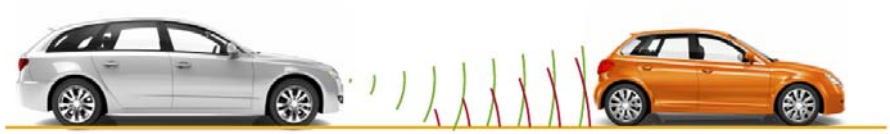
Developing Active Safety Systems Using MATLAB and Simulink



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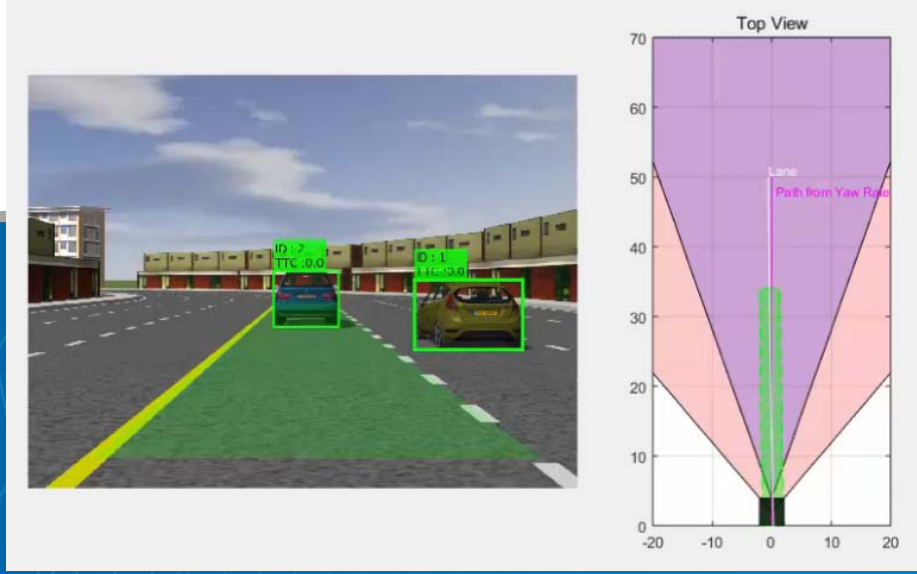

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Introduction & Motivation

- Active Safety Systems must operate consistent and robust also in unpredictable environments
- Testing these systems in a real world environment is dangerous and can cause serious damage
- Examples:
  - Lane Keeping Systems
  - Adaptive Cruise Control Systems
  - Automated Emergency Braking

Develop and verify your

active safety system functionality and

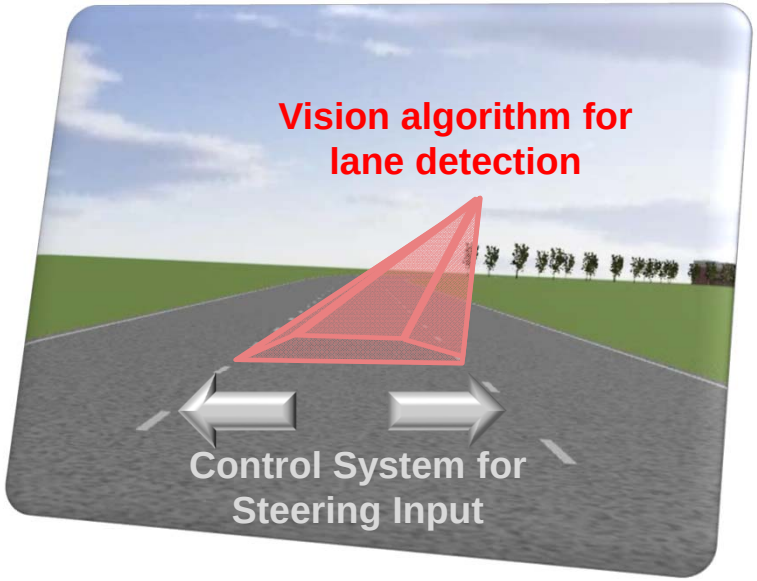
improve robustness using system level simulation.

What is Active Safety?

- Safety systems that are active *prior* to an accident
  - Use an understanding of the state of the vehicle and its environment to avoid and minimize the effects of a crash.
  - Interpret signals from various sensors and decide how to help the driver to control the vehicle.

