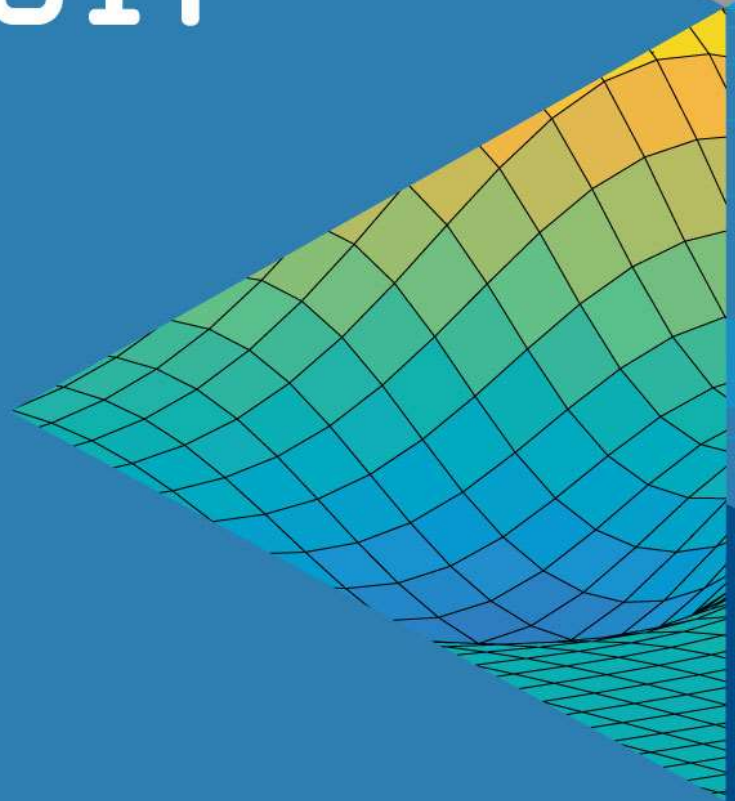
MATLAB EXPO 2017 KOREA

4월 27일, 서울

등록 하기 matlabexpo.co.kr



컴퓨터비전의 최신기술
: Deep Learning, 3D Vision and Embedded Vision

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Three Main Topics

New capabilities for computer vision system design:

AlexNet
PRETRAINED MODEL

VGG-16
PRETRAINED MODEL

Caffe
MODELS

- Deep Learning
- 3-D Vision and Image Processing
- Embedded Vision

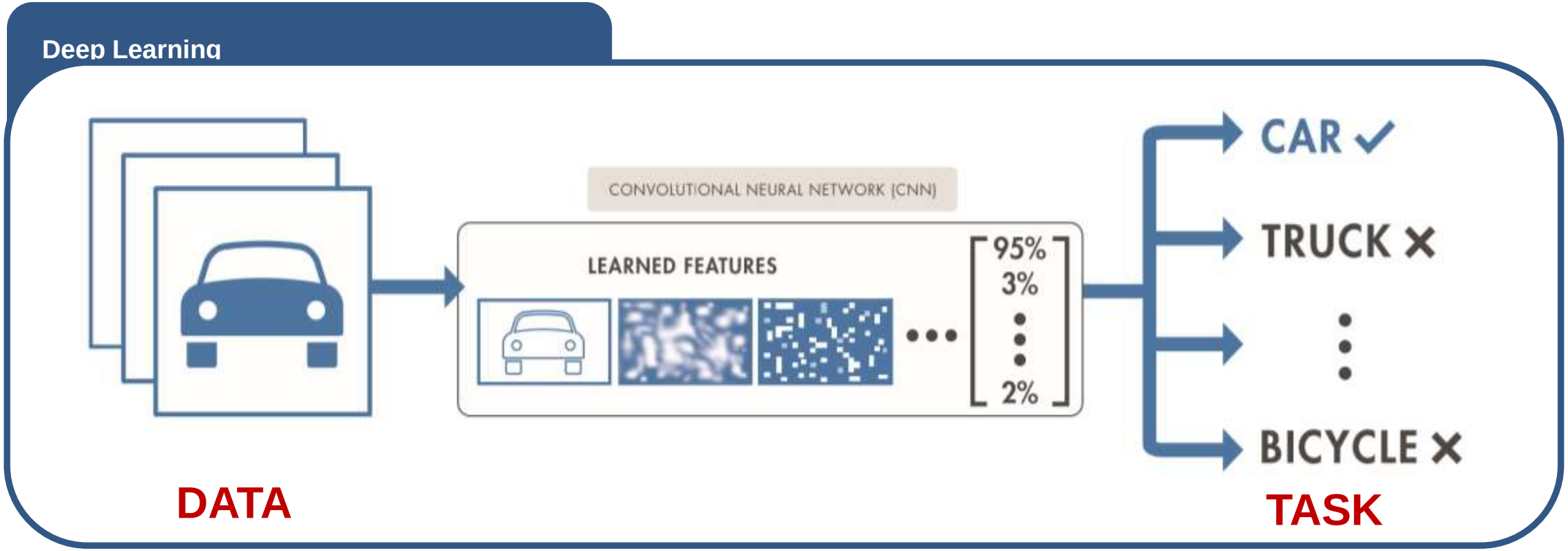
New MATLAB framework makes deep learning easy and accessible

and

MATLAB can be used by experts for real deep learning(computer vision) problems

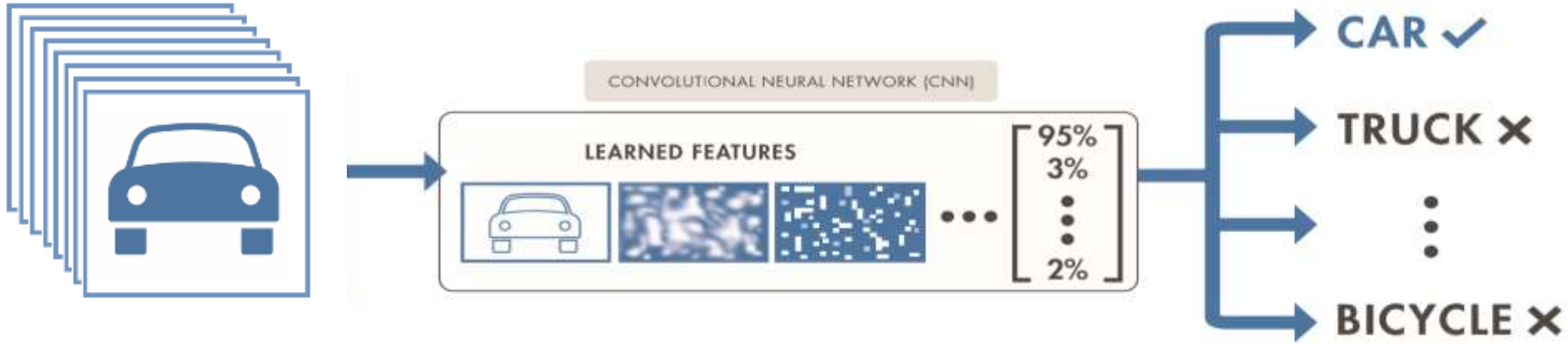
What is Deep Learning ?

Deep learning is a type of machine learning that performs end-to-end learning by learning tasks directly from images, text, and sound.

