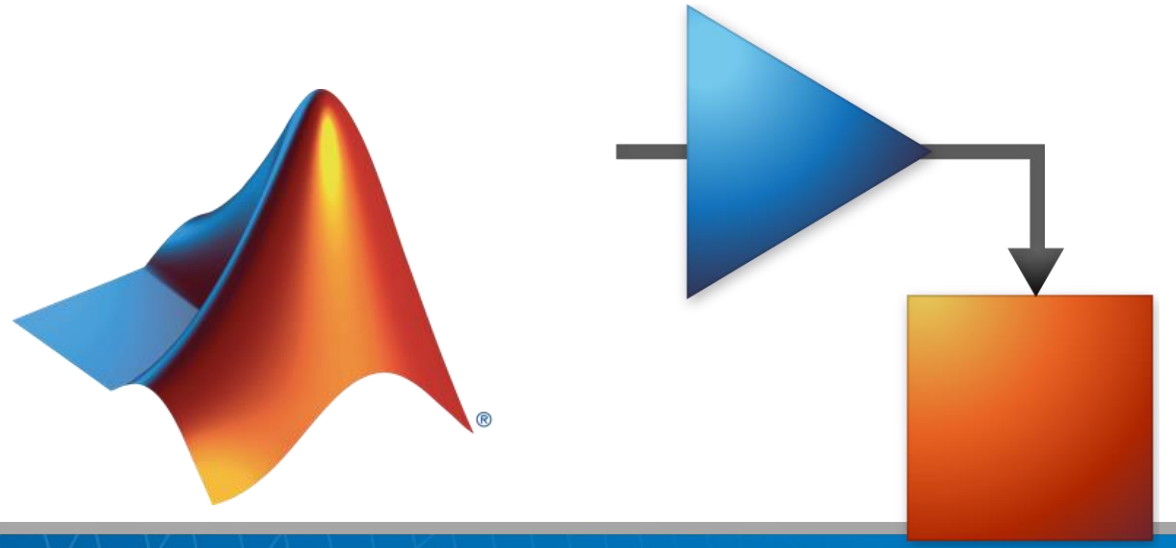
MATLAB & Simulink for Cyber Physical Systems



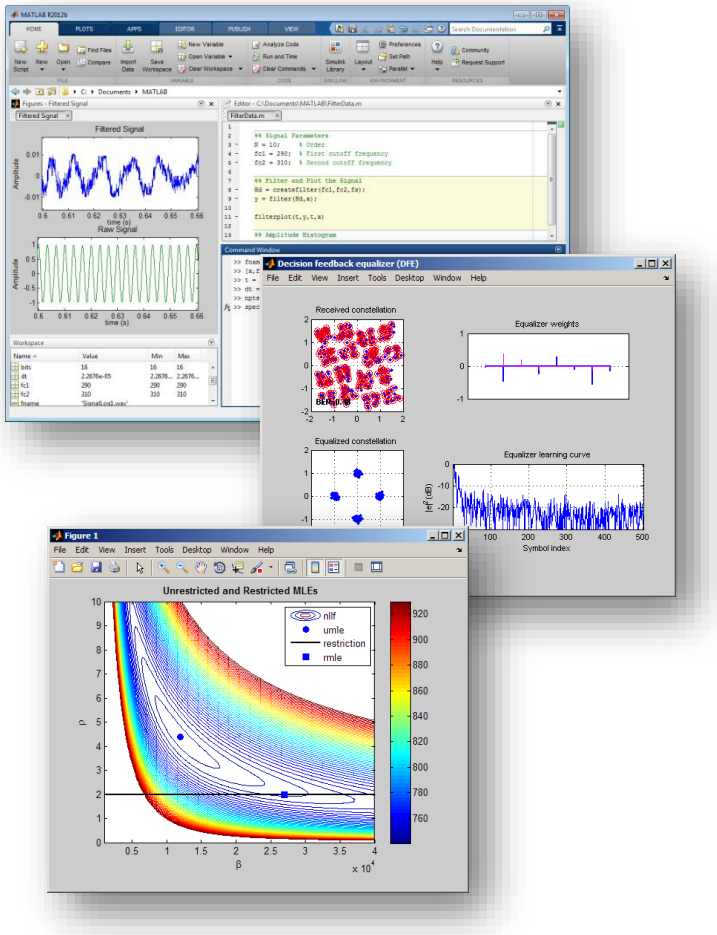
Sumit Tandon – Senior Customer Success Manager, MathWorks

Agenda

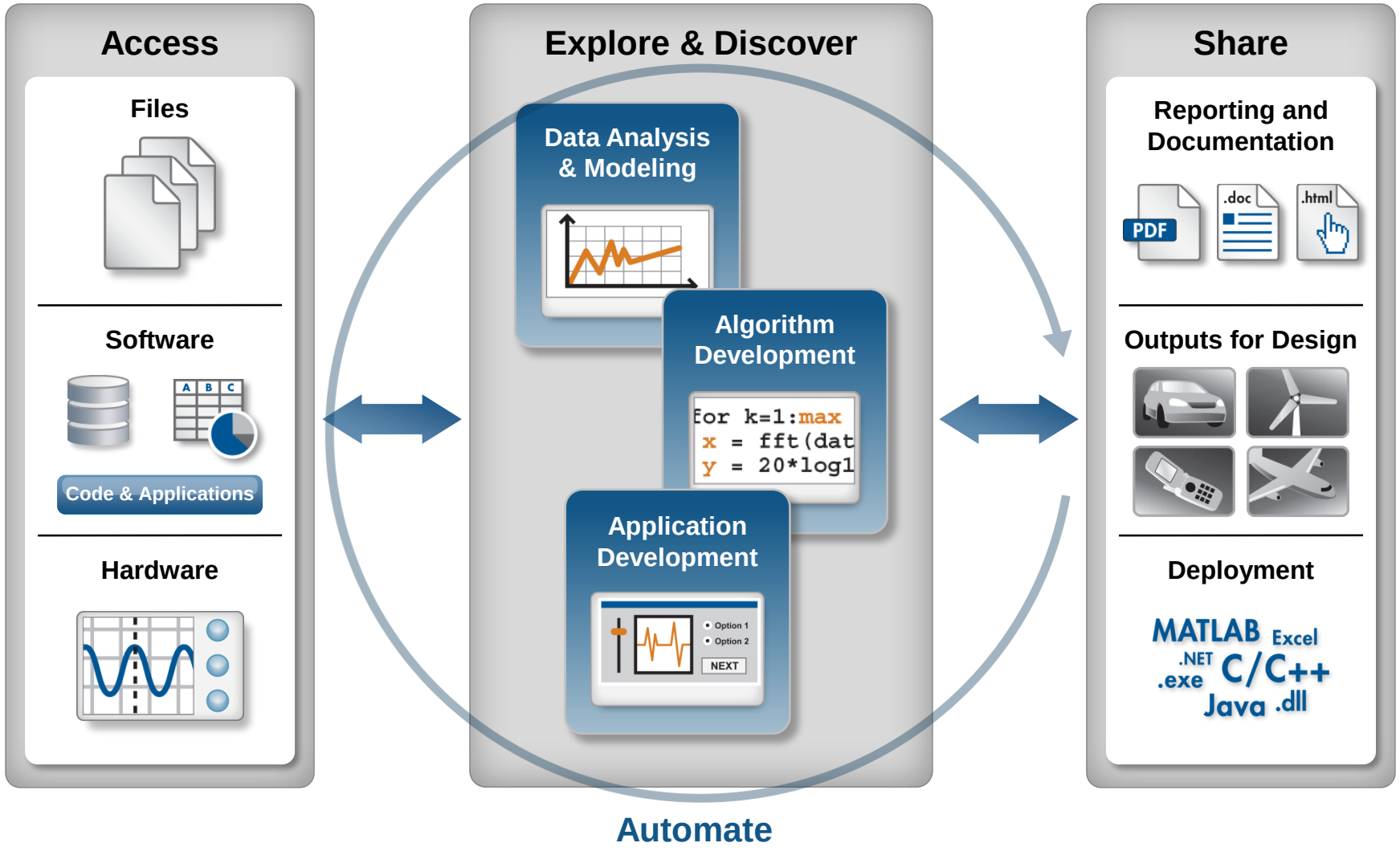
- Intro to MATLAB and Simulink
  - What, where, who, how, quick demos
- Intro to Automated Driving System Toolbox
  - What, where, why, quick demos
- Resources
- Q & A

What is MATLAB?

