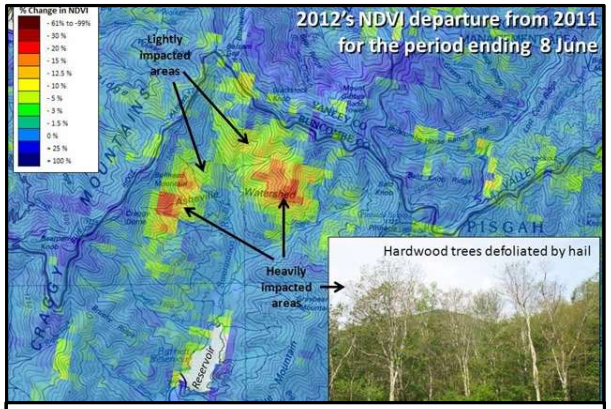
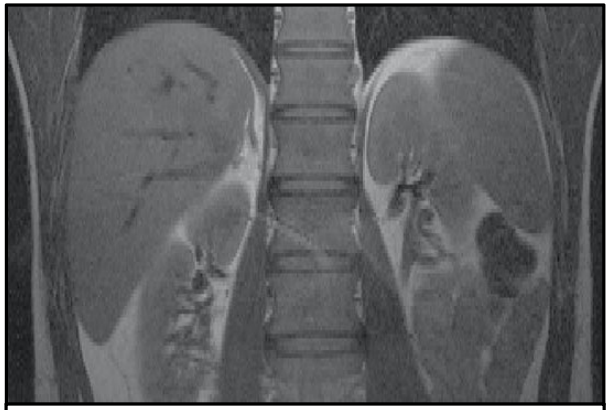
Presentation Title

By Author
Date

Image Processing and Computer Vision Applications



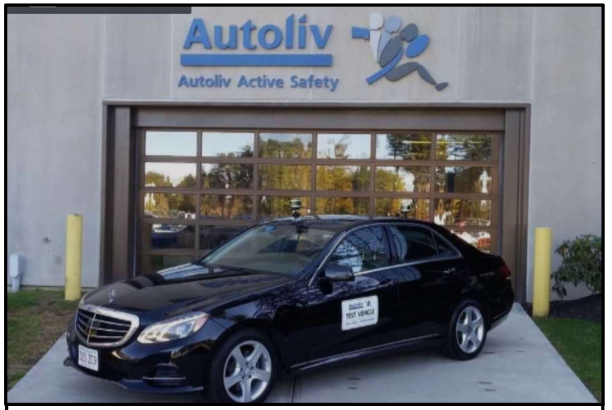
NASA Develops Warning System for Detecting Forest Disturbances