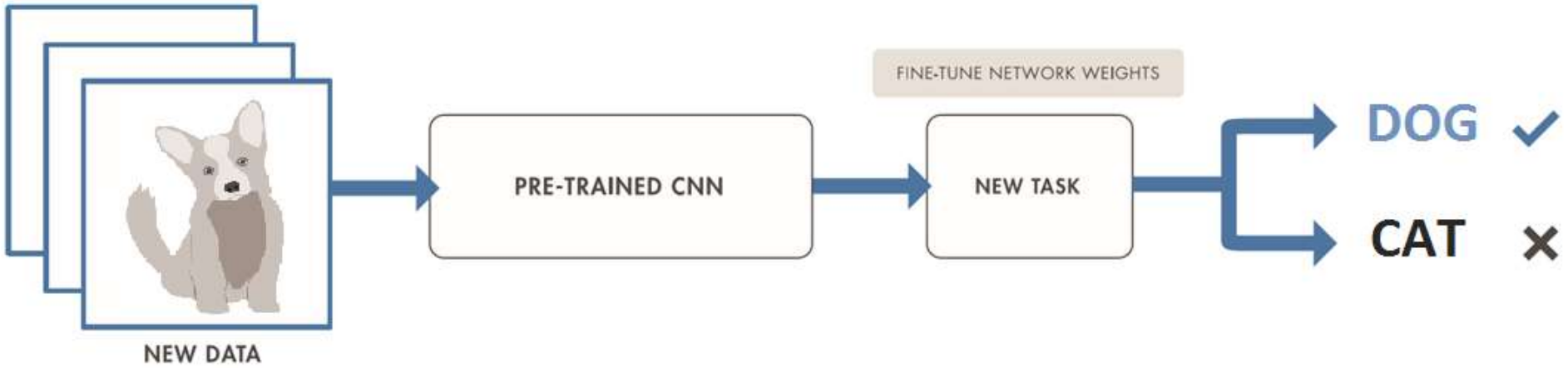


Two Approaches for Deep Learning

1. Train a Deep Neural Network from Scratch



2. Fine-tune a pre-trained model (transfer learning)



Example: Classify Vehicles With Transfer Learning

AlexNet Pretrained Model

1000 classes
Trained on millions of images

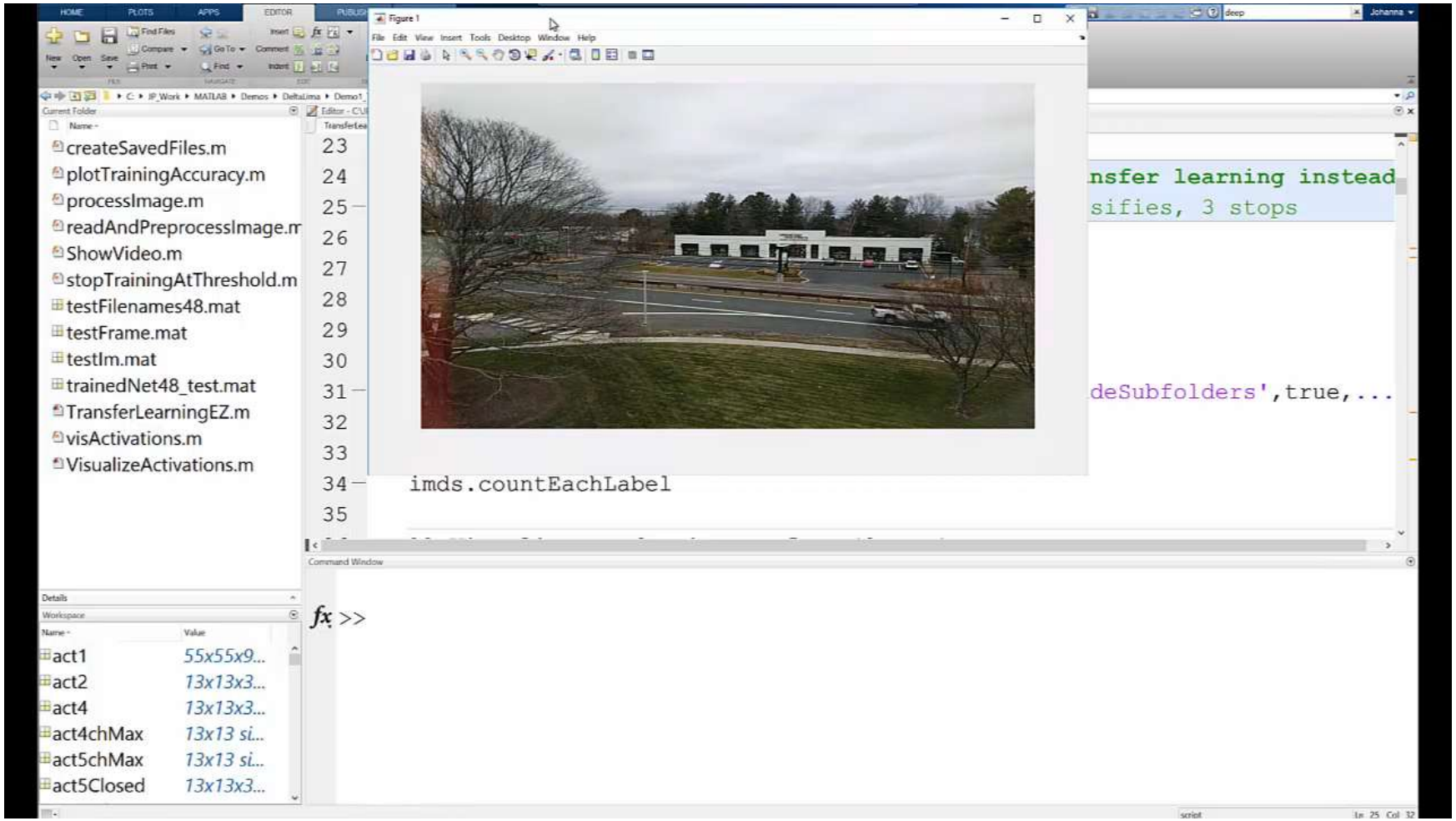
Transfer learning – use AlexNet as starting point

New Data

Vehicle Classifier (5 Class)

Car
SUV
Van
Truck
Large Truck

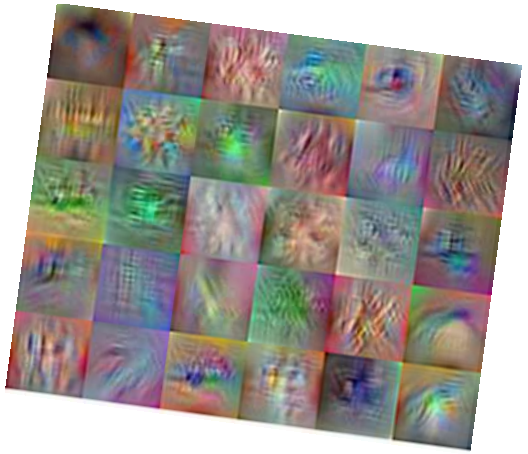
Transfer Learning to Classify New Objects



MATLAB makes Deep Learning Easy and Accessible

Learn about new MATLAB capabilities to

- Handle and label large sets of images
- Accelerate deep learning with GPU's
- Visualize and debug deep neural networks
- Access and use models from experts