- High-level language
- Interactive development environment
- Used for:
  - Numerical computation
  - Data analysis and visualization
  - Algorithm development and programming
  - Application development and deployment

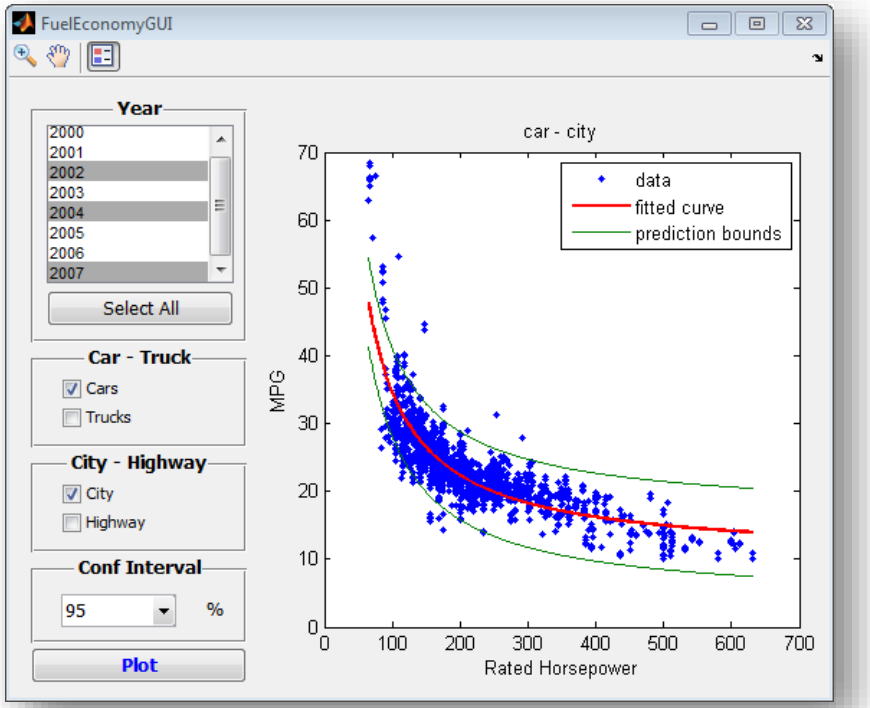


Data Analysis Workflow



Demo: Fuel Economy Analysis

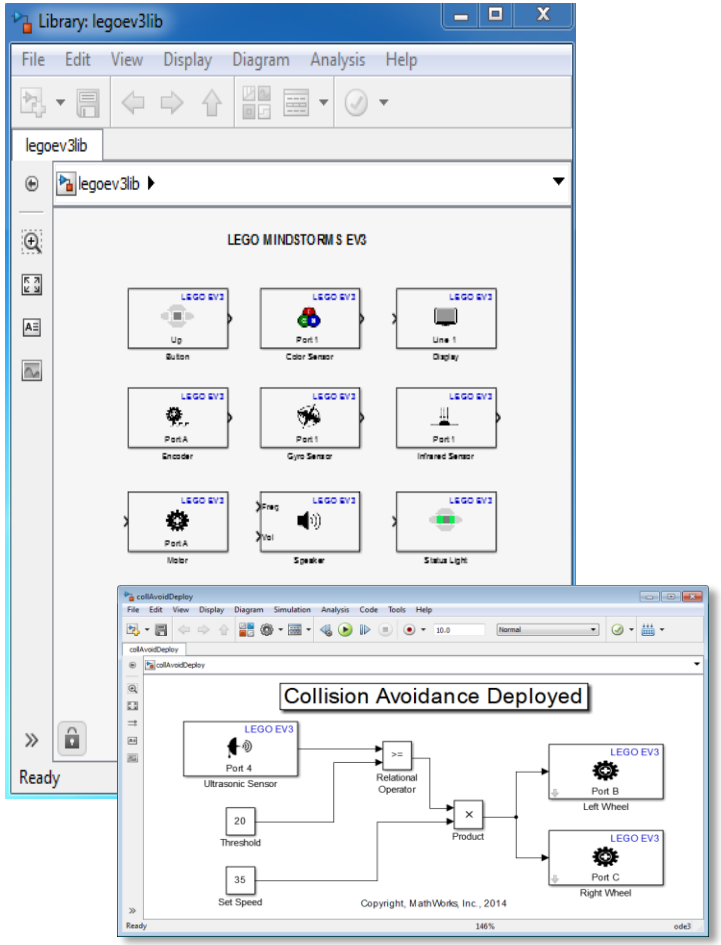
- Goal:
  - Study the relationships between fuel economy, horsepower, and type of vehicle
- Approach:
  - Import data from spreadsheet
  - Interactively visualize and explore trends
  - Create a model
  - Document results



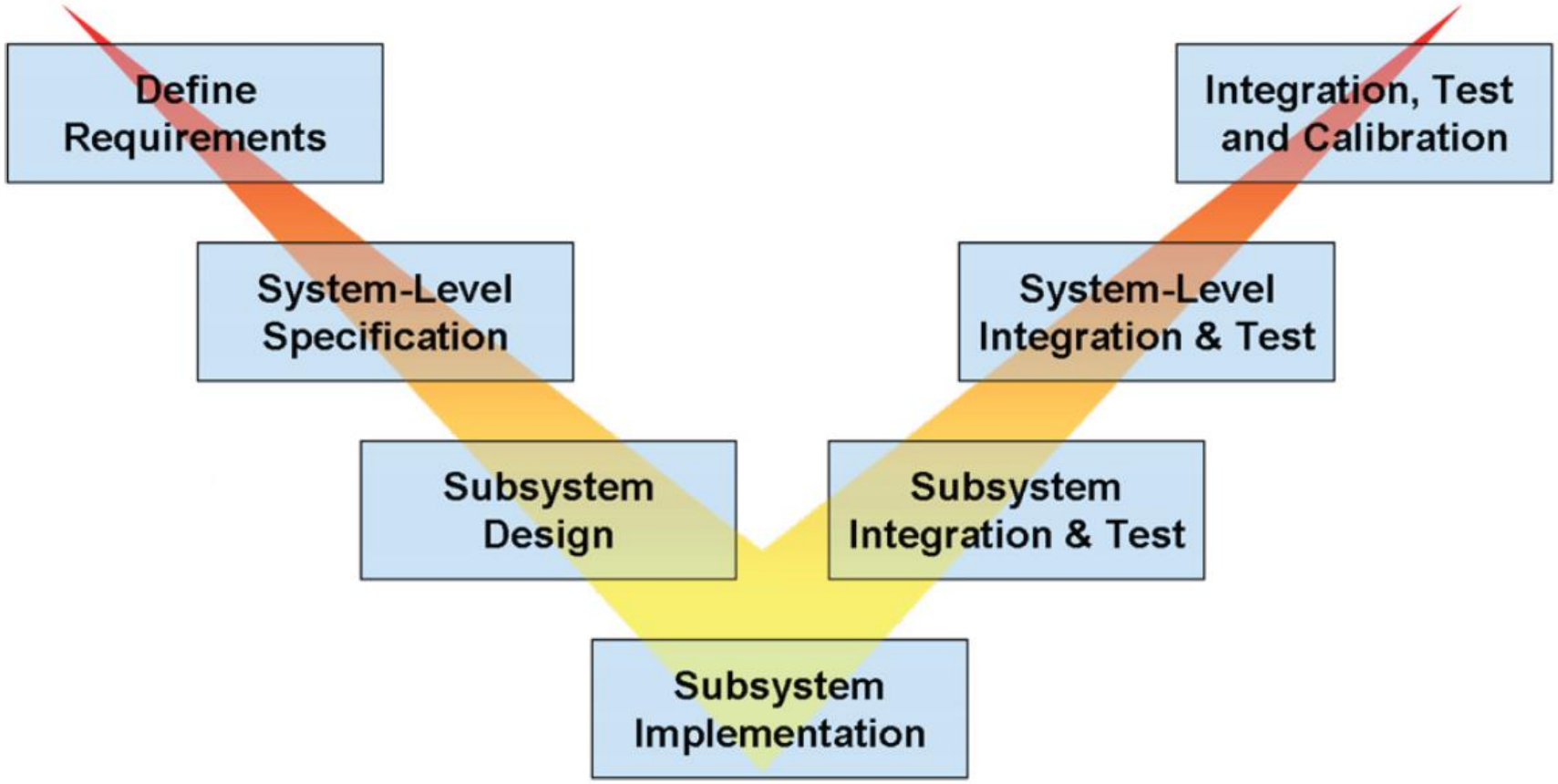
Simulink

The leading environment for modeling, simulating, and implementing dynamic and embedded systems

