Demo: A Simulator for Cooperative and Automated Driving Security

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***Abstract*—Ensuring the safety of connected and automated vehicles (CAV) is critical for their public adoption. However, security attacks targeting CAVS are a significant deterrent to achieving public trust in AVs. Implementing and testing those attacks and corresponding countermeasures in real road conditions are costly and time-consuming tasks. Thus, an automotive simulator prevents those drawbacks. Therefore, we provide our security simulator for CAVs, which include both V2X and sensors' data synchronized in simulation time.**

I. Introduction

Connected and automated vehicles (CAV) have been the target of several attacks along the years. Evaluating the attack feasibility and efficiency against each type of CAVs is currently an arduous task (e.g., cost of a CAV and proprietary autonomous driving stack). Known art aims to develop simulator for autonomous driving. However, known simulators focus only on automotive sensor acquisition [1] or vehicle-to-everything (V2X) communication [2]. Our contribution is the first simulator that supports simultaneously, communication, sensor, and security aspects (attacks and attack detectors).

II. Demonstration

The *cooperative perception simulation* module synchronizes Artery [2], CARLA [1], and SUMO [3]. The co-simulation (CARLA and SUMO) allows the synchronization of all vehicles and offering realistic traffic simulations. Our solution uses this co-simulation and increments it with Artery simulation for V2X data, attack, and detection modules. Mainly, this led us to implement the following modules (Figure 1):

The *V2X data collection* module collects and parses Cooperative Awareness Messages (CAMs). Whenever a vehicle generates a CAM, this CAM is transmitted through socket to the CARLA's client, which processes it for autonomous driving and for misbehavior detection related use cases .

The *V2X attack injection* module creates attacks targeting CAM. The module materializes, in real simulation time, attacks as 3D objects based on their corresponding malicious CAMs allowing to observe attacks' impact on road users. The module also implements a simple attack that creates a new CAM for a ghost vehicle ahead of the attacker vehicle.

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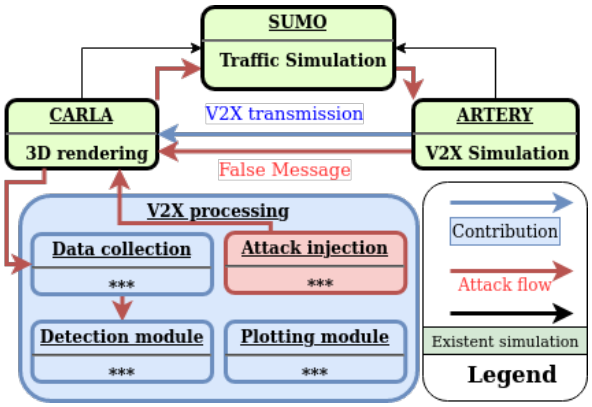

Fig. 1. Demo: Simulator's architecture with main contributions

Different attacks can be implemented by inheriting from the generic attack model.

The *V2X detection* module runs V2X detectors. For the demonstration, our simulator runs a simple speed check.

The *V2X plotting* module provides a visualization for V2X communications, attacks, and detectors.

III. Conclusion

This demonstration[1][2] shows how to use our simulator to define V2X misbehavior attacks and detectors. It's a first milestone towards a simulator for secure CAV. Future improvements could be new modules for automotive sensor security.

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[1]Video Demonstration: https://youtu.be/JF7R3qVpVZQ
[2]https://github.com/mohammedLamine/CarlaSumoArtery-CoSimulation