AlexNet
PRETRAINED MODEL

VGG-16
PRETRAINED MODEL

Caffe
MODELS

3D Image Processing

3-D Image Processing

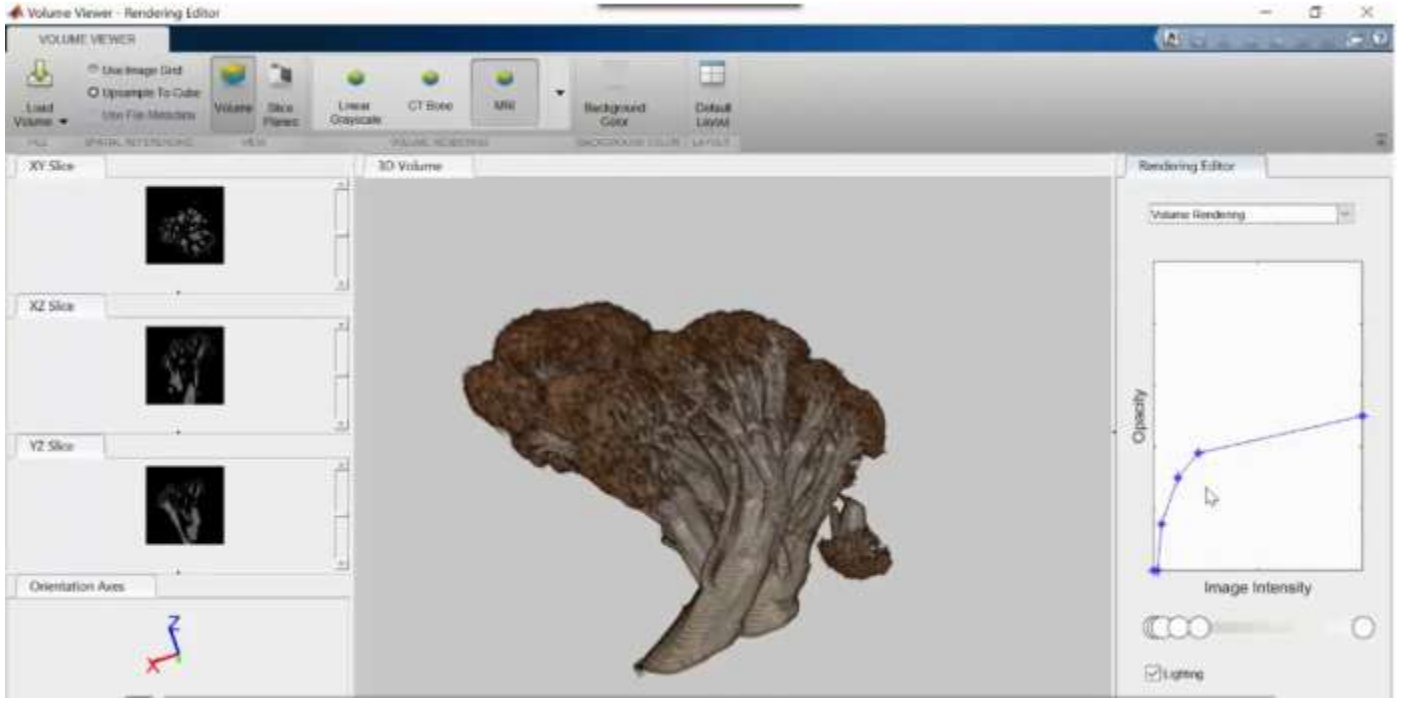
R2016b R2017a

Over *40 functions* support 3-D volumetric image processing

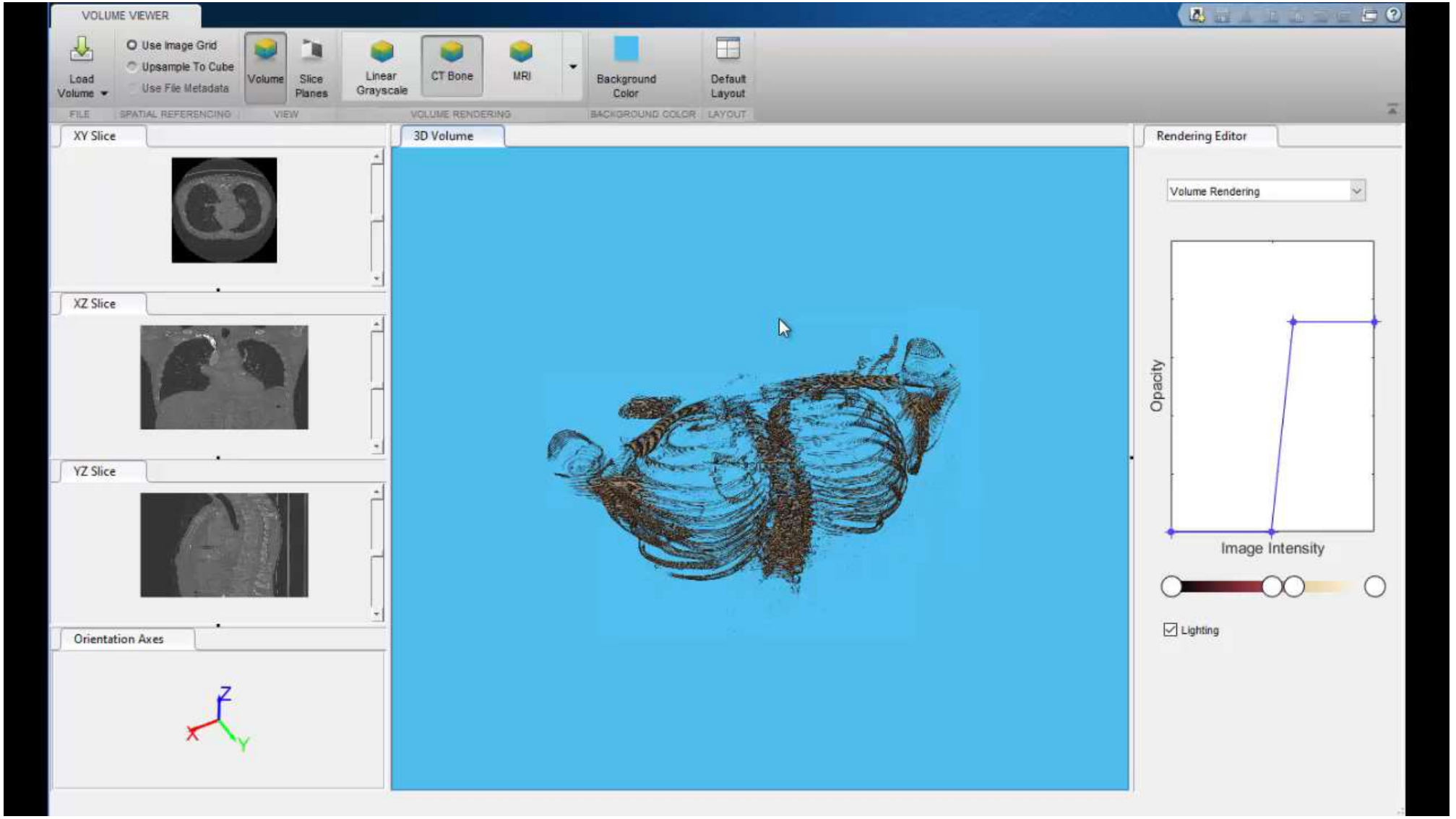
Capabilities Includes:

- Image arithmetic
- Morphology
- Segmentation
- Geometric transforms
- Enhancement