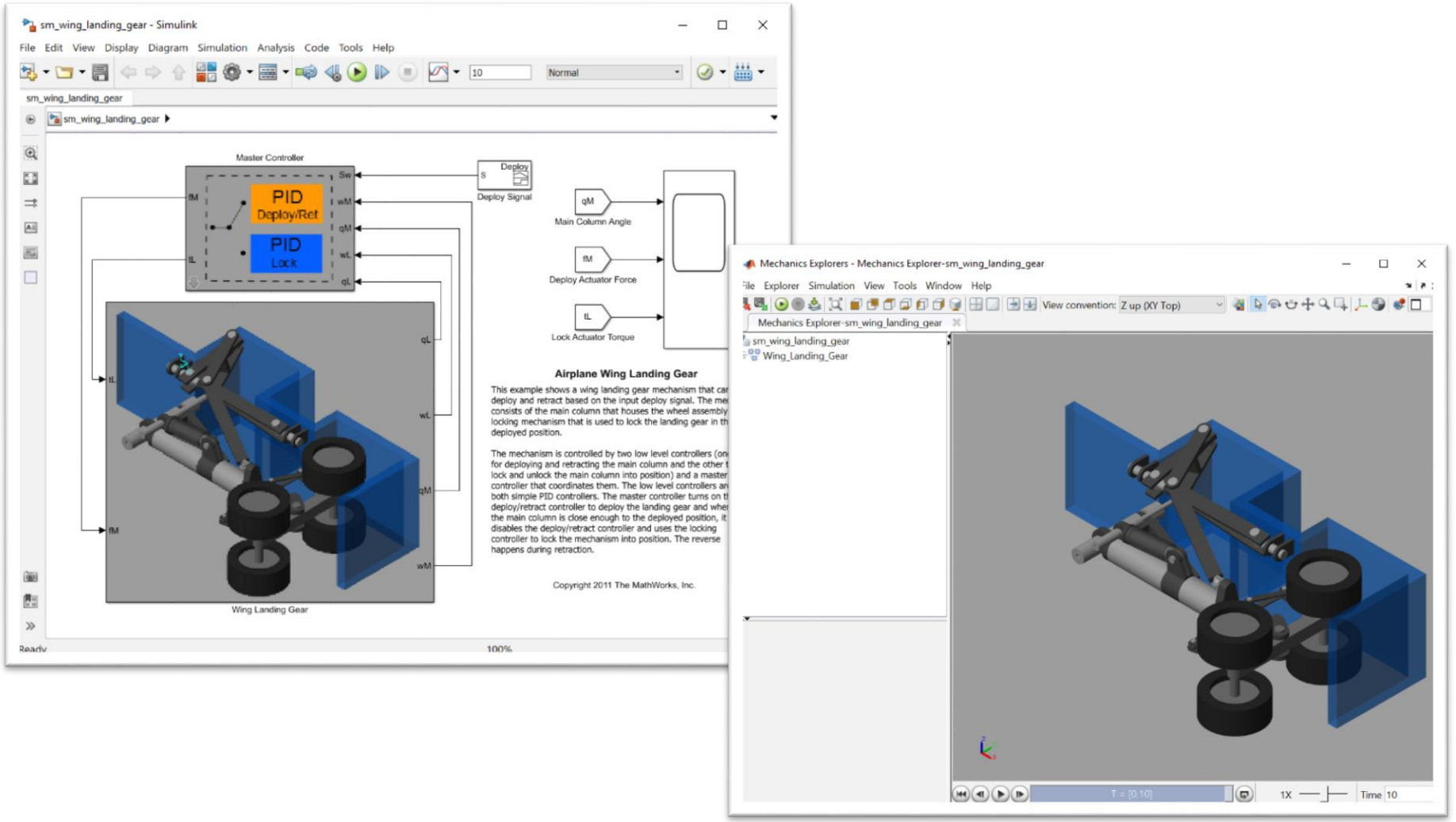
- **Block-diagram** environment
- Model, simulate and analyze **multidomain** systems
- Accurately design, implement, and test:
  - Control systems
  - Signal processing systems
  - Communications systems
  - And other **dynamic** systems
- Platform for **Model-Based Design**



System Design Process



Demo: Wing Landing Gear System

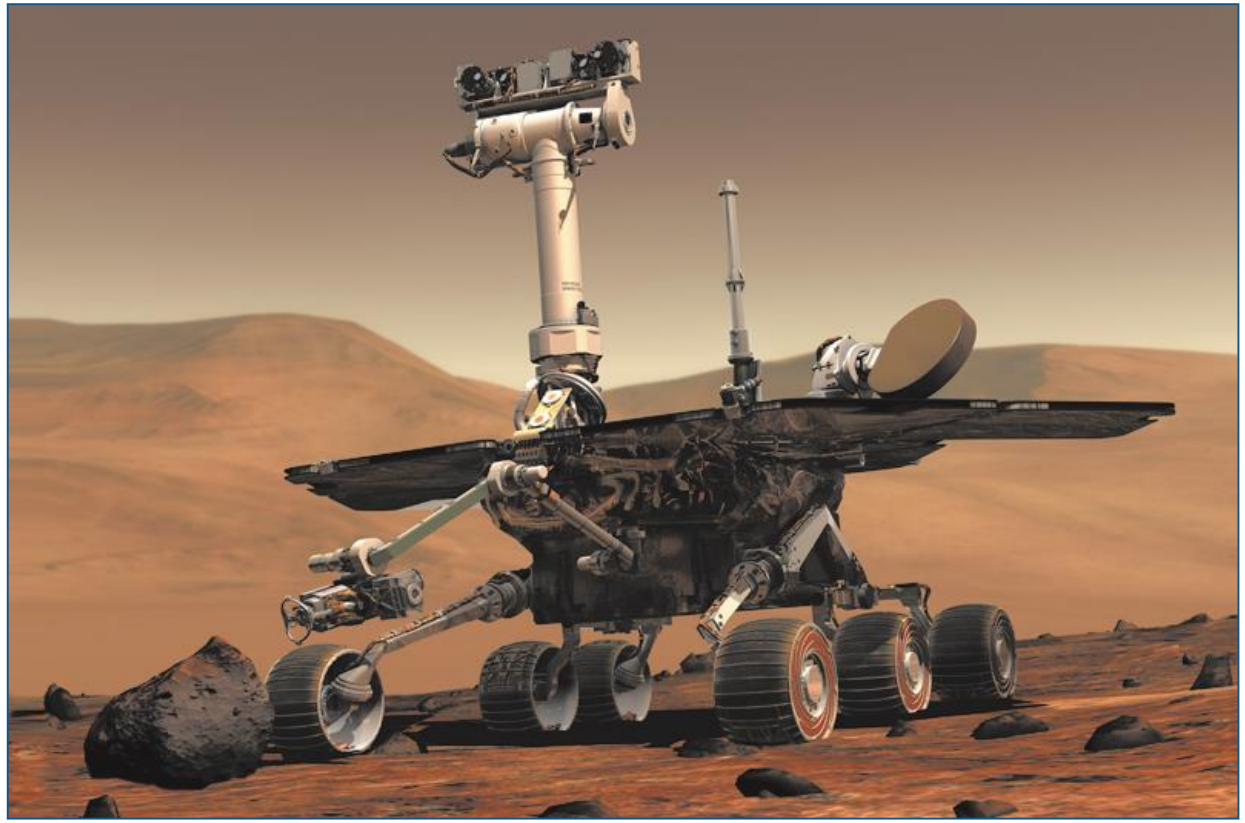


What people do in industry:

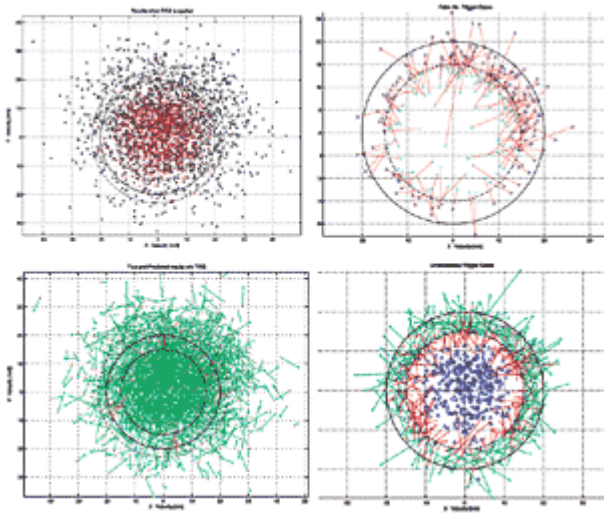
Mars Rovers – NASA Jet Propulsion Lab

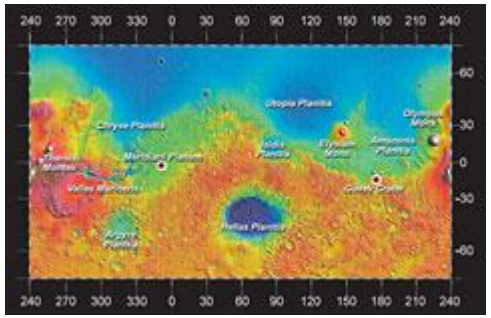
MATLAB is used for:

