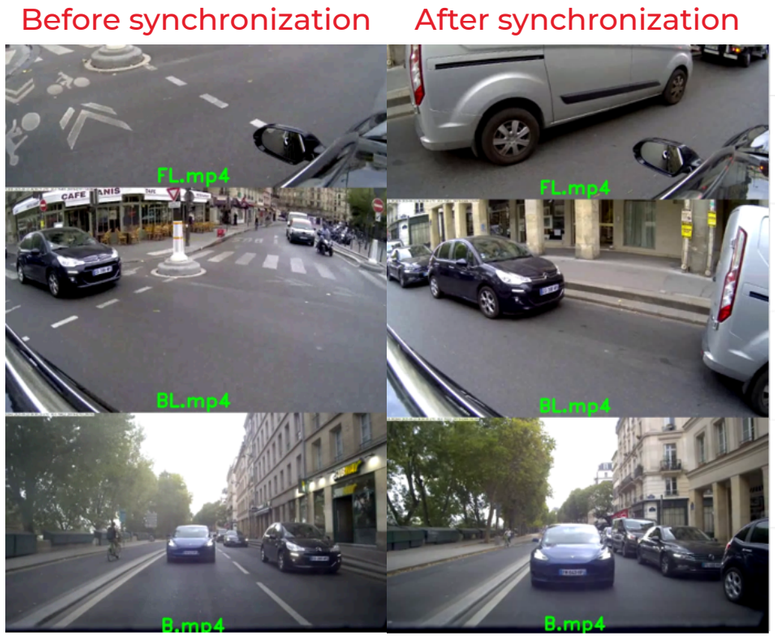


Results

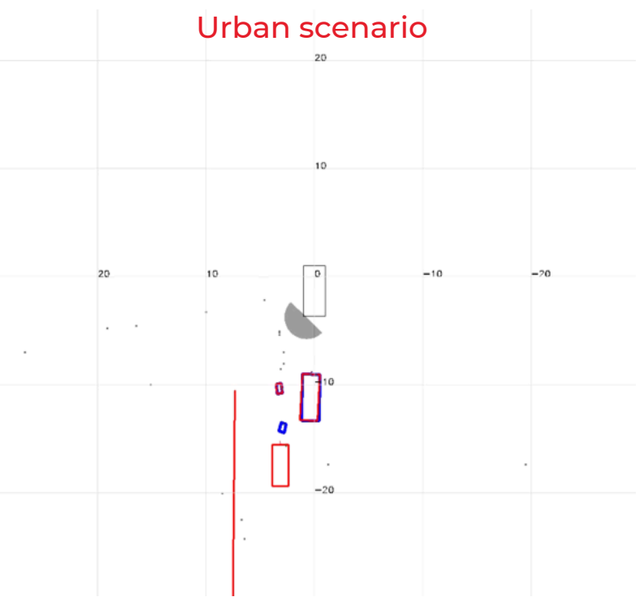
Pedestrian detection

Before synchronization

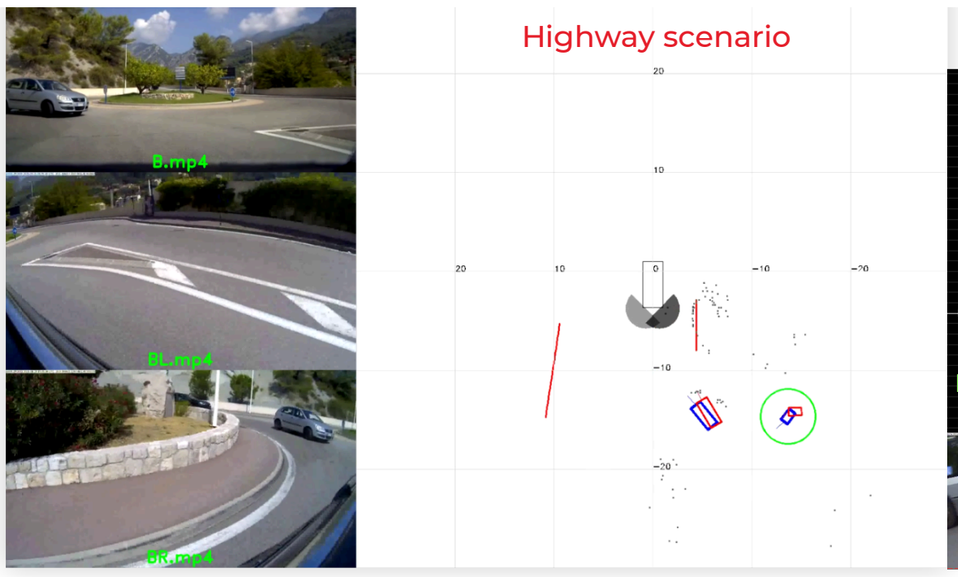
After synchronization



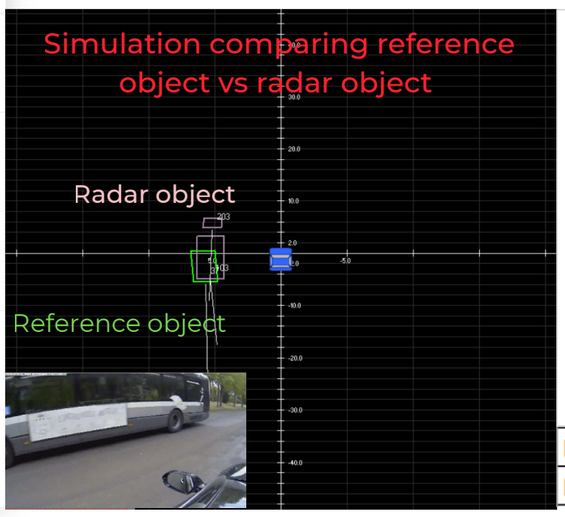
Urban scenario

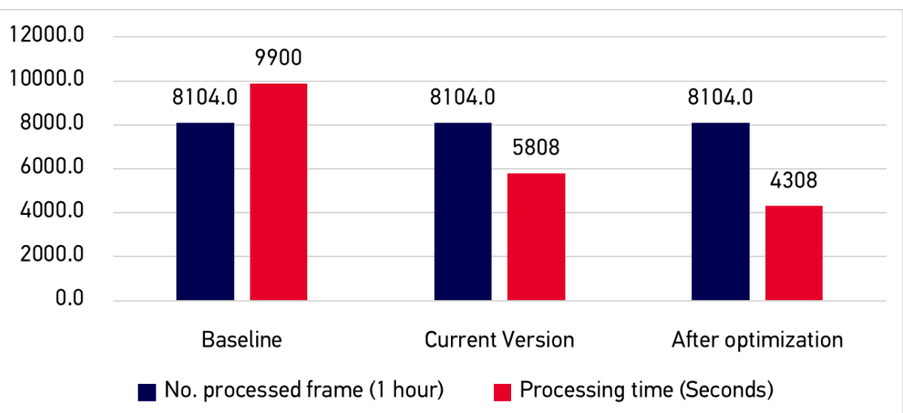


Highway scenario



Simulation comparing reference object vs radar object





Improved processing time to Baseline (tool run at default)	56%
Improved processing time to Original (tool run at Hella's settings)	26%