Volume Viewer App for exploration



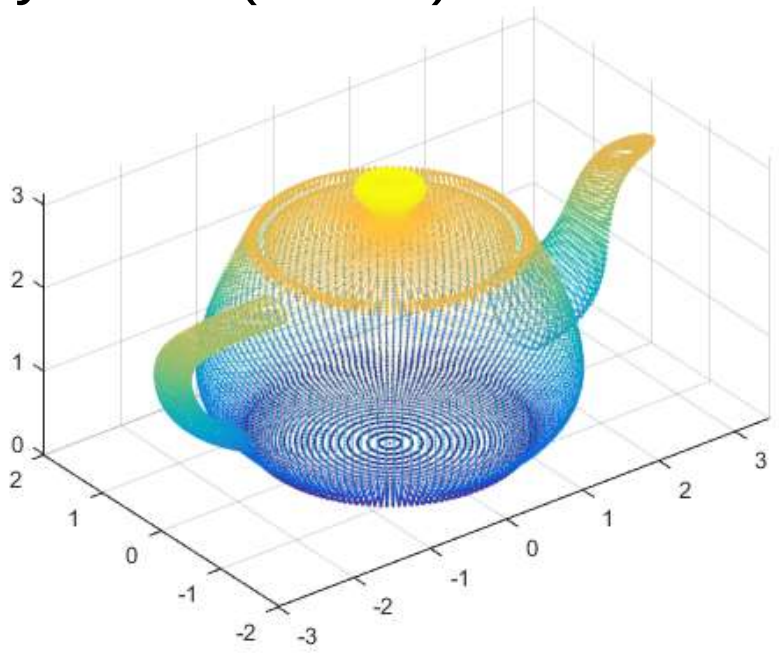
3-D Image Processing

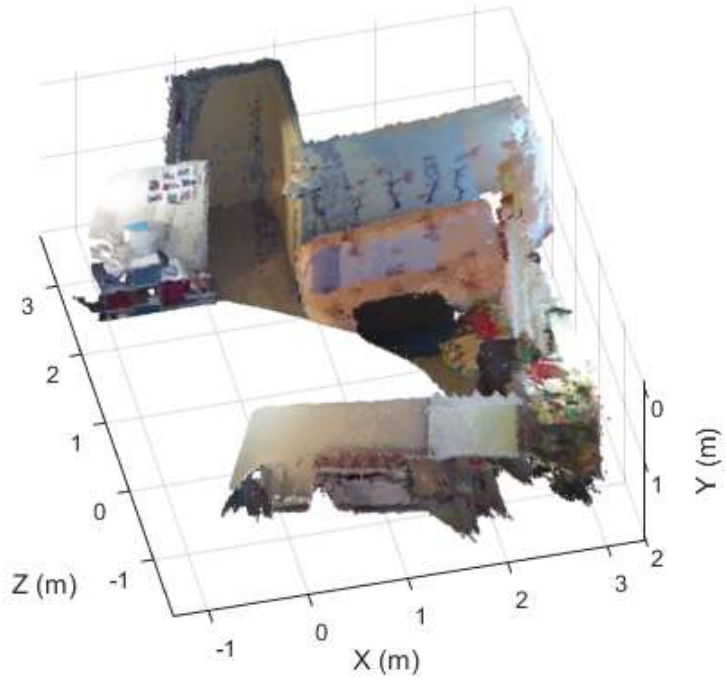


3D Vision – LiDAR Processing

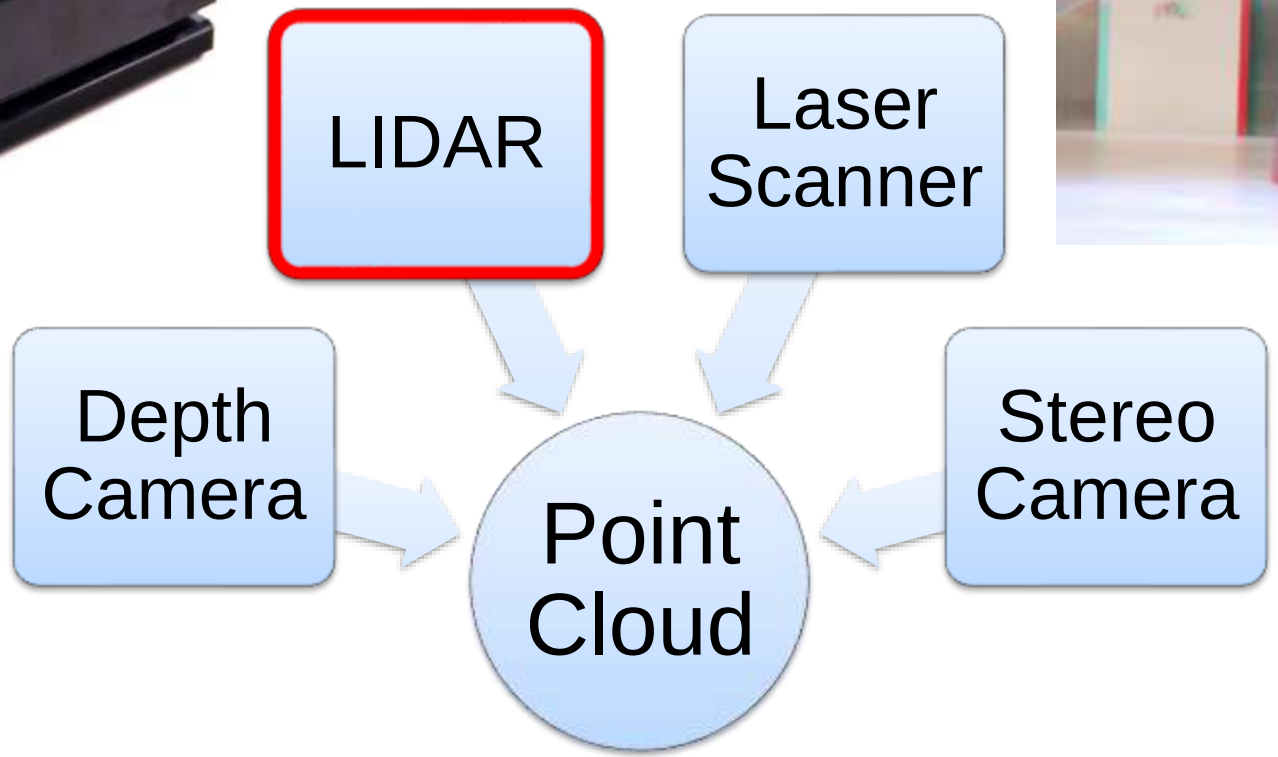
What are Point Clouds?

- Point clouds represent a set of data points in a 3-D coordinate system
- Typically used to measure physical world surfaces
- Used for navigation and perception in robotics and Advanced Driver Assista nce Systems (ADAS)