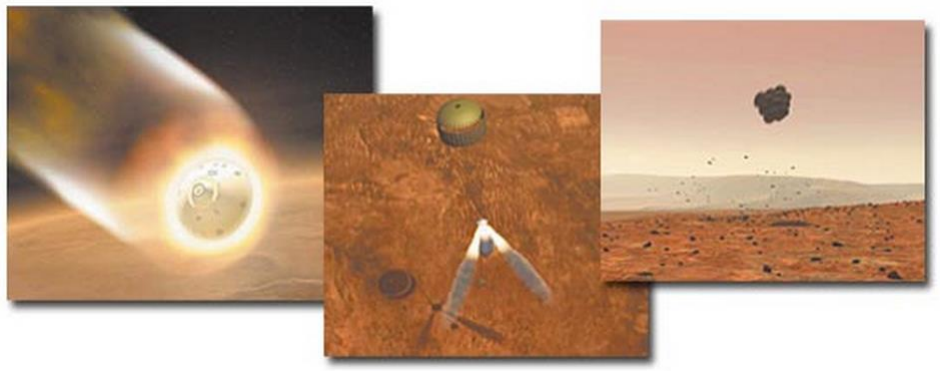
Entry, Descent, and Landing System Design, Navigation, and Data Analysis…



Artist's rendition of Mars rover.
Graphics courtesy of NASA/JPL/Cornell



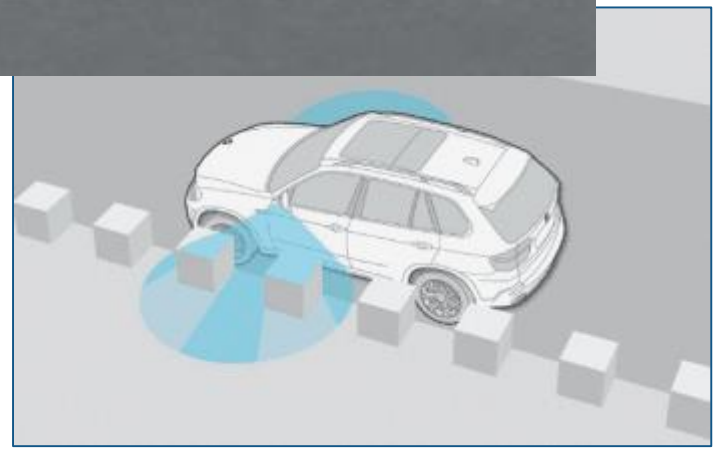




What people do in industry:
Motion-Stereo Parking – BMW

MATLAB is use for:
Motion-Stereo Systems, Object Detection, Computer Vision, Real-Time Control…

Vehicle equipped with side-view camera. As the vehicle moves, the side-view camera acquires images that are used to measure depth.



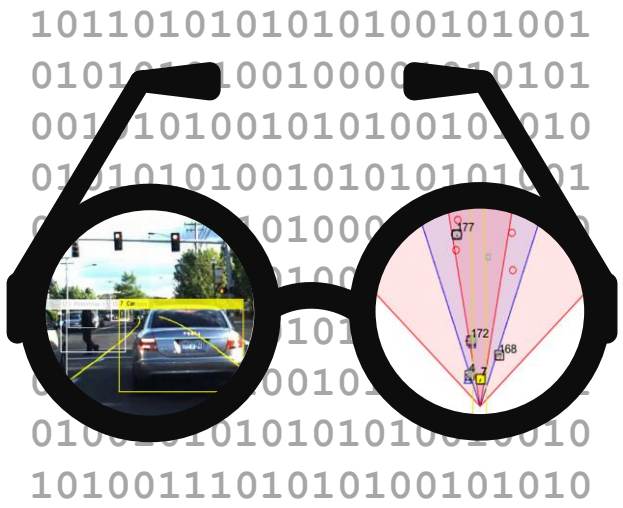
What people do in industry:

Prosthetic Arm – Applied Physics Lab

MATLAB is use for:
Simulation in Virtual Environment, Machine Learning, Real-Time Controller Design, and Clinical Application…

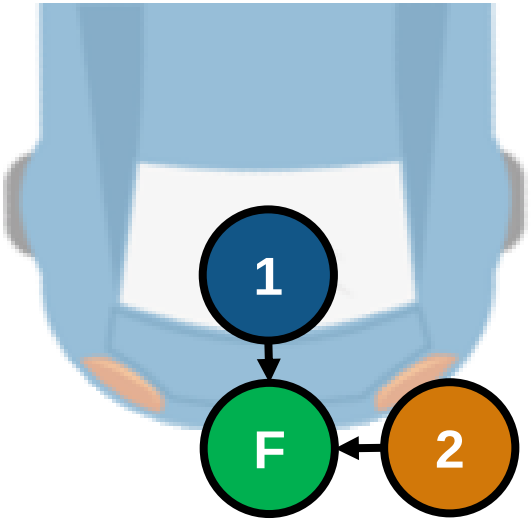
Automated Driving System Toolbox

Some common questions from automated driving engineers



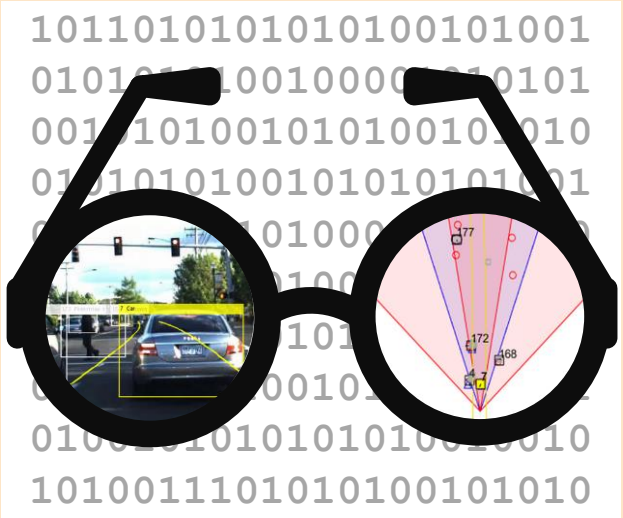
How can I visualize vehicle data?

How can I detect objects in images?



How can I fuse multiple detections?

Some common questions from automated driving engineers



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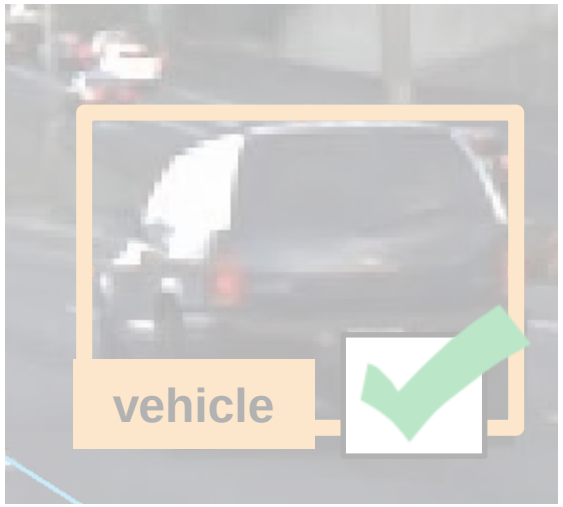

