# AutoInsight: A Comprehensive Testing and Analysis Platform for Autonomous Driving Systems

Major Liu, Seulbae Kim*, Seungmok Kim+, **Congzhou Li, Chung Hwan Kim**
University of Texas at Dallas, *Georgia Tech, +Korea University

Research Problem & Goals

- Active Development of Autonomous Driving Systems in Recent and Coming Years
- **Autonomous Driving Accidents:** How to Prevent, Detect, and Analyze them?
- Current Focus of Research Community: Perception Layer (e.g., Adversarial Samples)
- Need a **Comprehensive Analysis Platform** to:
  (1) Detect Corner Case Driving Bugs,
  (2) Help Developers Trace Bugs, and
  (3) Localize the Root Causes Automatically

Autonomous Driving Systems

- Bugs can be Anywhere and Exploitable
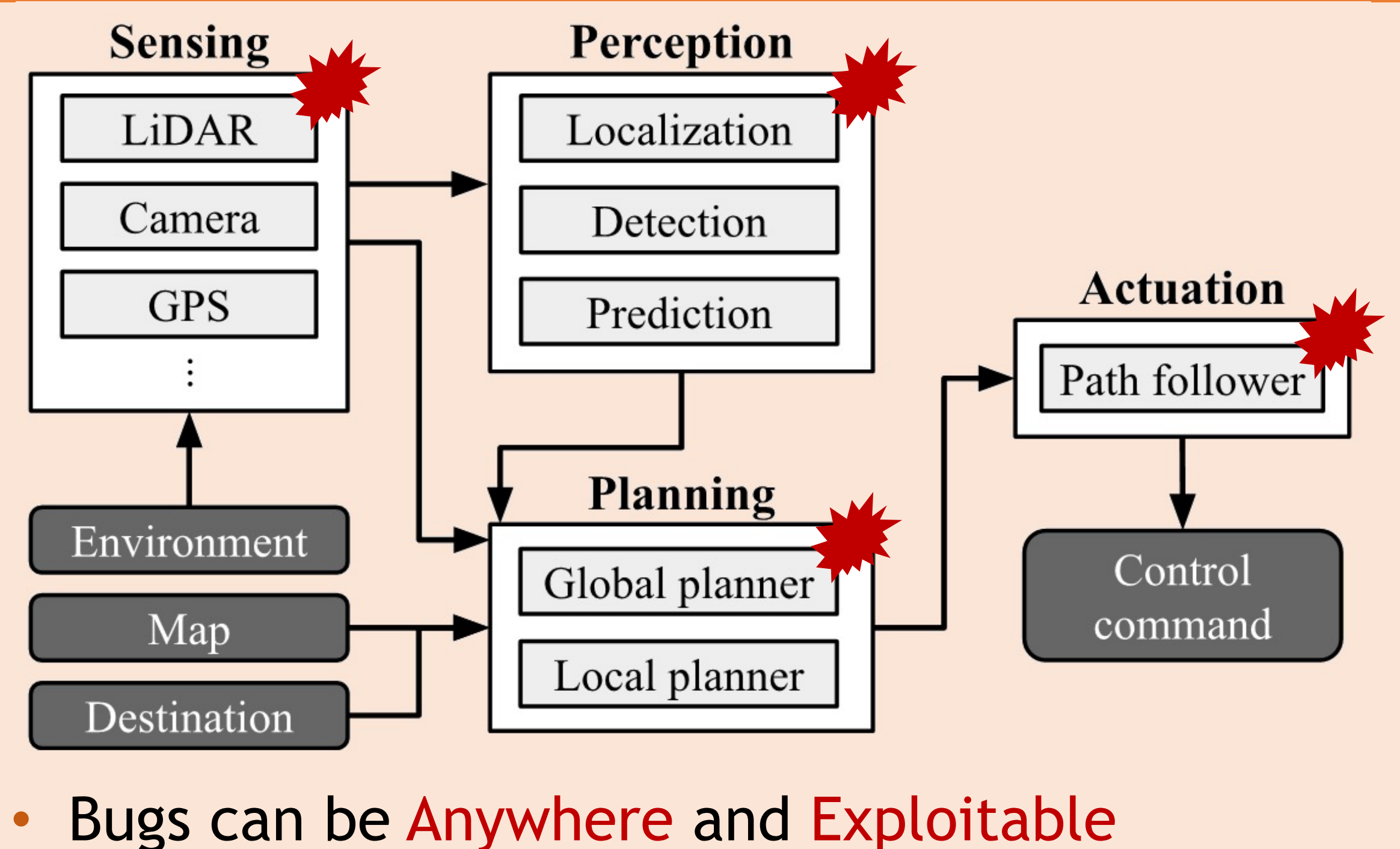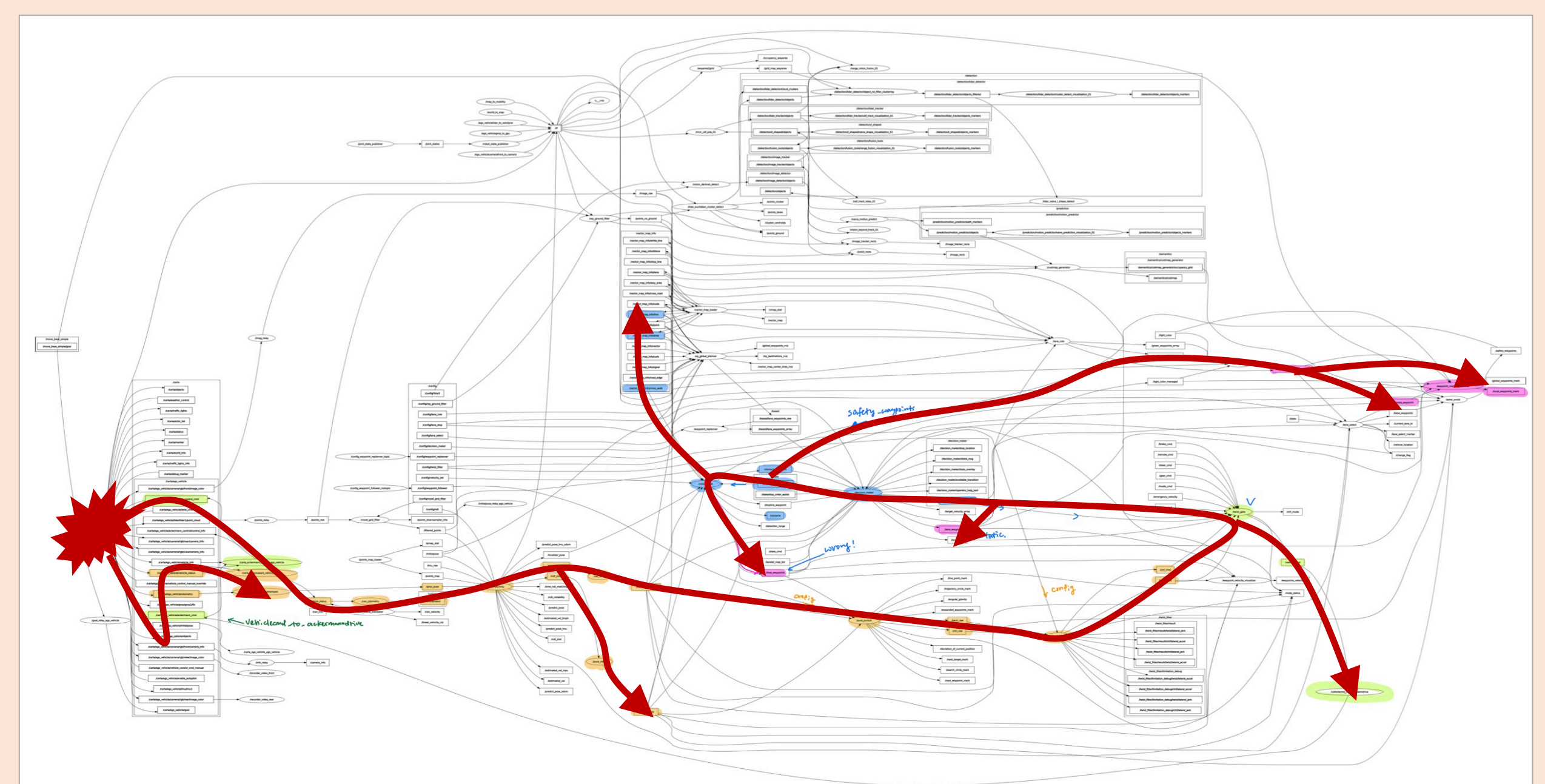
Fuzzing Autonomous Driving Systems