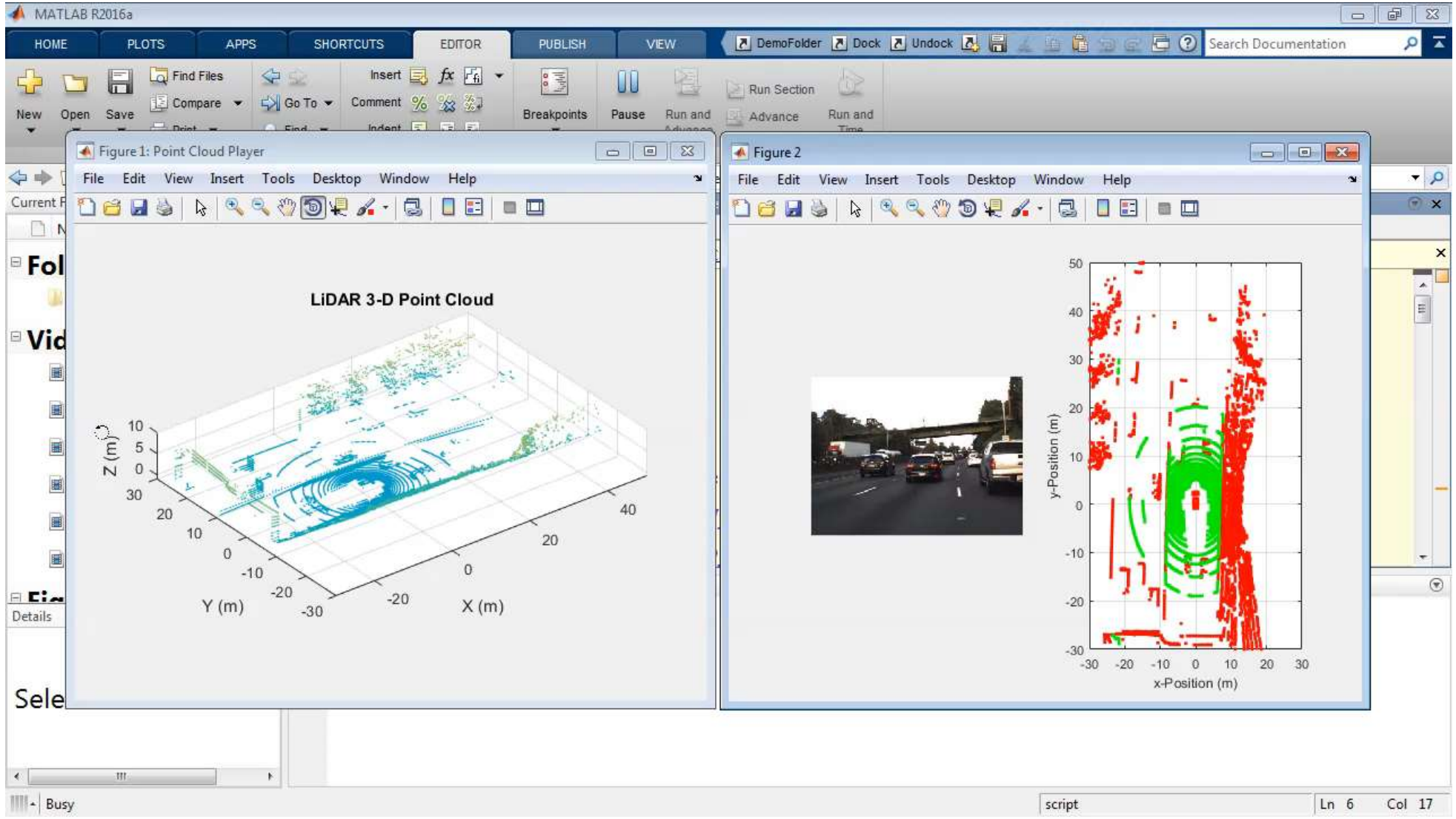




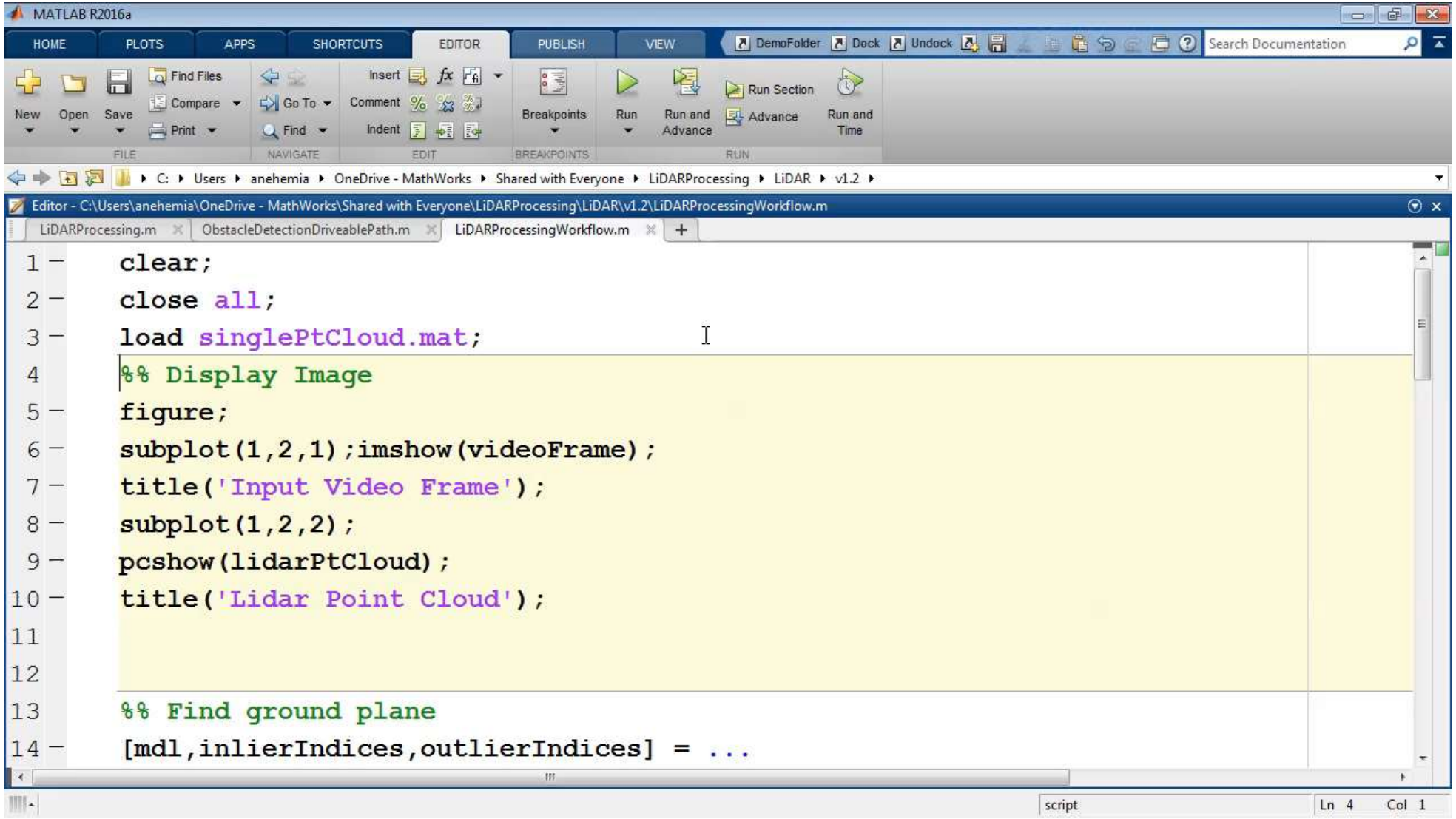
Common Sources of Point Cloud Data



3-D Vision: Design LiDAR Processing

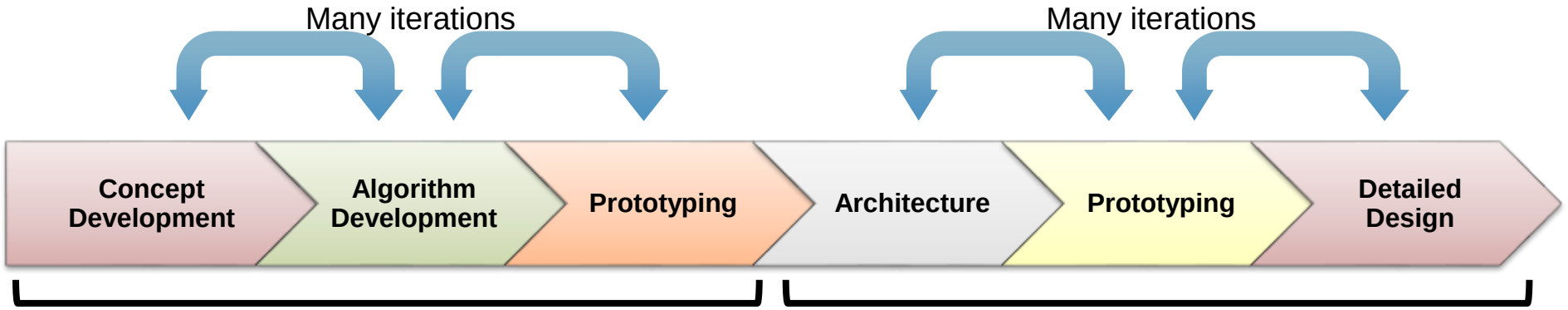


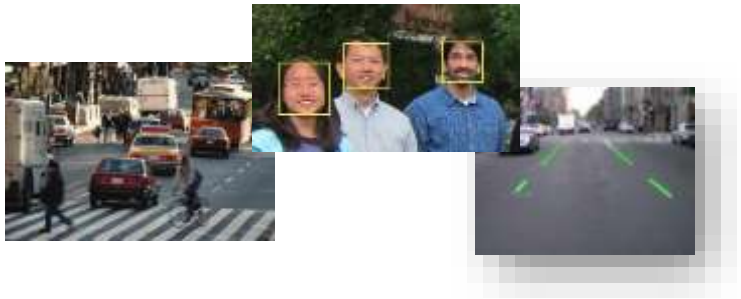
3:D Vision: Design LiDAR Processing



Embedded Vision System Development using Automatic Code Generation

Typical Workflow for Embedded Vision System Development





- Is my idea new? What is required?
- Is it robust to all kinds of conditions? (lighting noise, etc.)