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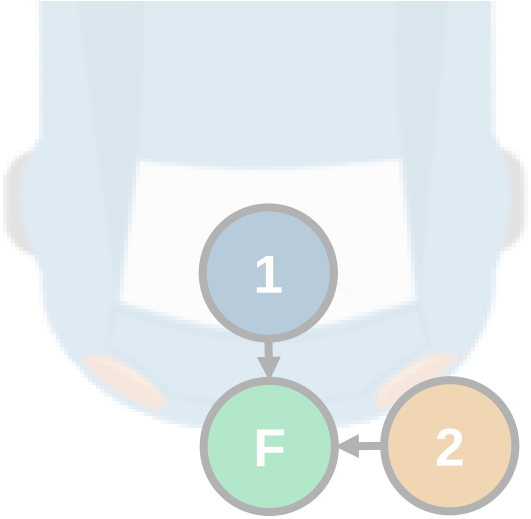
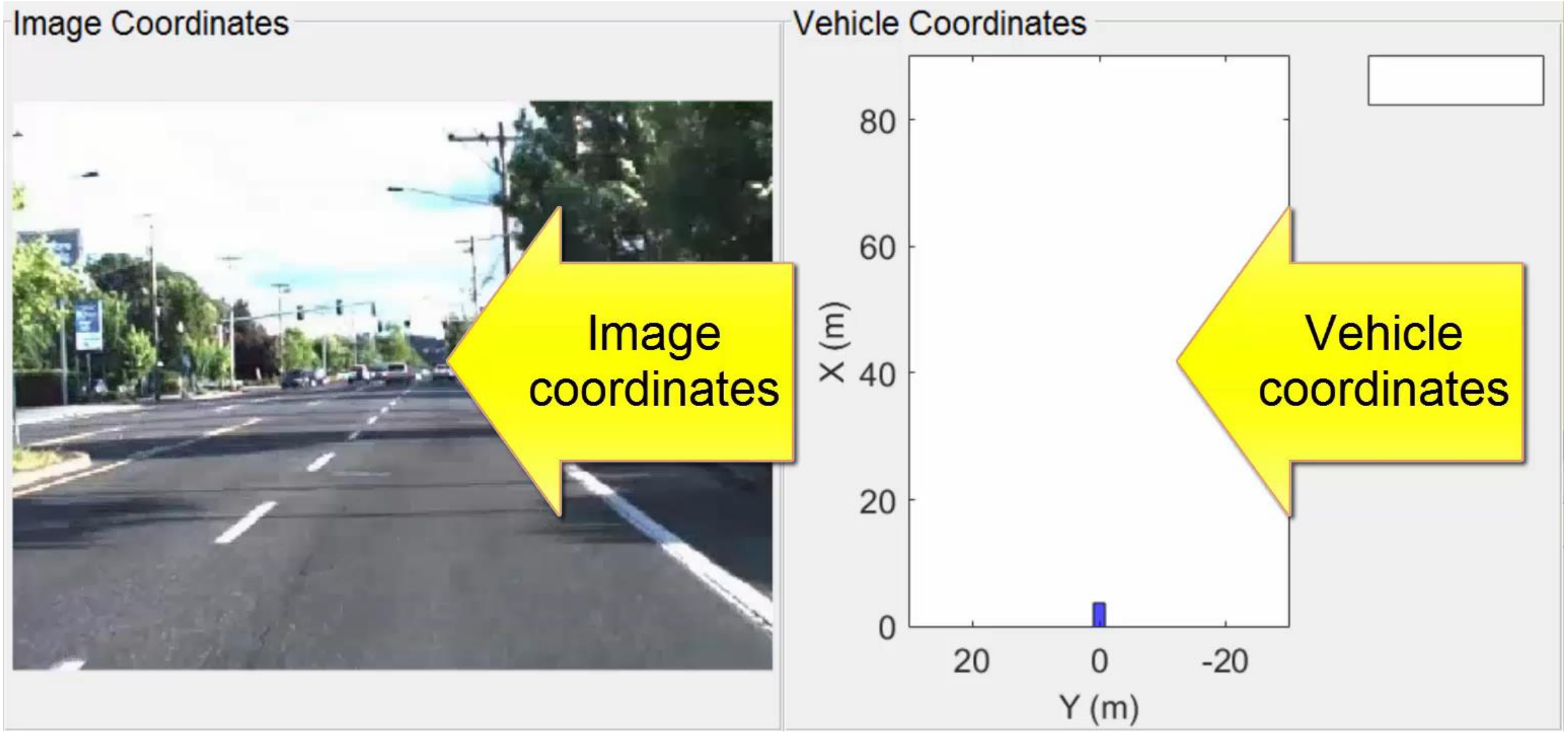
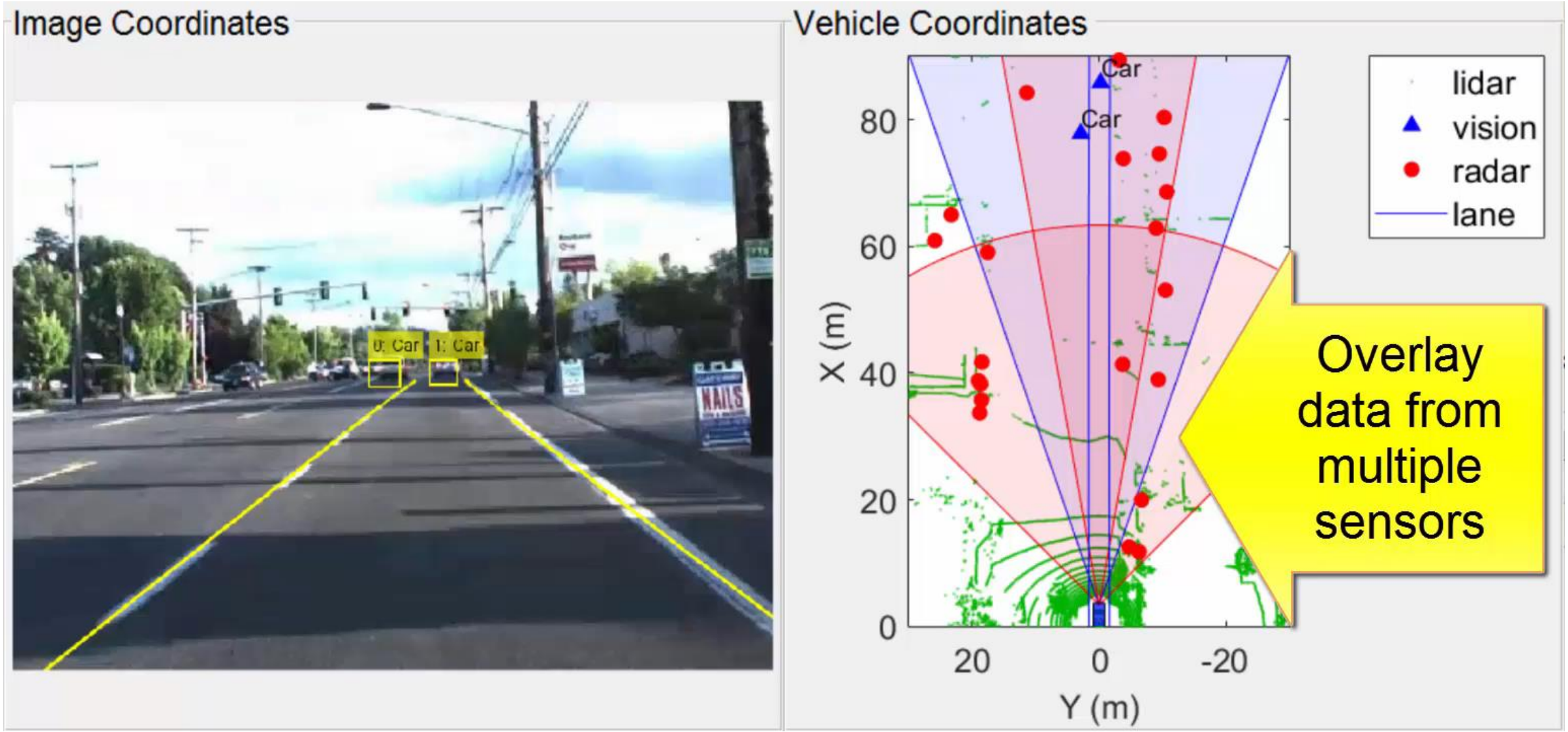


How can I fuse multiple detections?

Visualize sensor data

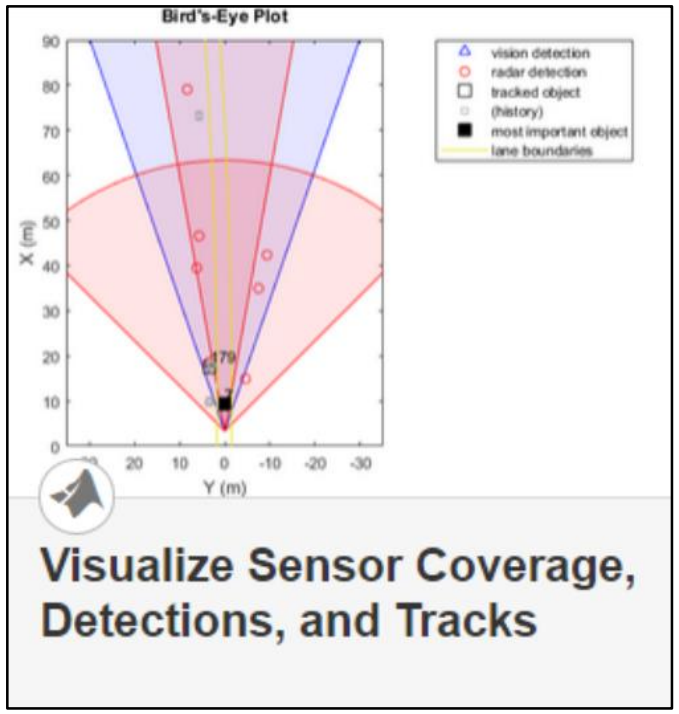


Visualize differences in sensor detections



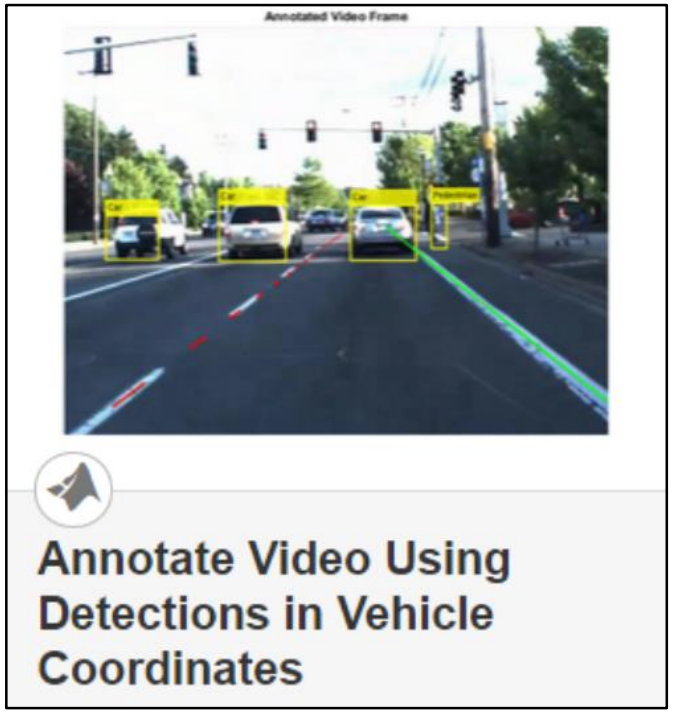
Learn more about visualizing vehicle data