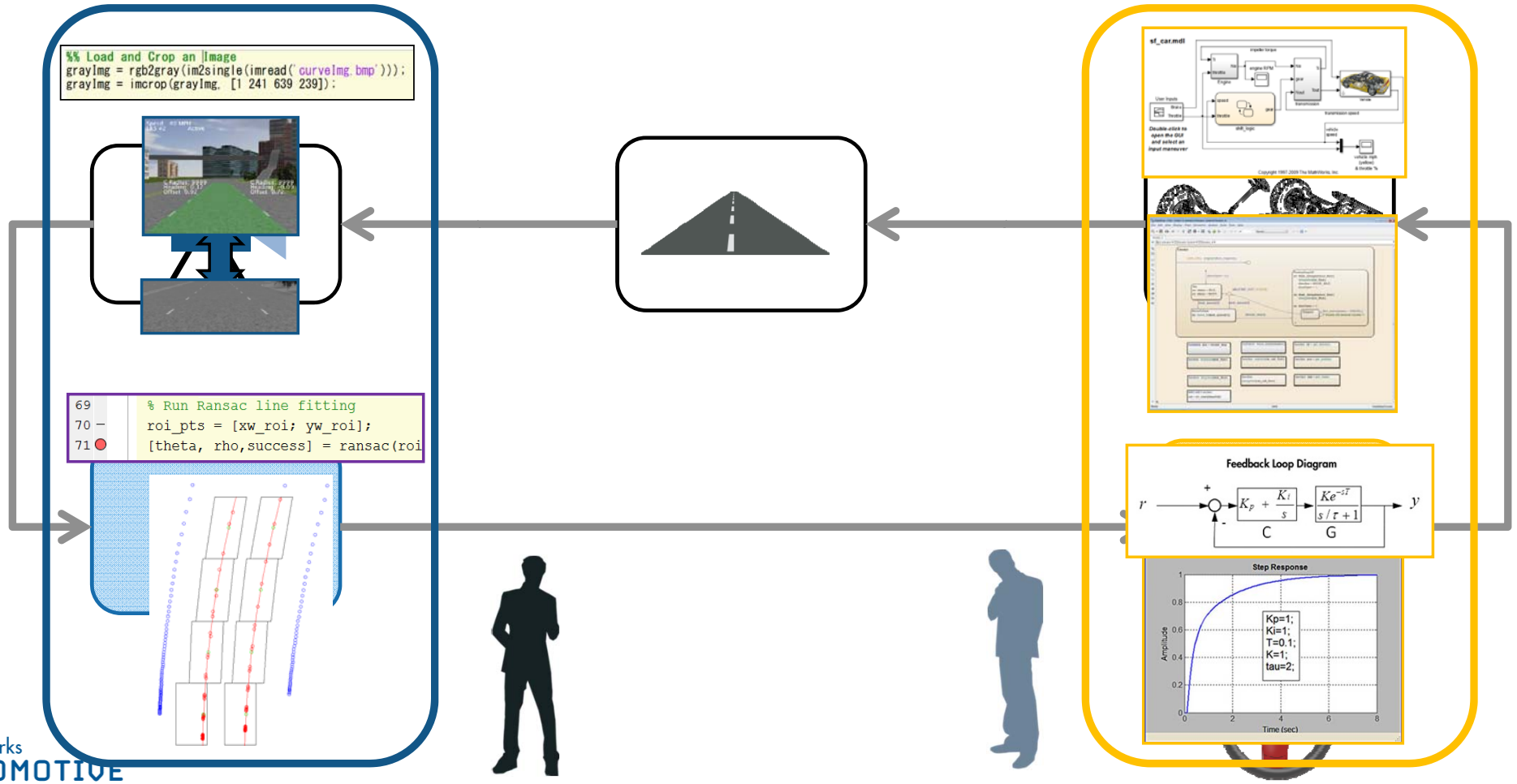
Case Study: Lane Keeping System

- Detect the vehicle‘s departure from its lane
- Warn the driver or actively steer the vehicle