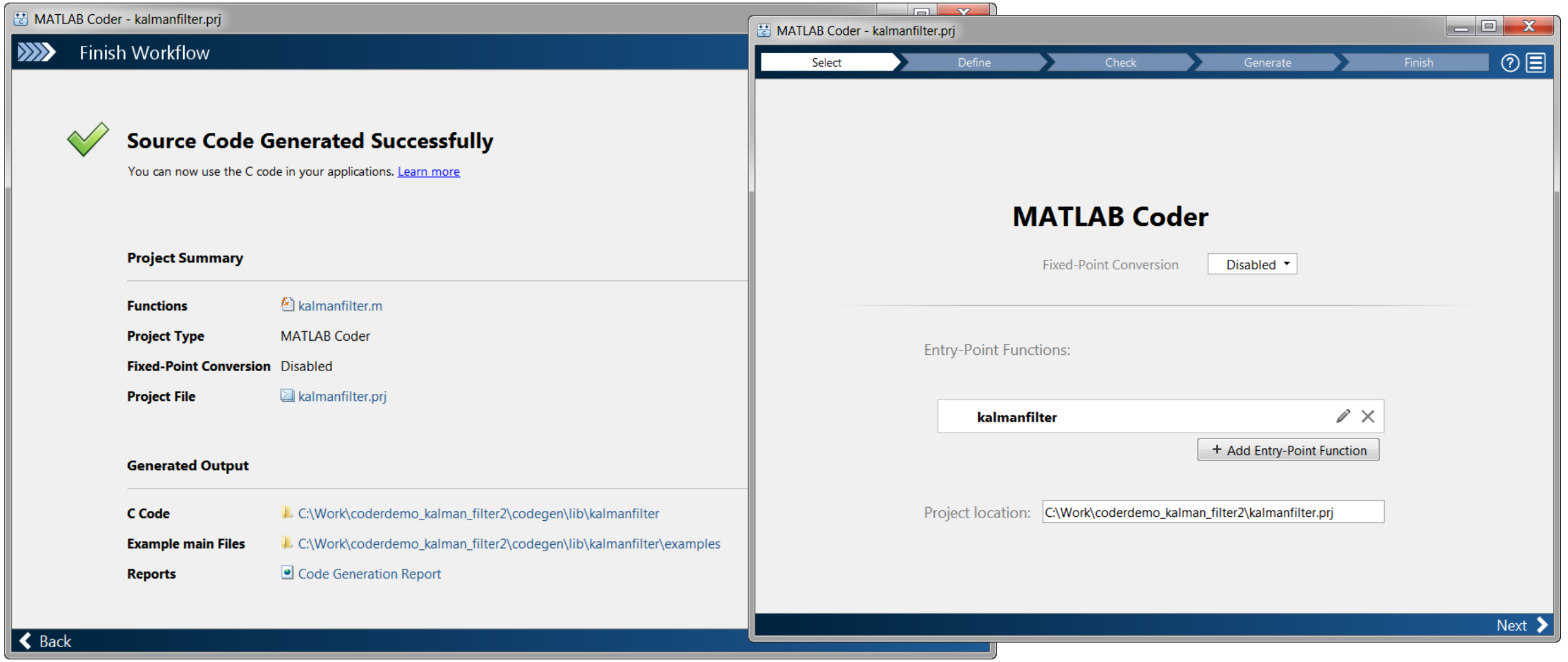
- Consideration of HW platform
  - FPGA? CPU? DSP? GPU?
- Speed and resource requirement
  - Resolution, Frame-rate constraint
  - Memory constraint

Development of the algorithm and implementation are often done by different groups

MATLAB Coder app with Integrated Editor and Simplified Workflow

R2015a

New user interface simplifies code generation workflow

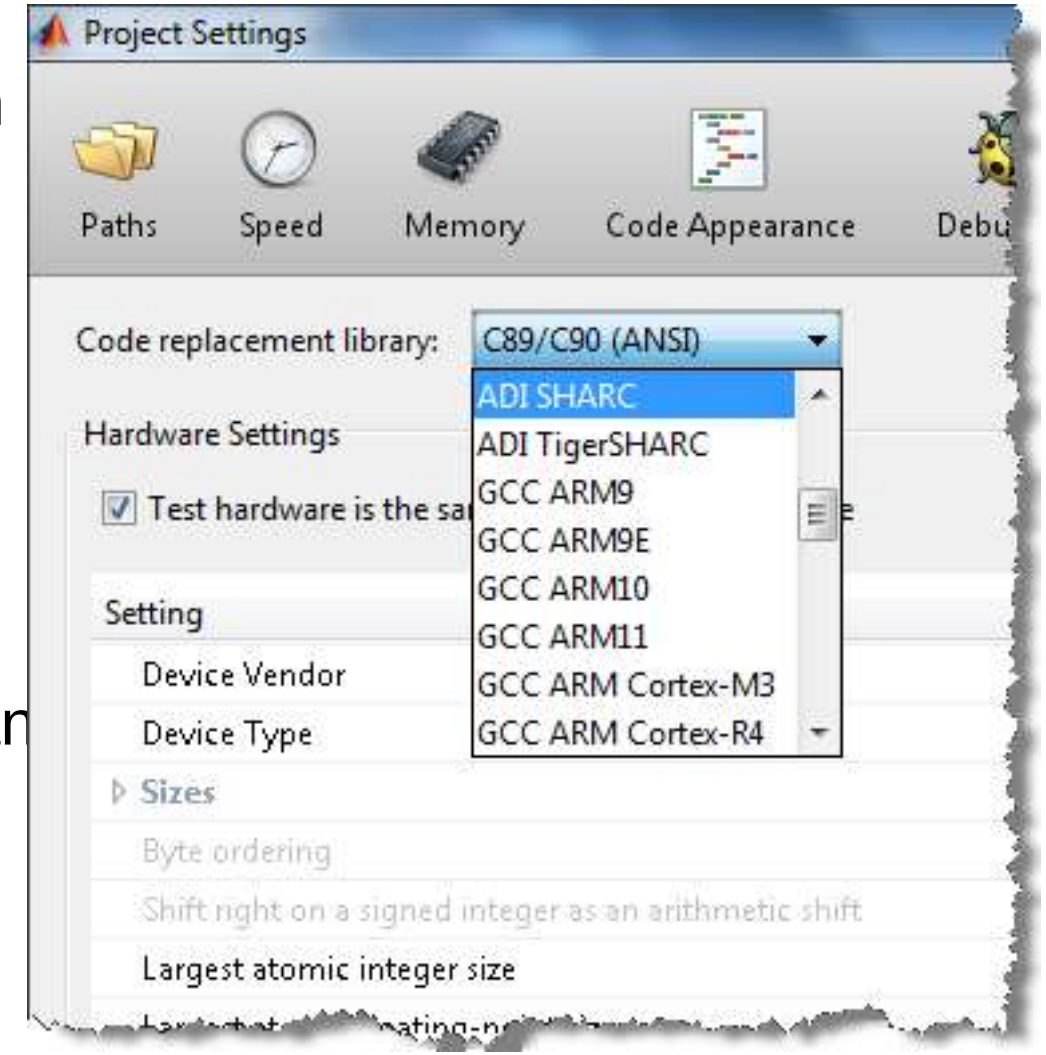


Embedded Coder for Optimized Code

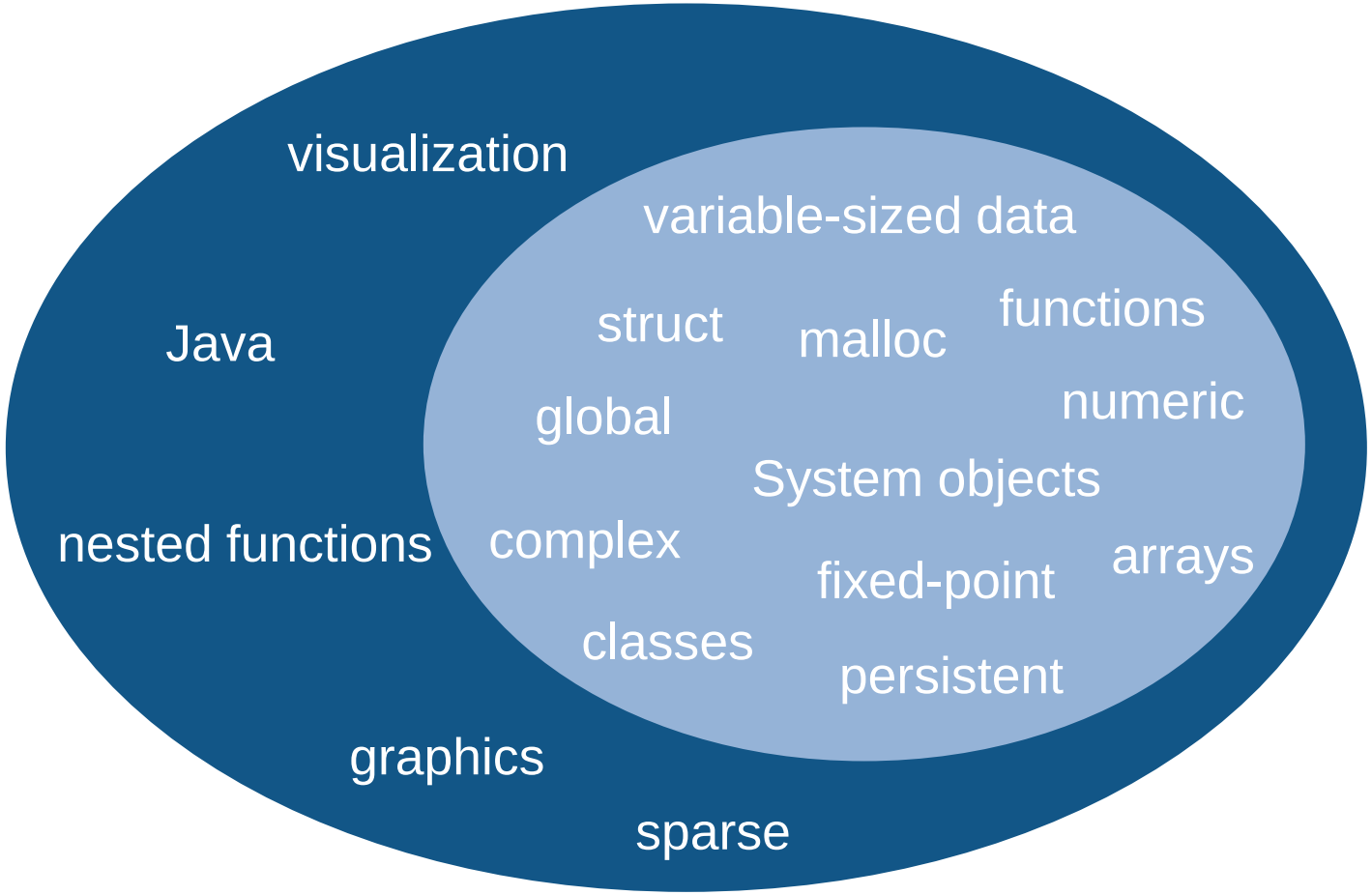
Embedded Coder extends MATLAB Coder with