Beth Israel Medical Center Improves MRI Accuracy

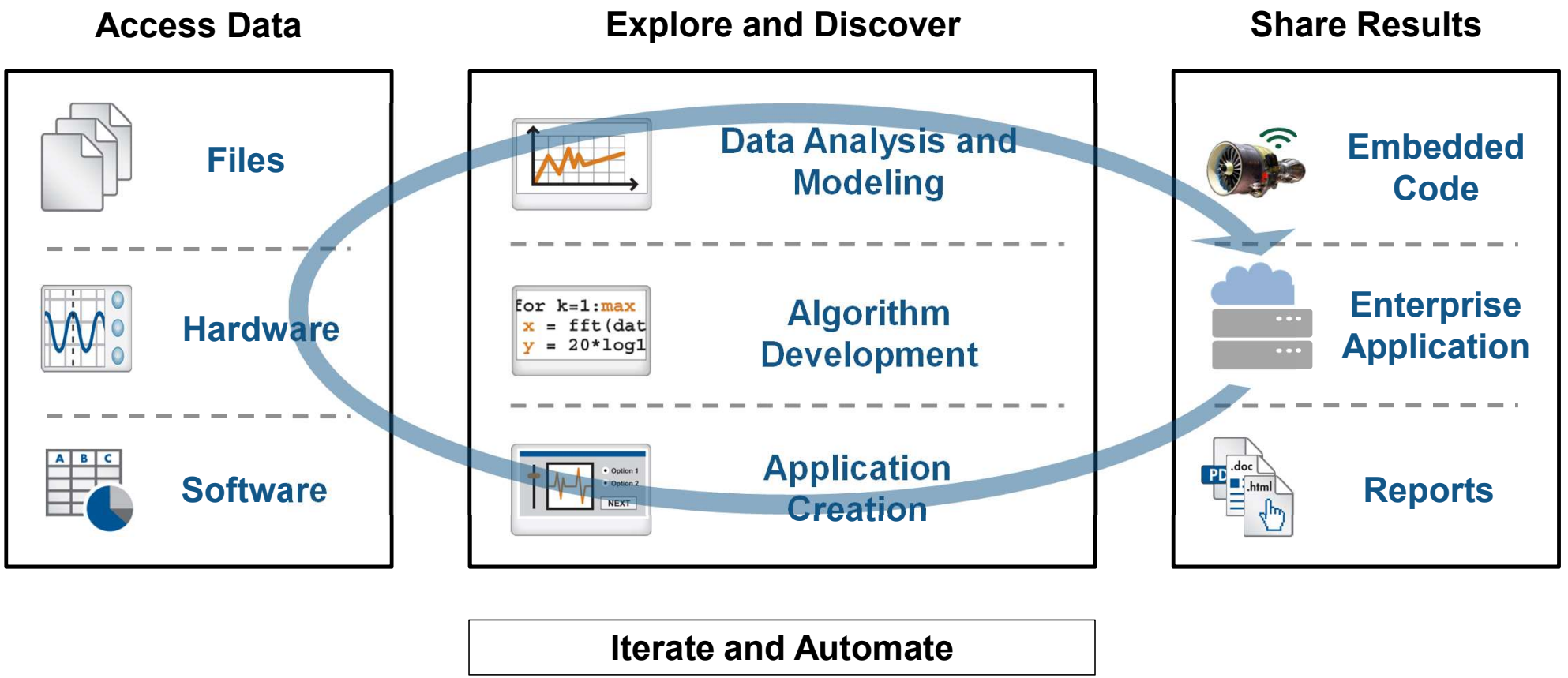
CNH Develops Intelligent Filling System for Forage Harvesters

FLIR Accelerates Development of Thermal Imaging FPGA



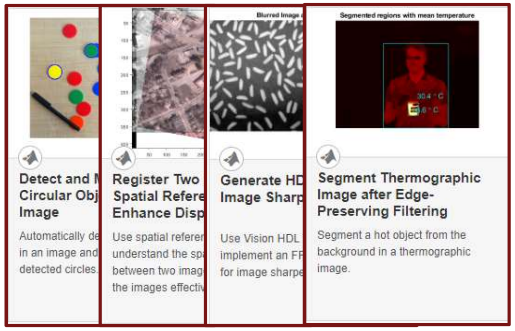
Veoneer (Autoliv) Builds Radar Sensor using LiDAR-Based Verification

Image Processing Workflow



Why Use MATLAB?

Ease of Use and Thorough Documentation



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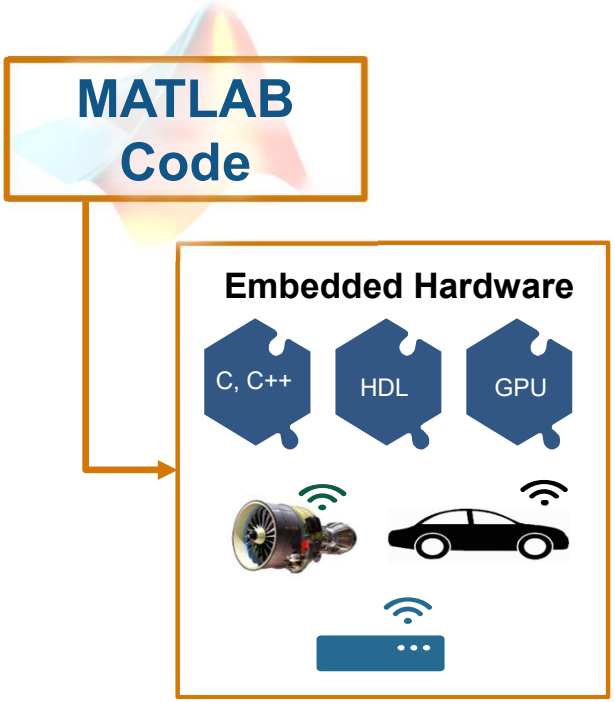
Rapid Prototyping and Algorithm Development