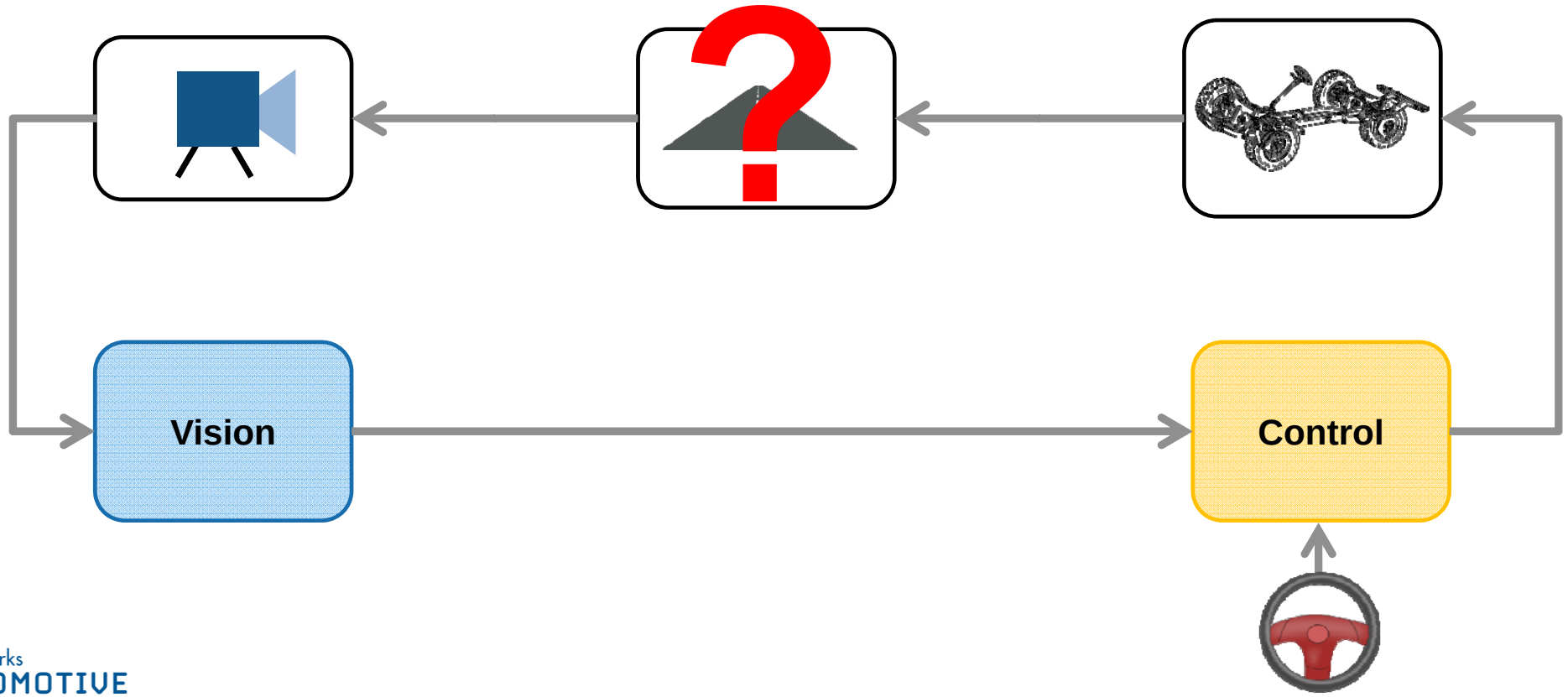
Developing Active Safety Systems

A Multi-Domain Problem



Developing Active Safety Systems

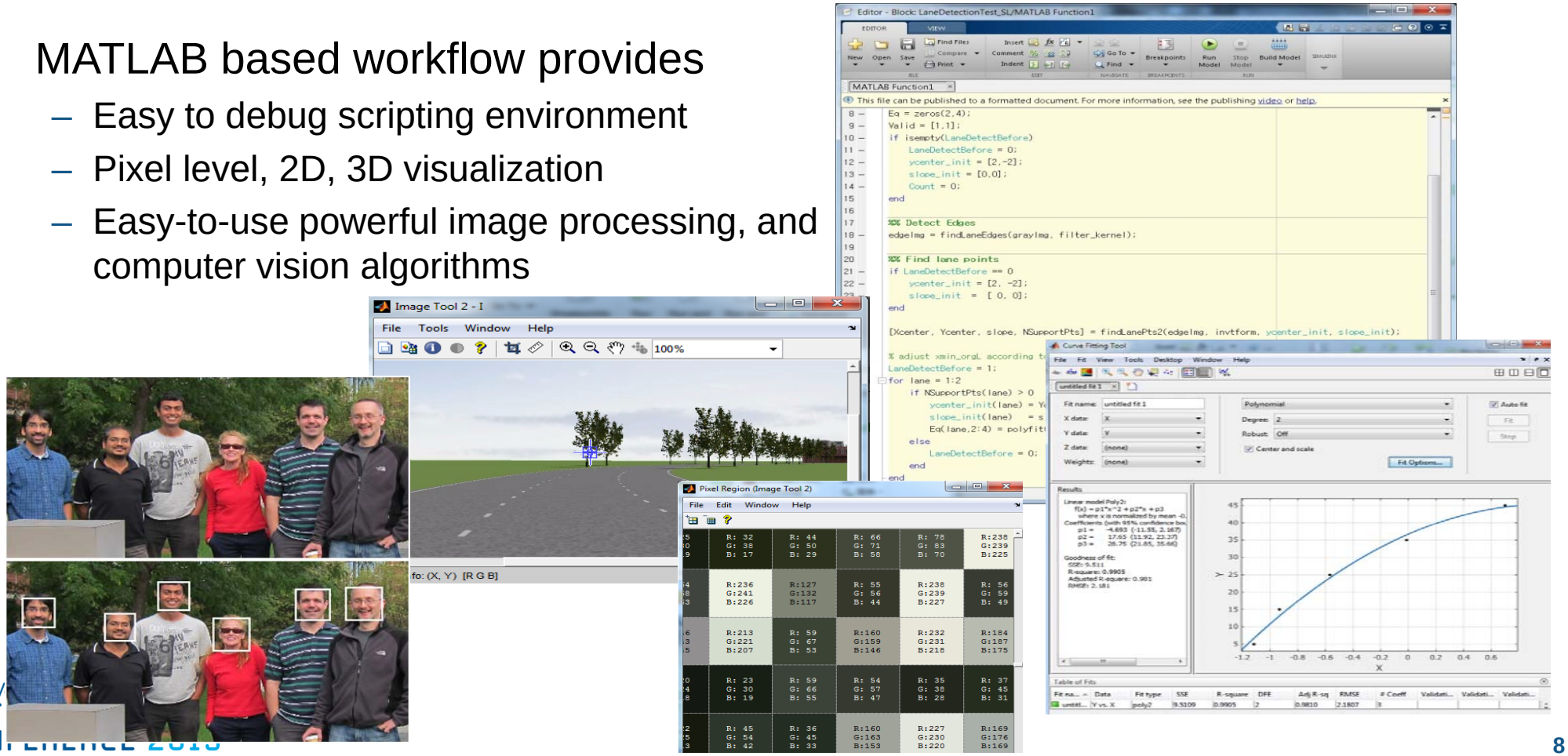
The Challenge: Closed Loop with Environment



Developing Active Safety Systems

Developing the Vision Algorithm Part

- MATLAB based workflow provides
  - Easy to debug scripting environment
  - Pixel level, 2D, 3D visualization
  - Easy-to-use powerful image processing, and computer vision algorithms