by exploring examples in the Automated Driving System Toolbox



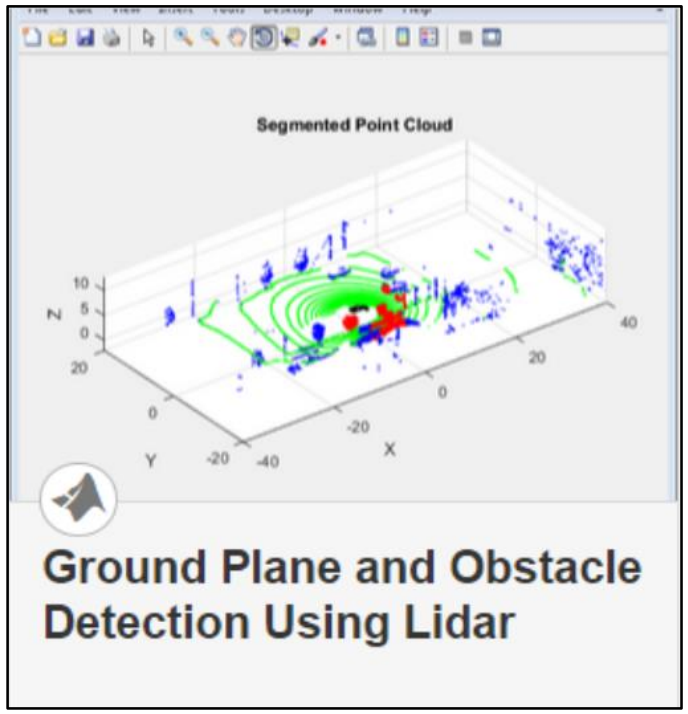
Visualize Sensor Coverage, Detections, and Tracks

- **Plot object detectors in vehicle coordinates**
  - Vision & radar detector
  - Lane detectors
  - Detector coverage areas



Annotate Video Using Detections in Vehicle Coordinates

- **Transform between vehicle and image coordinates**



Ground Plane and Obstacle Detection Using Lidar

- **Plot lidar point cloud**

Some common questions from automated driving engineers

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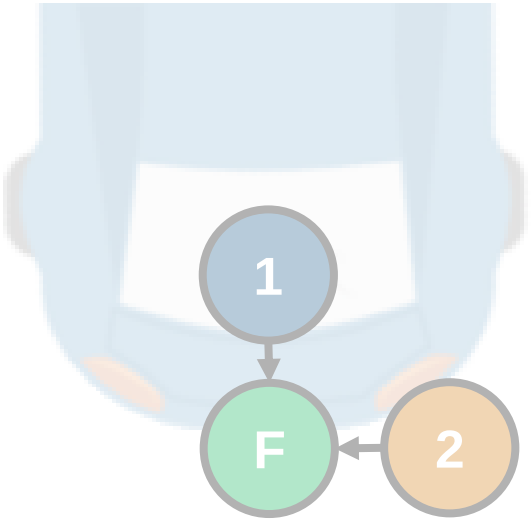
How can I detect objects in images?



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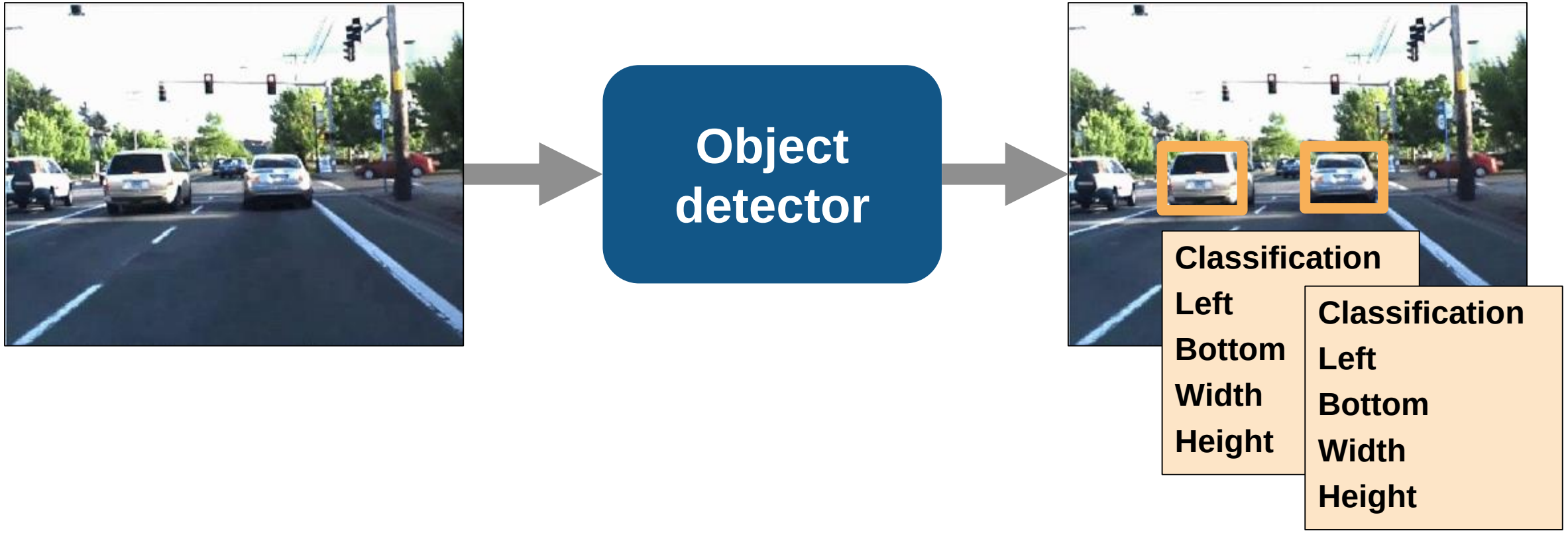
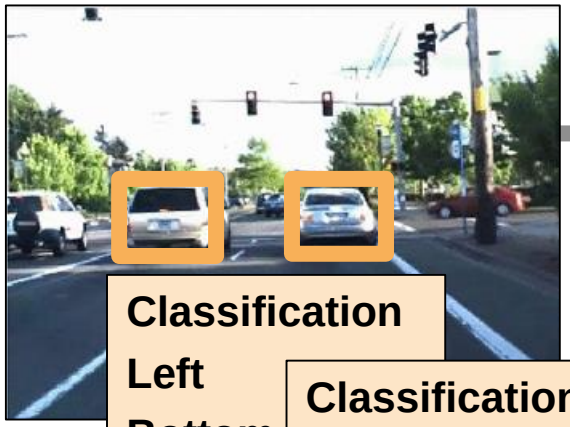