- Generate Driving Scenarios in SITL Simulation
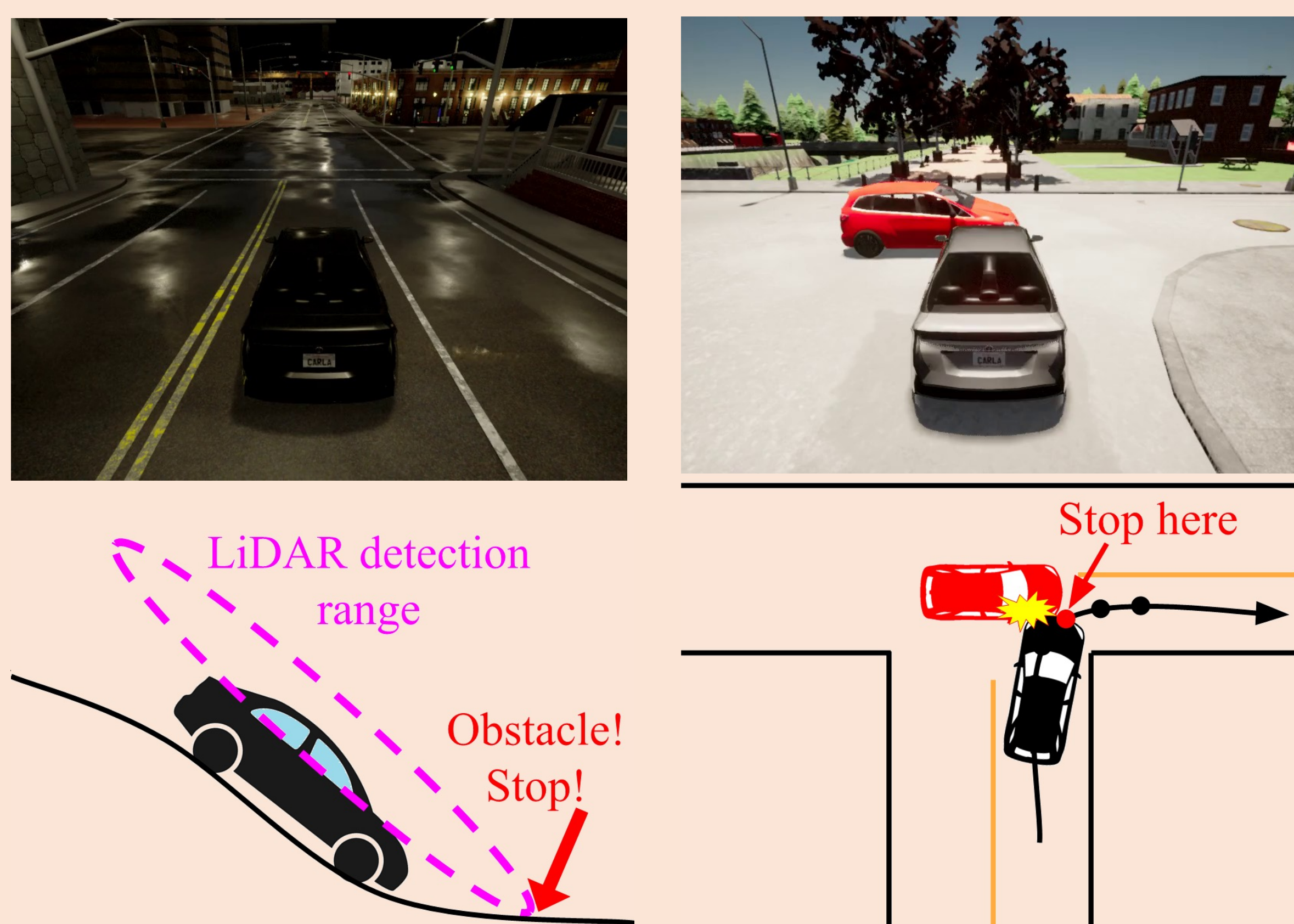- Detect Failures