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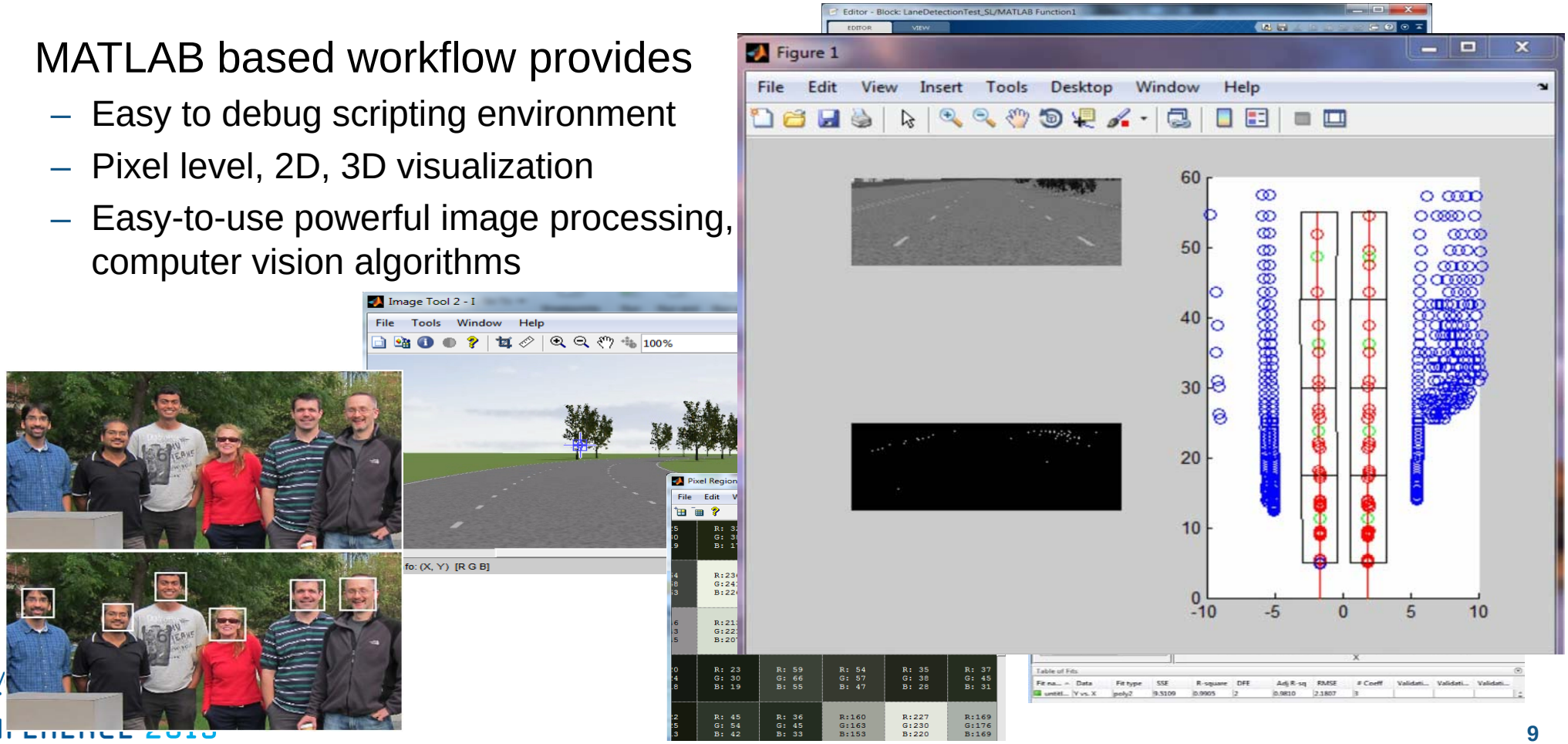