- Processor-specific code generation
  - Built-in support for select processors
  - Open APIs for use with any processor
- Speed, memory, and code appearance advan

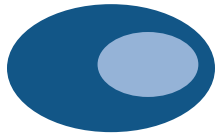
  ced features



MATLAB Language Support for Code Generation



Supported MATLAB Language Features and Functions



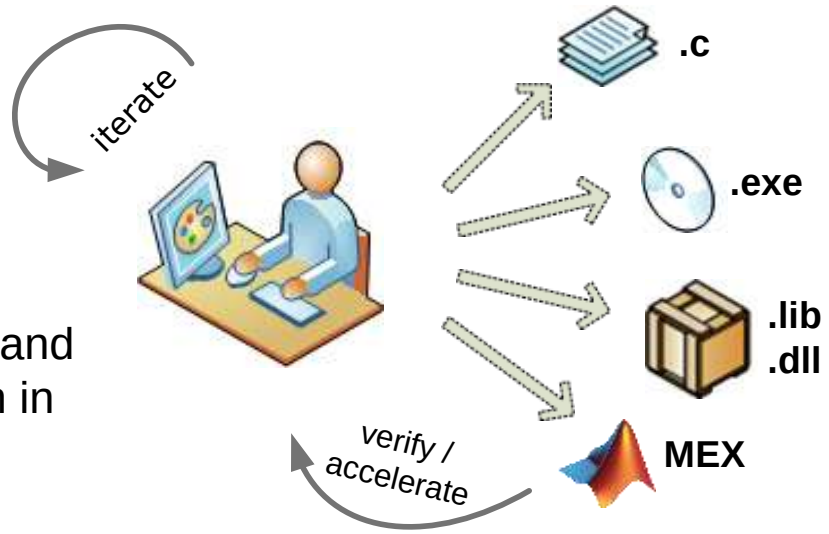
Broad set of language features and functions/system objects supported for co de generation

Matrices and Arrays	Data Types	Programming Constructs	Functions

• Matrix operations
• N-dimensional arrays
• Subscripting
• Frames
• Persistent variables
• Global variables
	• Complex numbers
	• Integer math
	• Double/single-precision
	• Fixed-point arithmetic
	• Characters
	• Structures
	• Cell arrays
	• Numeric class
	• Variable-sized data
	• MATLAB Class
	• System objects
		• Arithmetic, relational, and logical operators
		• Program control (`if, for, while, switch`)
			• MATLAB functions and subfunctions
			• Variable-length argument lists
			• Function handles
			
			Supported algorithms
			• More than 1300 MATLAB operators, functions, and System objects for:
			  • Communications
			  • Computer vision
			  • Image processing
			  • Neural networks
			  • Phased Array signal processing
			  • Robotics
			  • Signal processing
			  • Statistics and machine learning

Automatic Translation of MATLAB to C

Algorithm Design and Code Generation in MATLAB



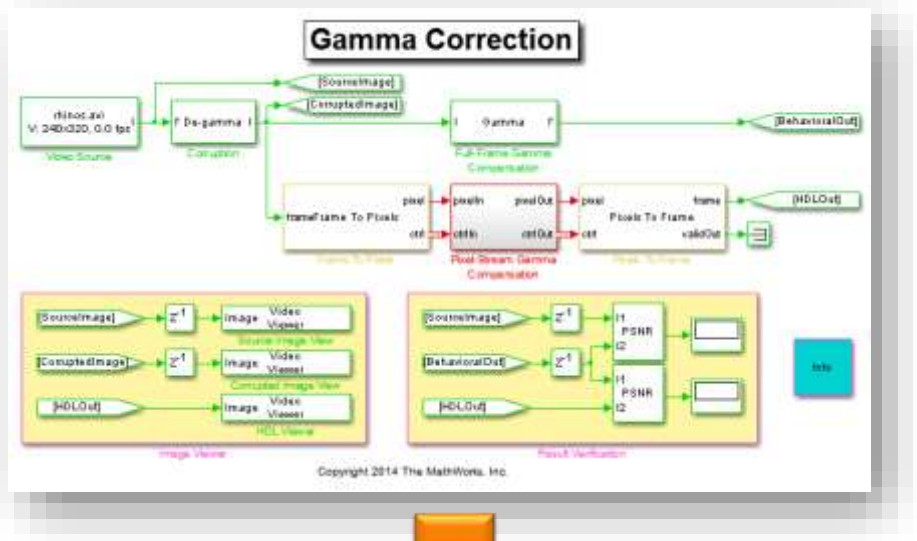
With MATLAB Coder, design engineers can:

- Maintain one design in MATLAB
- Design faster and get to C quickly
- Test more systematically and frequently
- Spend more time improving algorithms in MATLAB

Vision HDL Toolbox

Design and prototype video image processing systems

- Modeling hardware behavior of the algorithms
  - Pixel-based functions and blocks
  - Conversion between frames and pixels
  - Standard and custom frame sizes