based on Driving Test Oracles
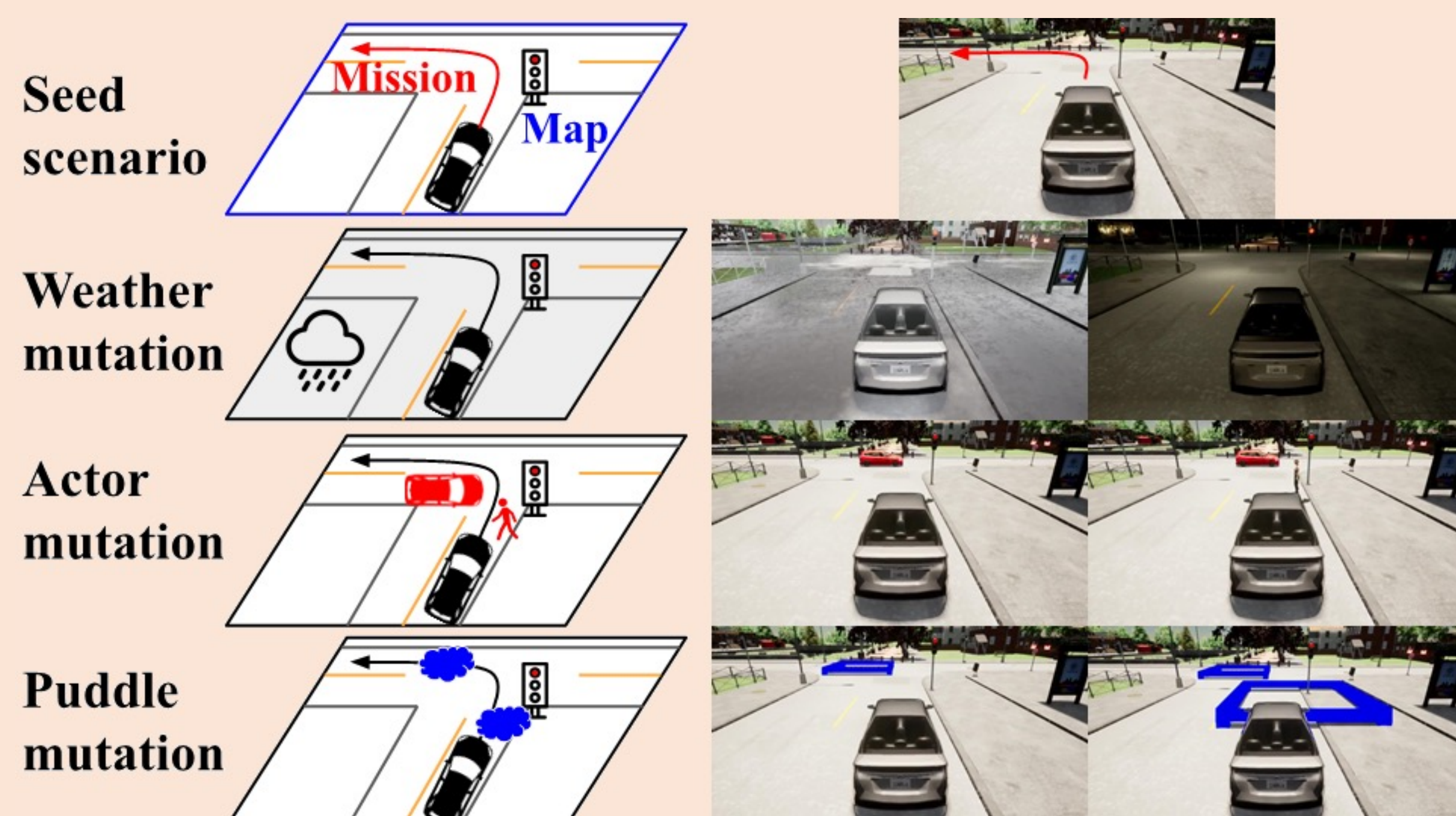
Backtracking Root Cause of Failures