Developing Active Safety Systems

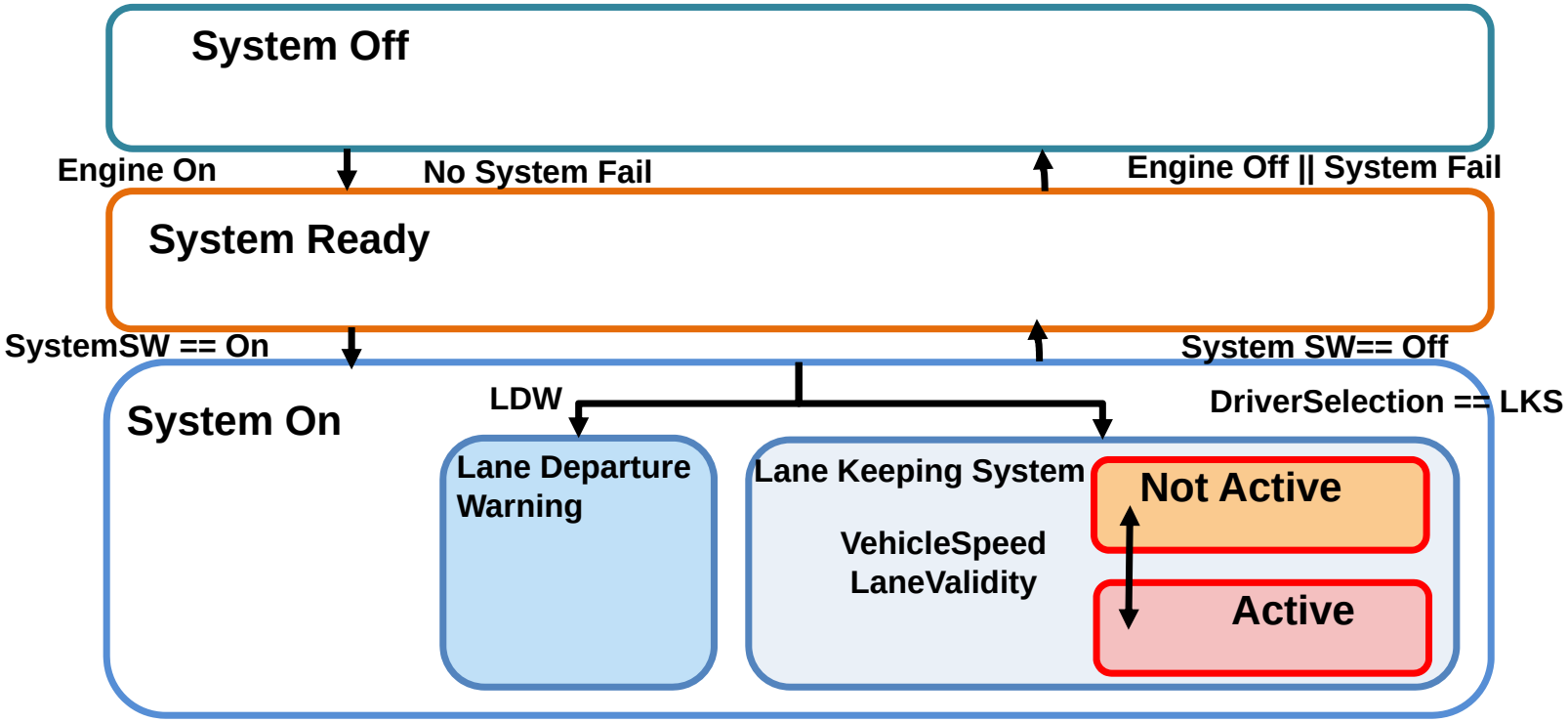
Developing the Controller Part

- Goal
  - Keep the vehicle within a lane by controlling steering input
- Controller configuration
  - Mode Selector (Stateflow)
  - Risk Assessment (Stateflow)
  - Steering angle compensator (Simulink)
    - Feed-back steer angle using heading & lateral offset
    - Feed-forward steer angle using curvature & vehicle speed
- Control Parameter Tuning

Developing Active Safety Systems

Developing the Controller Part

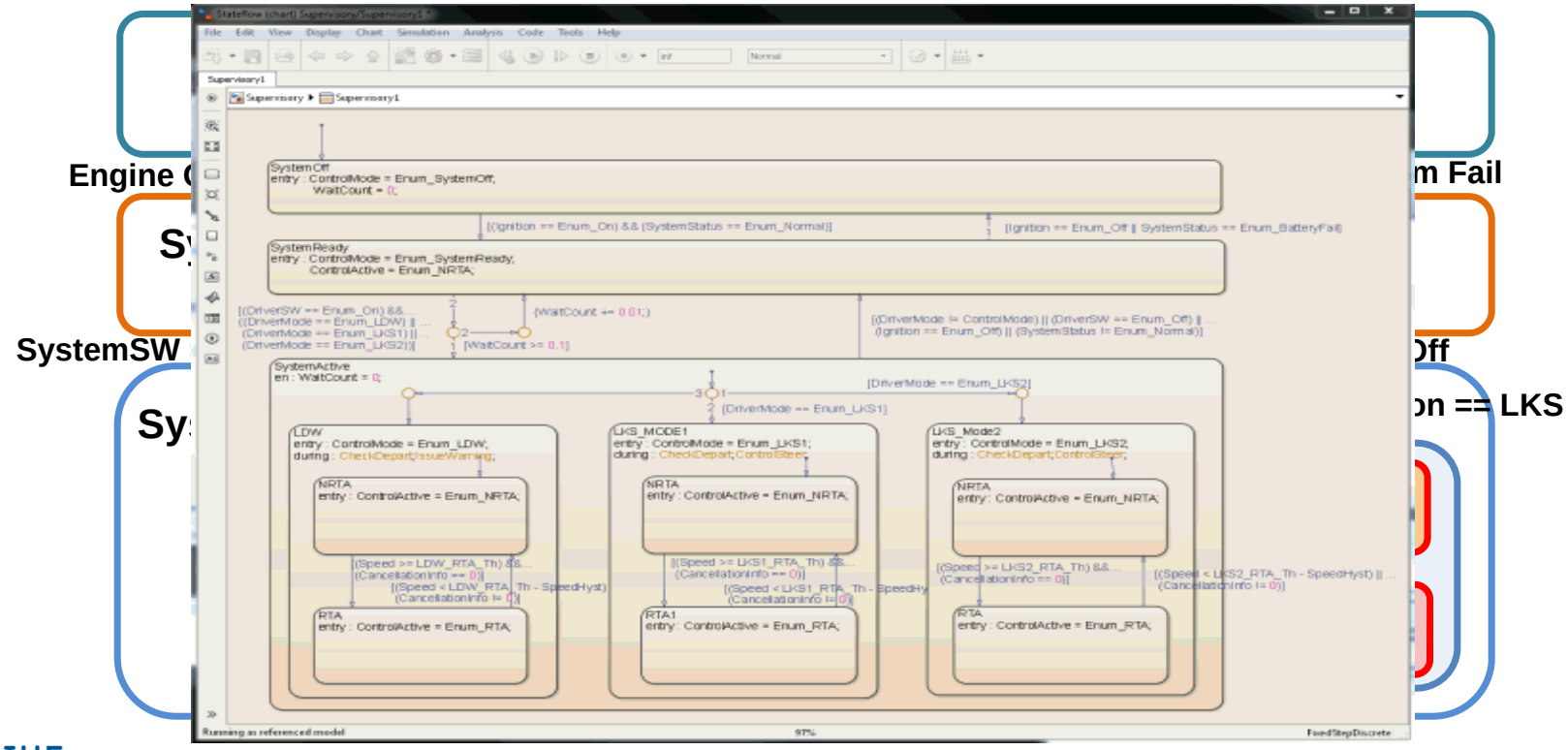
- **Determining Control Mode – creating the model**