Train object detectors based on ground truth



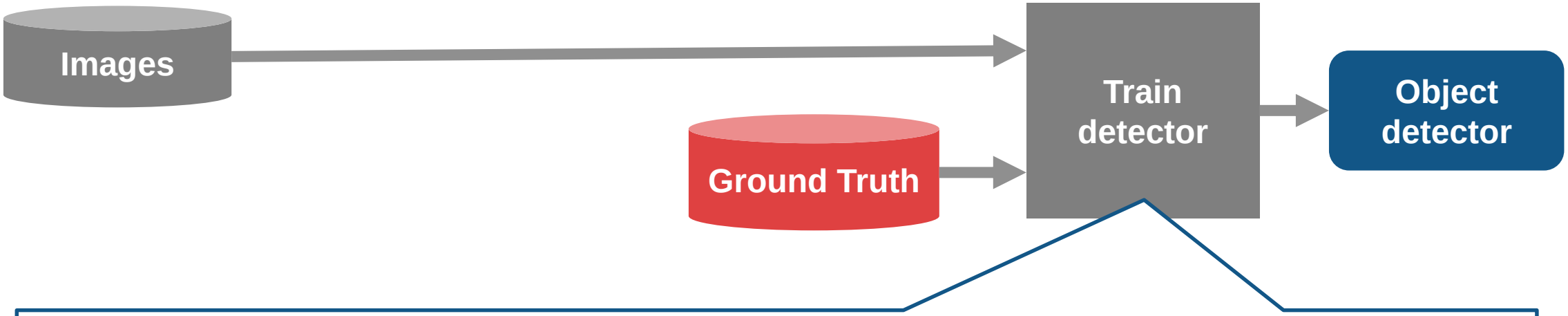
Classification
Left
Bottom
Width
Height

Classification
Left
Bottom
Width
Height

Train detector

Object detector

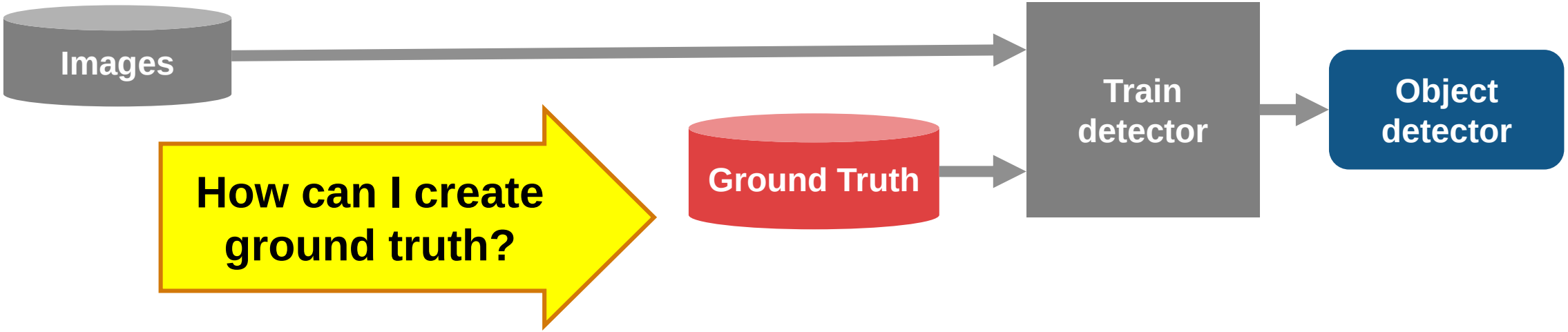
Train object detectors based on ground truth



Design object detectors with the Computer Vision System Toolbox

Machine Learning	Aggregate Channel Feature	`trainACFObjectDetector`
	Cascade	`trainCascadeObjectDetector`
Deep Learning	R-CNN (Regions with Convolutional Neural Networks)	`trainRCNNObjectDetector`
	Fast R-CNN	`trainFastRCNNObjectDetector`
	Faster R-CNN	`trainFasterRCNNObjectDetector`

Specify ground truth to train detector



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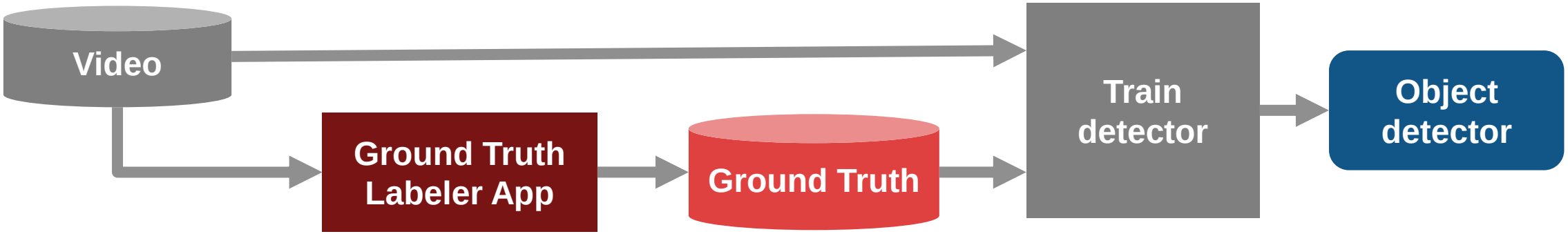

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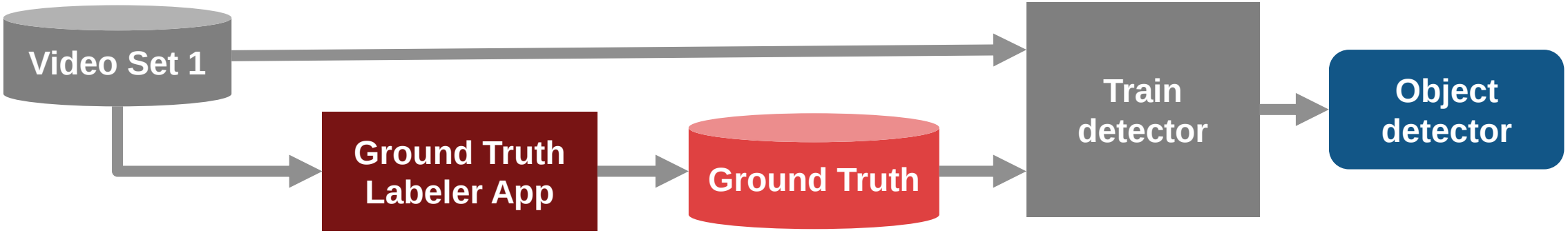
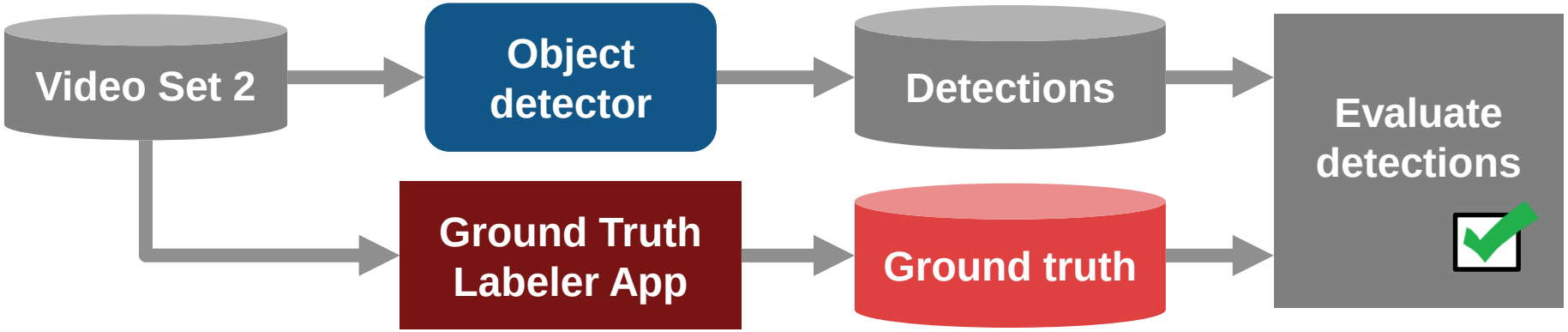
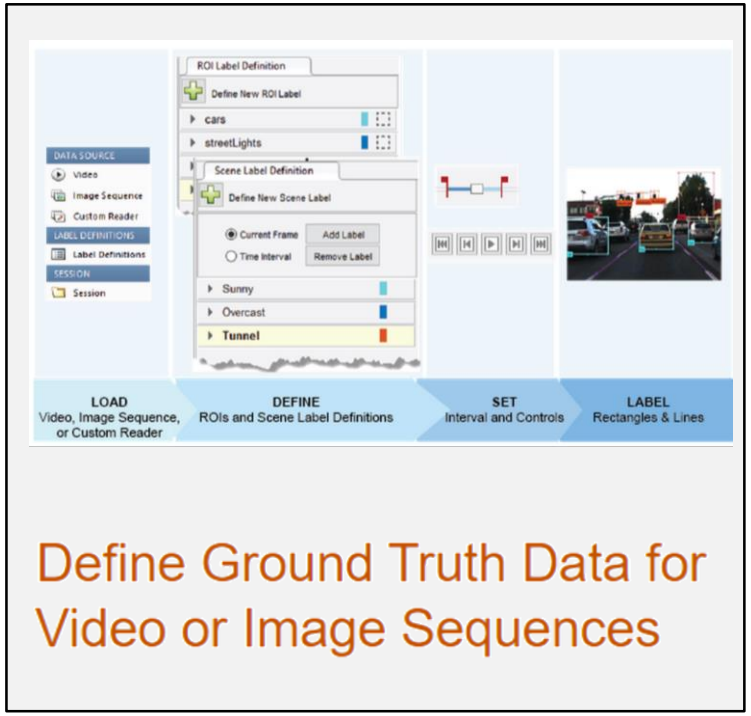