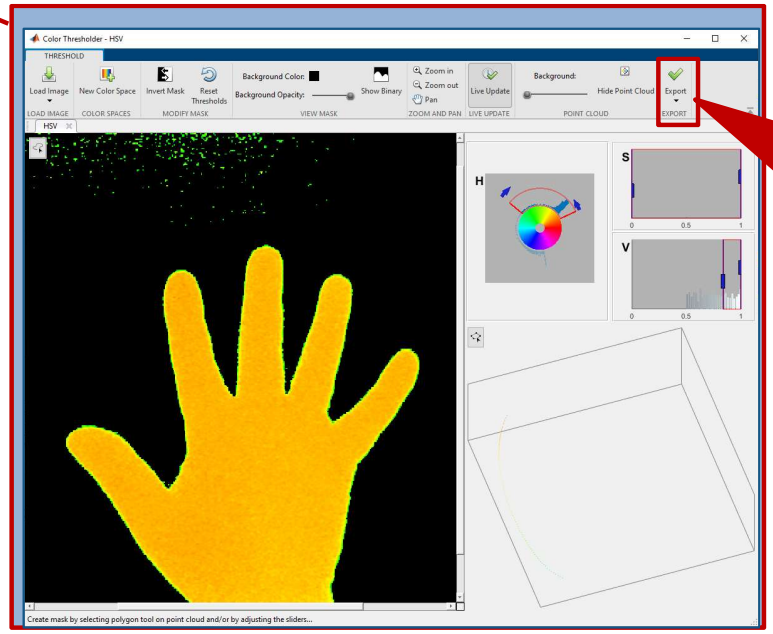
Code Generation for Embedded Deployment



Need Technical Help?

- Technical Support
- Application Engineers

Apps Accelerate Workflows



Color Thresholder App

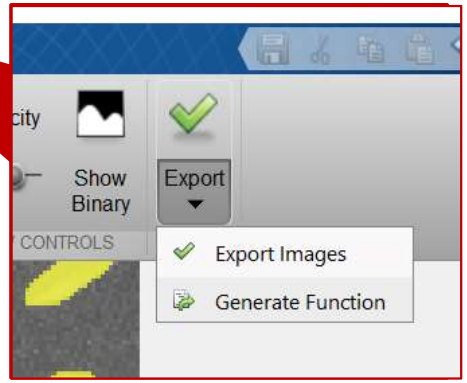
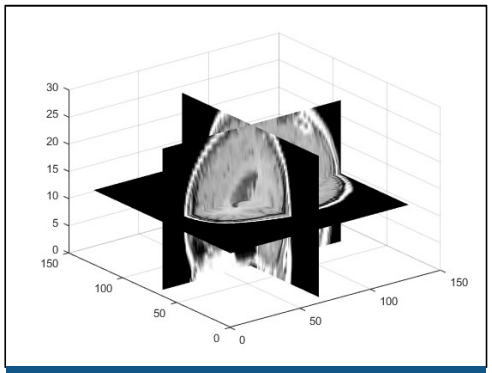


Image Processing Toolbox & Computer Vision Toolbox

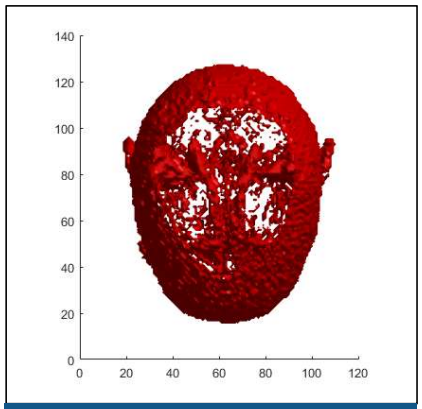
Import, Display, and Exploration	Camera Calibration and 3D-Vision
Geometric Transform and Image Registration	Tracking and Motion Estimation
Image Filtering and Enhancement	Feature Detection and Extraction
Image Segmentation and Analysis	LiDAR and Point Cloud Processing
3D Volumetric Processing	Deep Learning