Developing Active Safety Systems

Developing the Controller Part

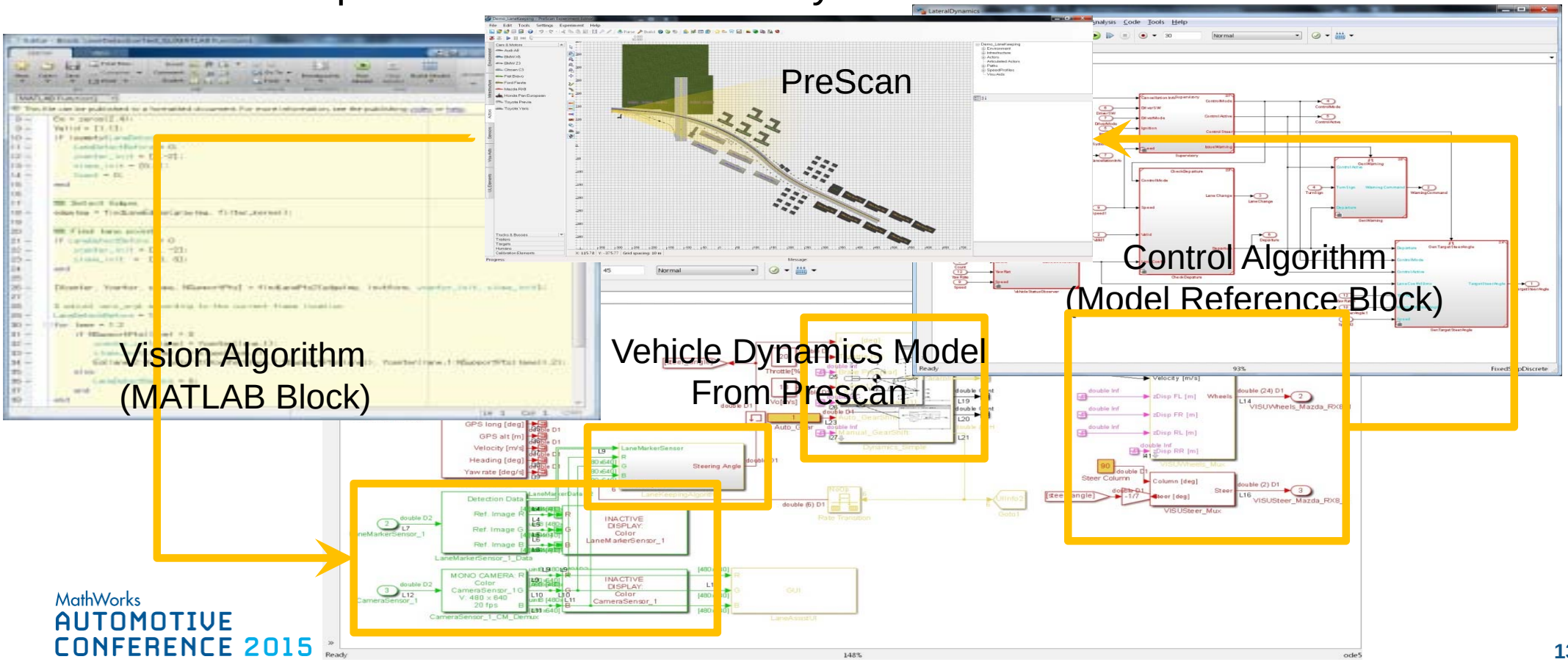
- **Determining Control Mode – creating the model**