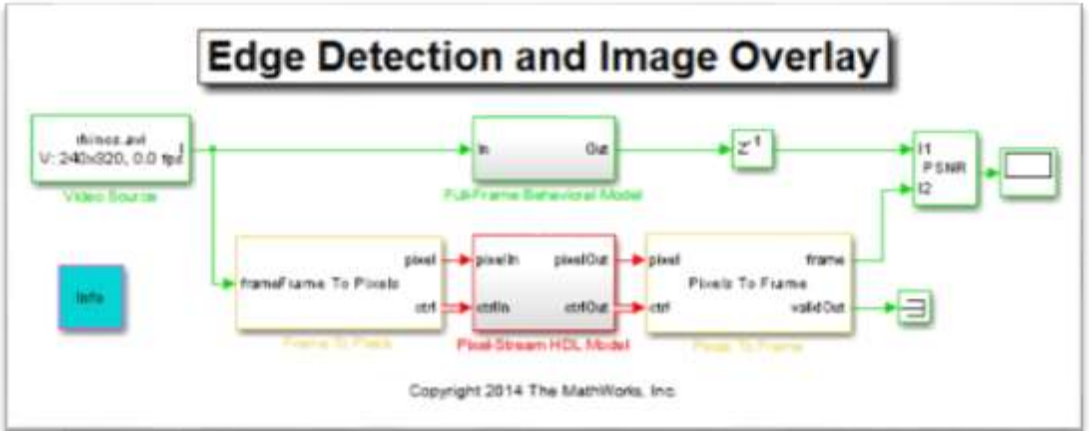
- Prototyping algorithms on hardware

  (**With HDL Coder**) Efficient and readable HDL code

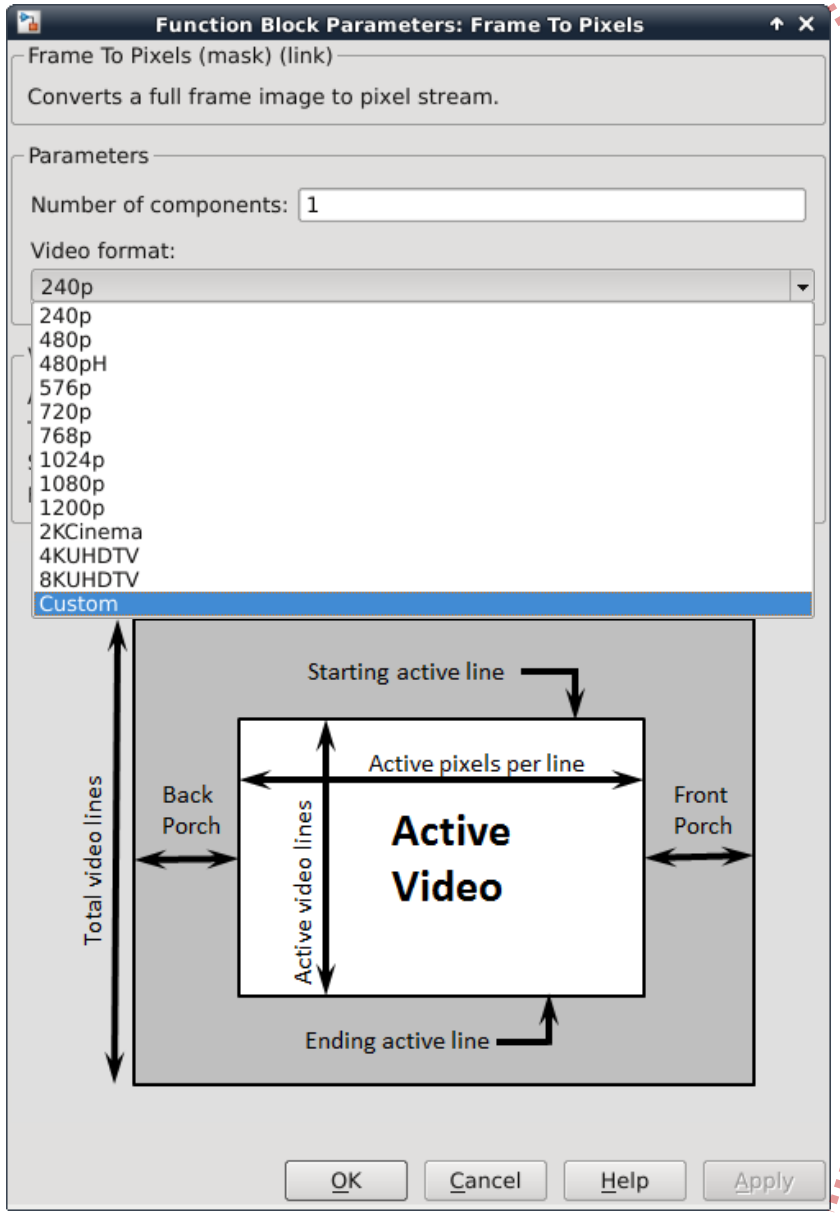
  (**With HDL Verifier**) FPGA-in-the-loop testing and acceleration

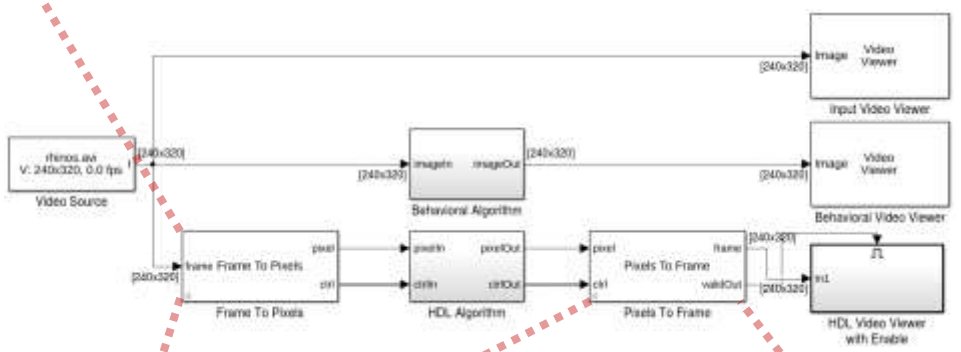
Pixel Based Video Image Algorithms

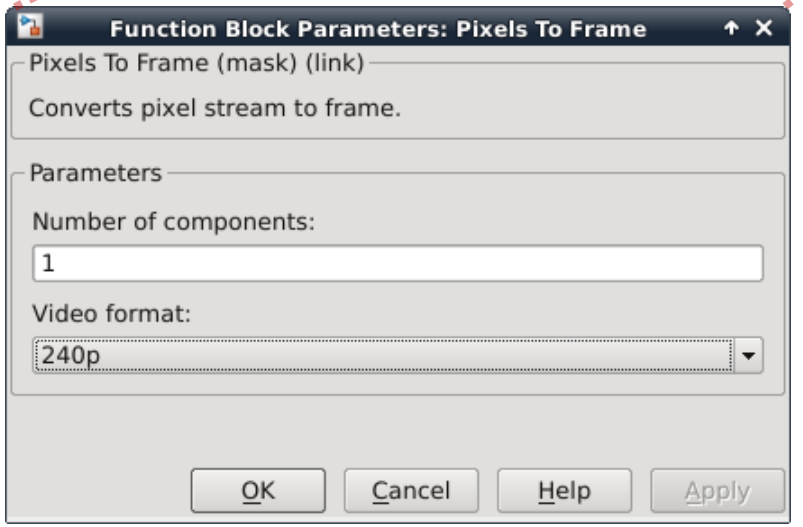
- **Analysis & Enhancement**
  - Edge Detection, Median Filter
- **Conversions**
  - Chroma Resampling, Color-Space Converter
  - Demosaic Interpolator, Gamma Corrector, Look-up Table
- **Filters**
  - Image Filter, Median Filter
- **Morphological Operations**
  - Dilation, Erosion,
  - Opening, Closing
- **Statistics**
  - Histogram
  - Image Statistics
- **I/O Interfaces**
  - Frame to Pixels, Pixels to Frame, FIL versions
- **Utilities**
  - Pixel Control Bus Creator
  - Pixel Control Bus Selector



Frame To Pixels and Pixels To Frame







A Complete Solution for Embedded Vision

Concept Development → Algorithm Development → Prototyping → Architecture design → Prototyping → Chip design

Frame based

Pixel based

Computer Vision System Toolbox

Image Processing Toolbox

Vision HDL Toolbox

HDL Coder

MATLAB Coder

Fixed Point Designer

HDL Verifier

MATLAB / Simulink

FLIR Accelerates Development of Thermal Imaging FPGA

Raw image (left) and image after applying filter developed with HDL Coder (right).

Challenge

Accelerate the implementation of advanced thermal imaging filters and algorithms on FPGA hardware

Solution

Use MATLAB to develop, simulate, and evaluate algorithms, and use HDL Coder to implement the best algorithms on FPGAs

Results

- Time from concept to field-testable prototype reduced by 60%
- Enhancements completed in hours, not weeks
- Code reuse increased from zero to 30%

"With MATLAB and HDL Coder we are much more responsive to marketplace needs. We now embrace change, because we can take a new idea to a real-time-capable hardware prototype in just a few weeks. There is more joy in engineering, so we've increased job satisfaction as well as customer satisfaction."

Nicholas Hogasten

FLIR Systems

Link to user story