Specify ground truth to evaluate detectors

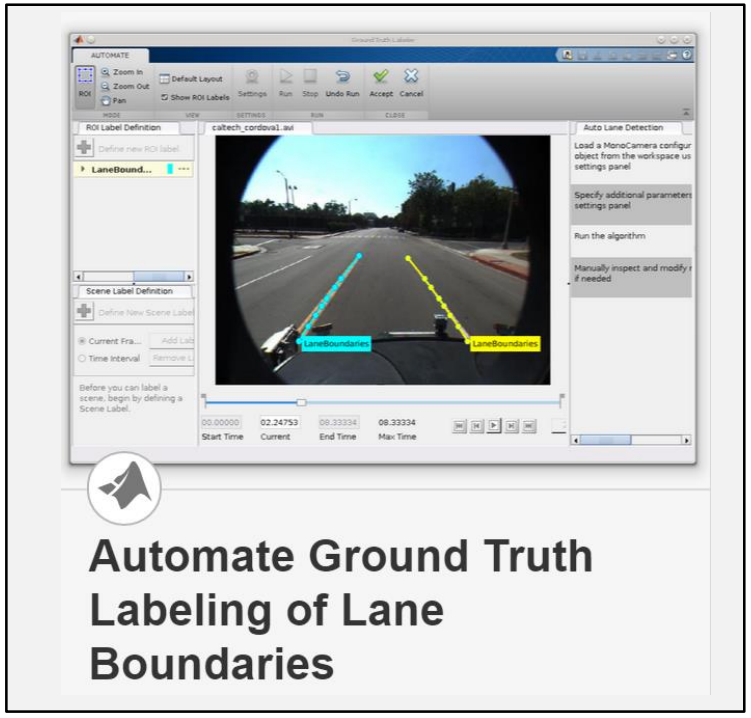


Learn more about detecting objects in images

by exploring examples in the Automated Driving System Toolbox



- **Label detections** with Ground Truth Labeler App

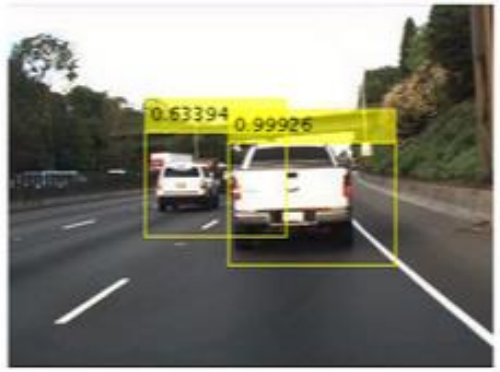


- **Add automation algorithm** for lane tracking

- **Extend connectivity** of Ground Truth Labeler App

Learn more about detecting objects in images

by exploring examples in the Automated Driving System Toolbox



Train a Deep Learning Vehicle Detector

- **Train object detector** using deep learning and machine learning techniques

Track Pedestrians from a Moving Car

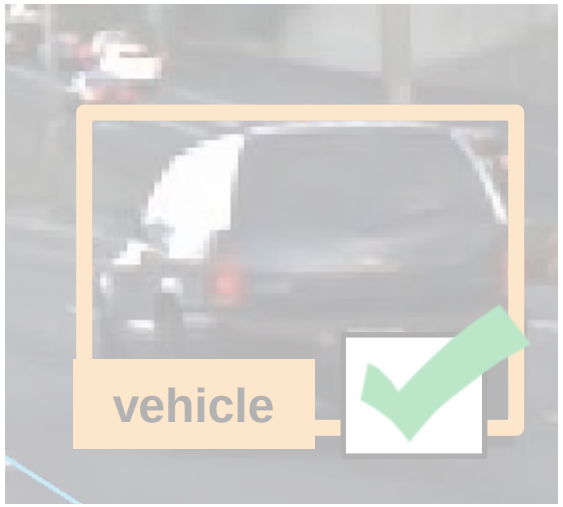
- **Explore pre-trained pedestrian detector**

Visual Perception Using Monocular Camera

- **Explore lane detector** using coordinate transforms for mono-camera sensor model

Some common questions from automated driving engineers

How can I visualize vehicle data?



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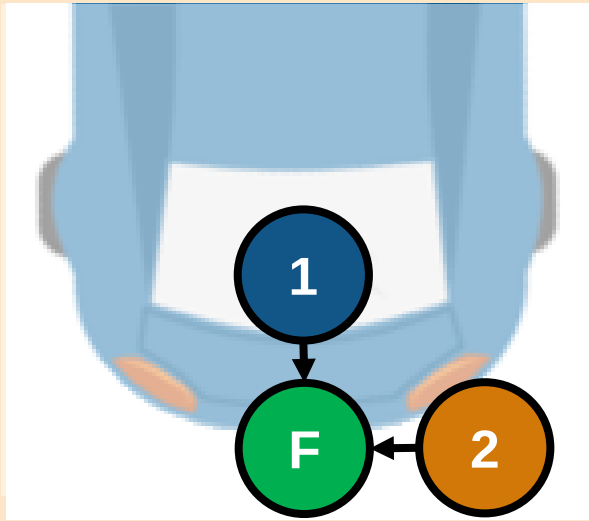
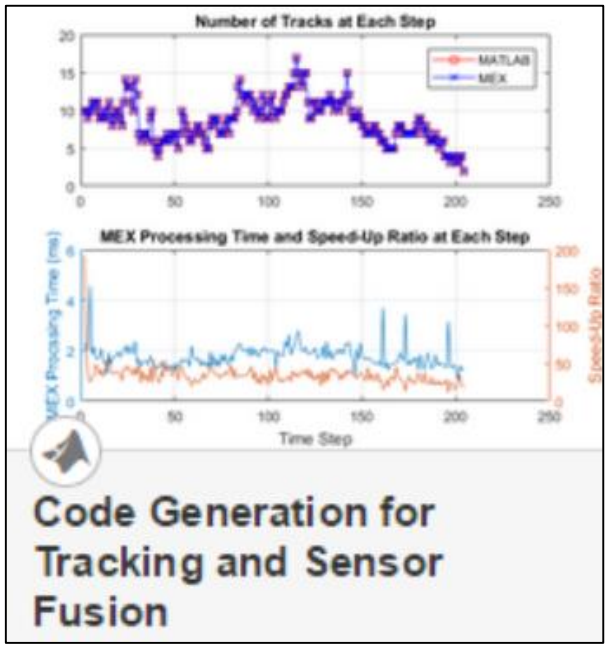


How can I fuse multiple detections?

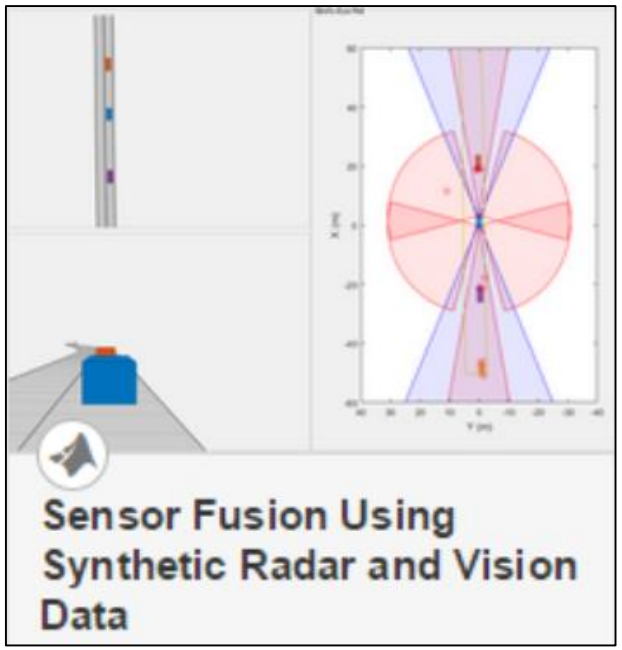
Learn more about sensor fusion

by exploring examples in the Automated Driving System Toolbox

- **Design** multi-object tracker based on logged vehicle data



- **Generate C/C++** code from algorithm which includes a multi-object tracker



- **Synthesize driving scenario** to test multi-object tracker

Upcoming Webinar:
Introduction to Automated Driving System Toolbox

Date	Time
25 Jan 2018	1:30 AM PST
25 Jan 2018	6:00 AM PST
25 Jan 2018	11:00 AM PST

www.mathworks.com > Events > Upcoming Webinars

https://www.mathworks.com/company/events/webinars/upcoming/introduction-to-automated-driving-system-toolbox-2355969.html

Resources

Q & A