Developing Active Safety Systems

System Level Simulation

- Closed-loop test harness model for system level validation



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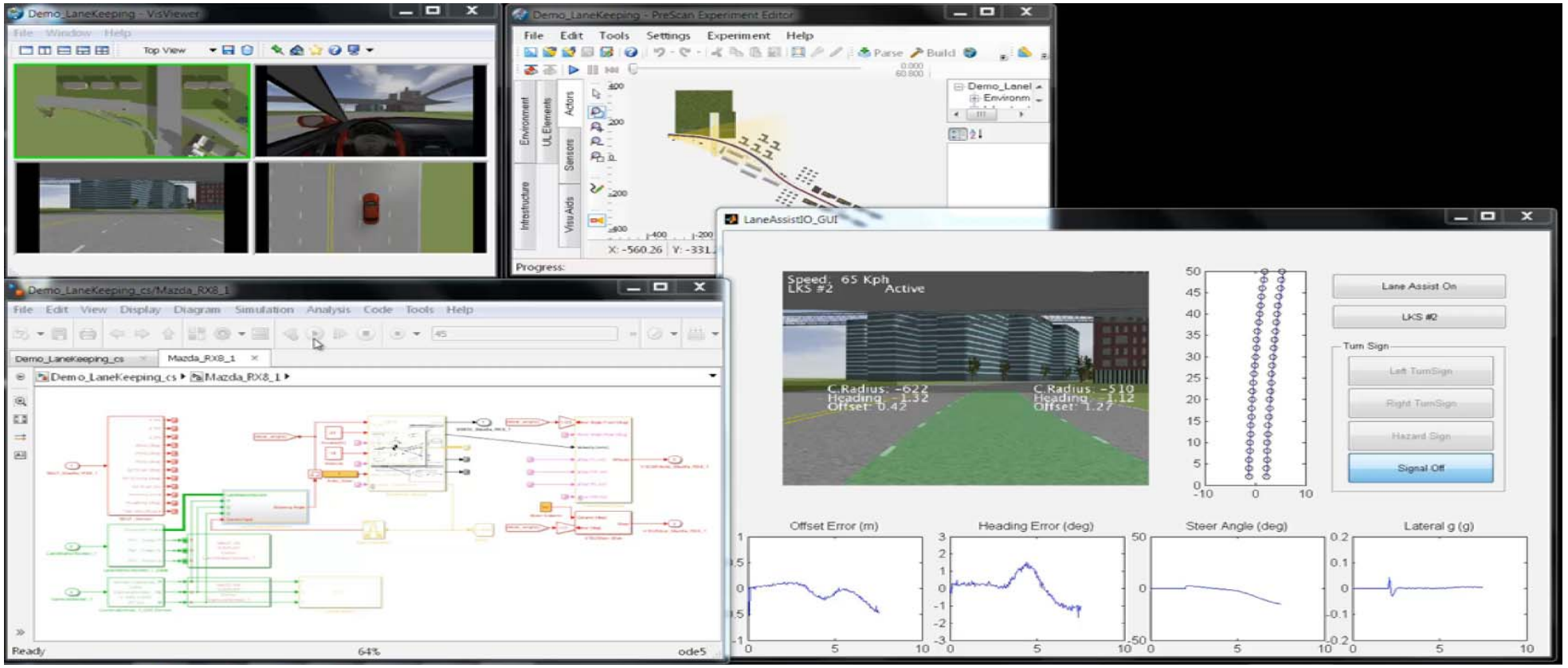
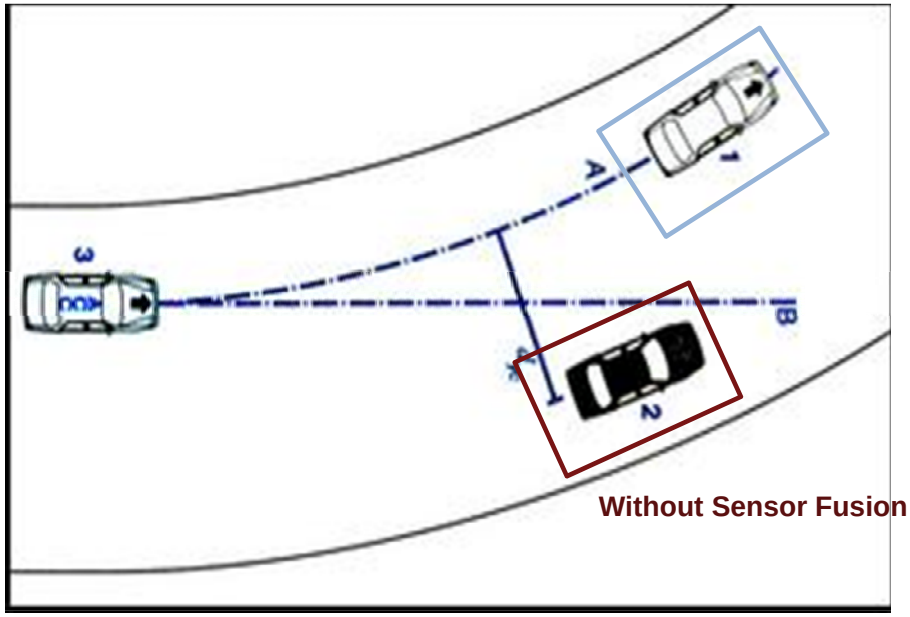
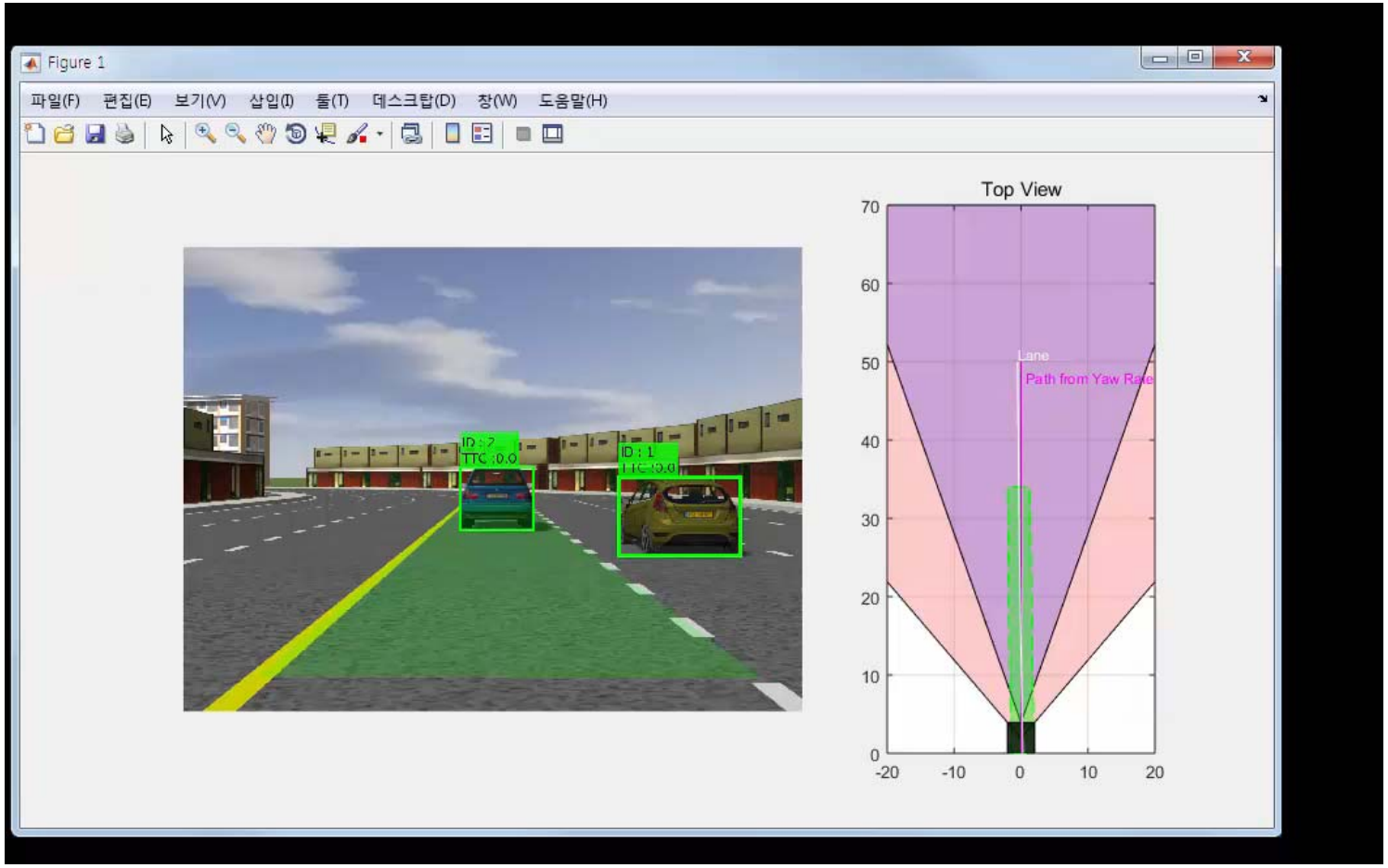