- Complex Network of ROS Nodes and Messages
- Localize Root Cause using a Node Dependency Graph and Data Flow Analysis


Bugs Discovered by the Fuzzer

- 20 New Bugs Discovered (10 Acknowledged)
- 14 Bugs from Non-Perception Layers

Challenges and Work in Progress

- Current Focus: Root Cause Analysis based on ROS Message Record and Replay
- **Challenge 1:** Non-Determinism in ROS Replay (e.g., Timing Issues, Message Losses)
- **Challenge 2:** Lack of Debugging Facilities for Complex Message-Driven ROS Systems
- **Challenge 3:** Simulation vs. Physical World
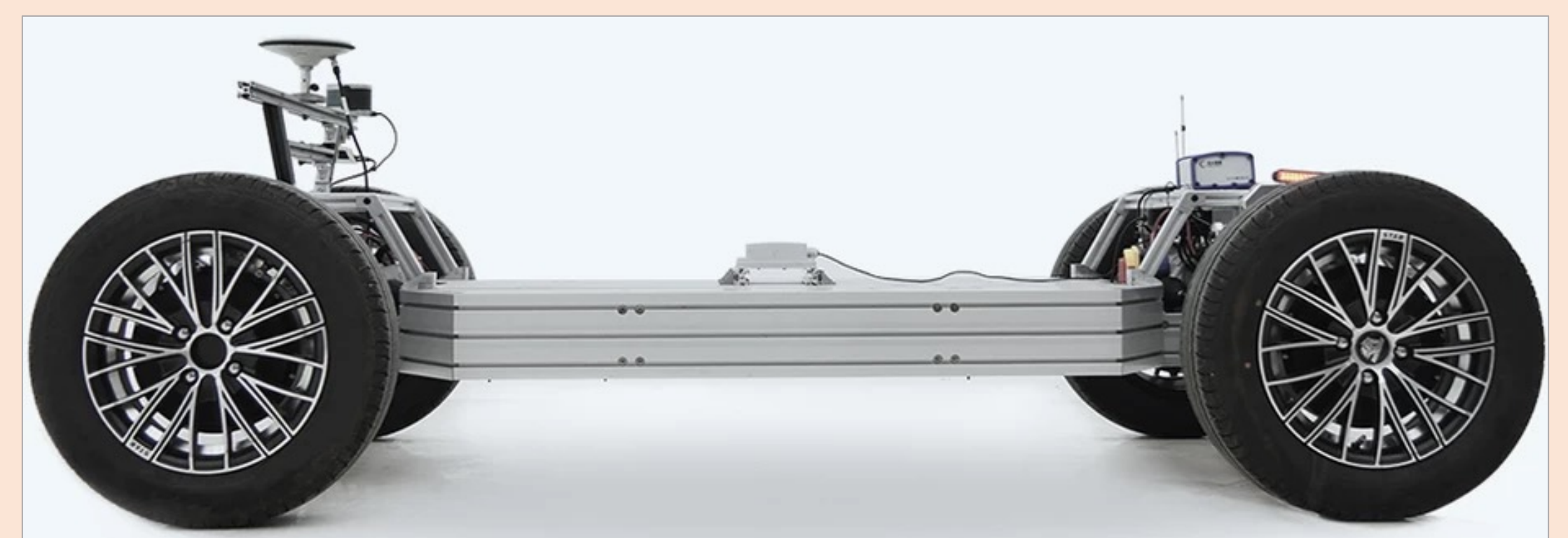
PIXKIT: An Autonomous Driving Vehicle We Are Using