Need for Sensor Fusion
Case study: Automated Emergency Braking

Accurate CIPV (Critical In-Path Vehicle) selection



Example: Radar and Camera Data Fusion



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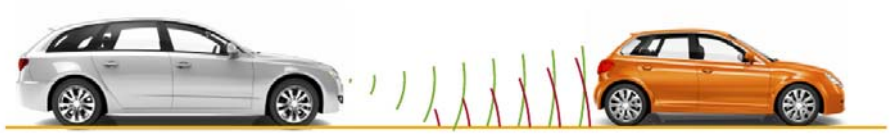

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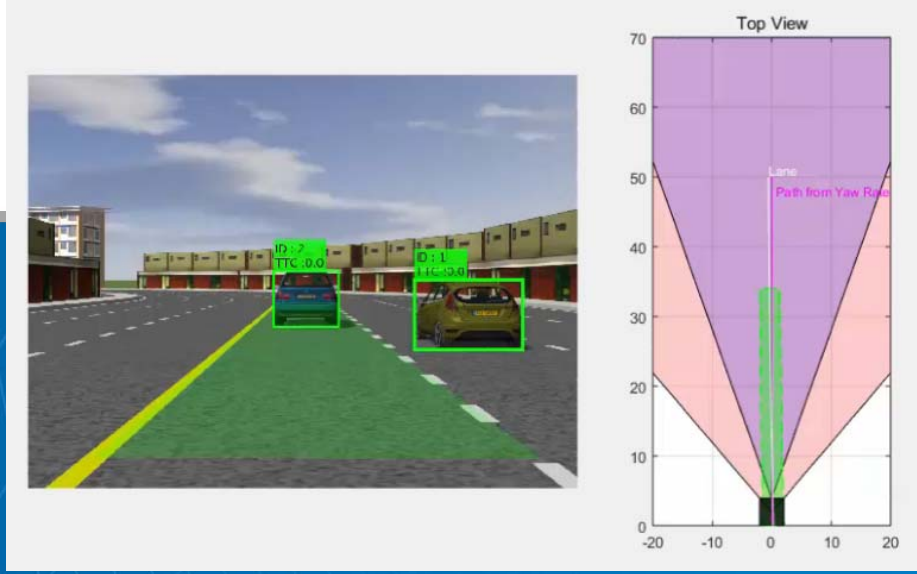

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