3-D Image Processing Functions and Apps

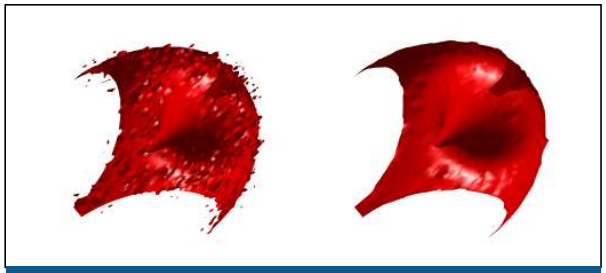
Over 65 functions supported for 3-D volumetric data



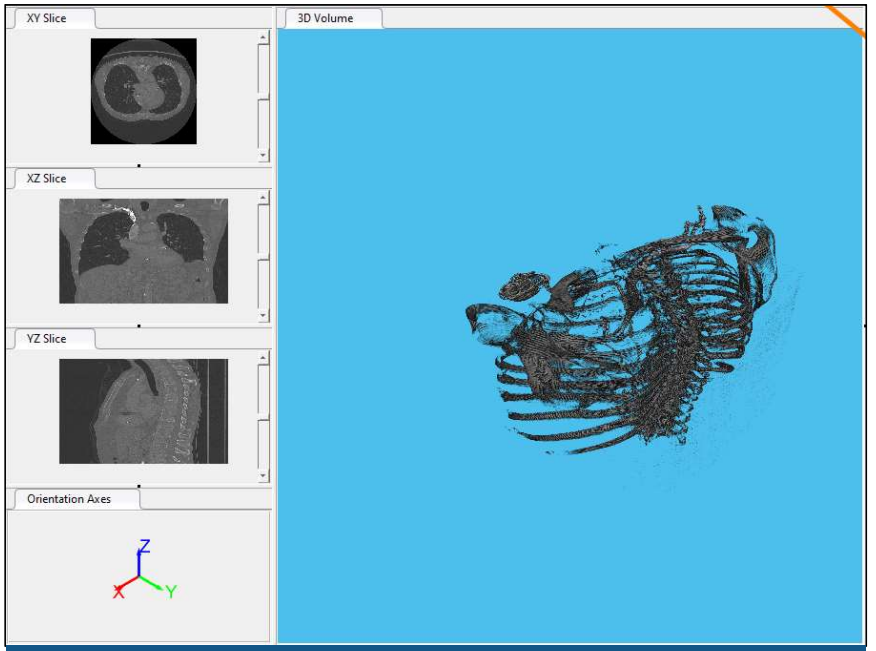
imresize3, imrotate3



activecontour



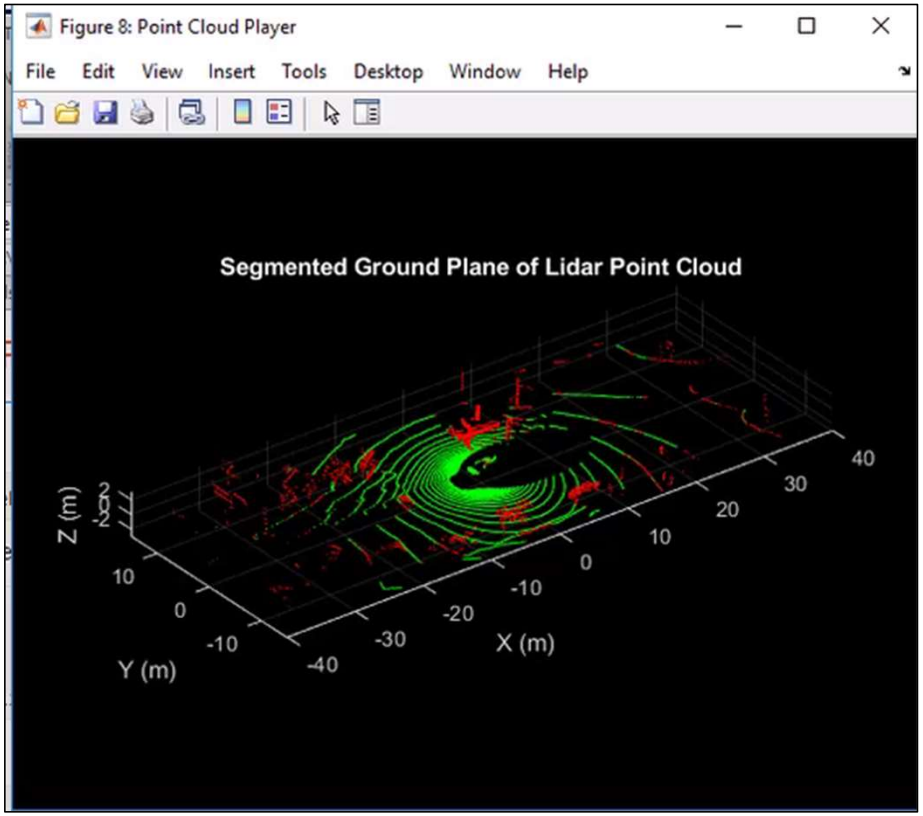
medfilt3



Volume Viewer App

Example: Segment Lungs from 3-D Chest Scan

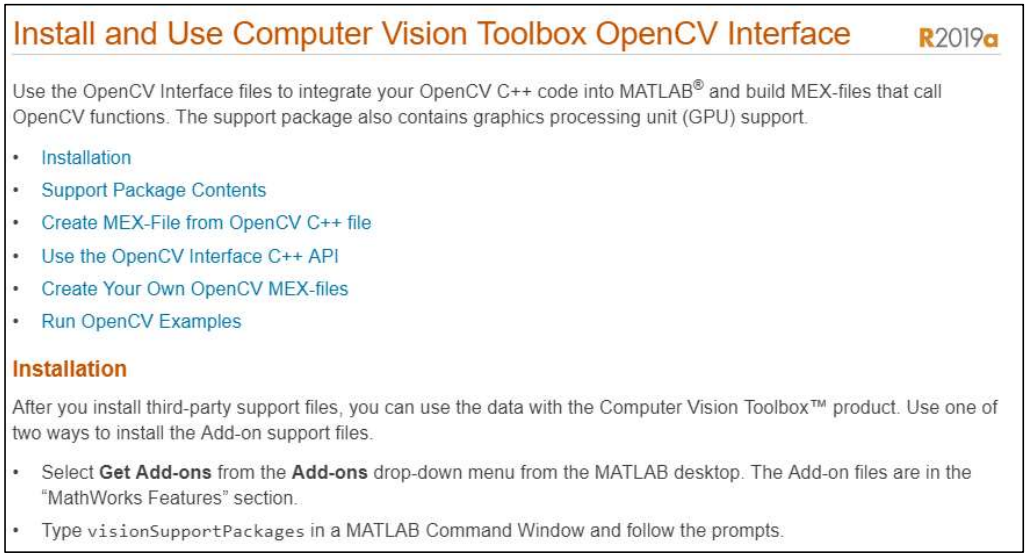
Lidar and Point Cloud Processing



Example: Track Vehicles Using Lidar: From Point Cloud to Track List

OpenCV Interface

- Bring OpenCV C/C++ code into MATLAB using MEX
- Ships with OpenCV-binaries (v3.4.0 as of 2018b)
- Large library of data type conversions
- Several examples to help get started



Install and Use Computer Vision Toolbox OpenCV Interface R2019a

Use the OpenCV Interface files to integrate your OpenCV C++ code into MATLAB® and build MEX-files that call OpenCV functions. The support package also contains graphics processing unit (GPU) support.

- Installation
- Support Package Contents
- Create MEX-File from OpenCV C++ file
- Use the OpenCV Interface C++ API
- Create Your Own OpenCV MEX-files
- Run OpenCV Examples

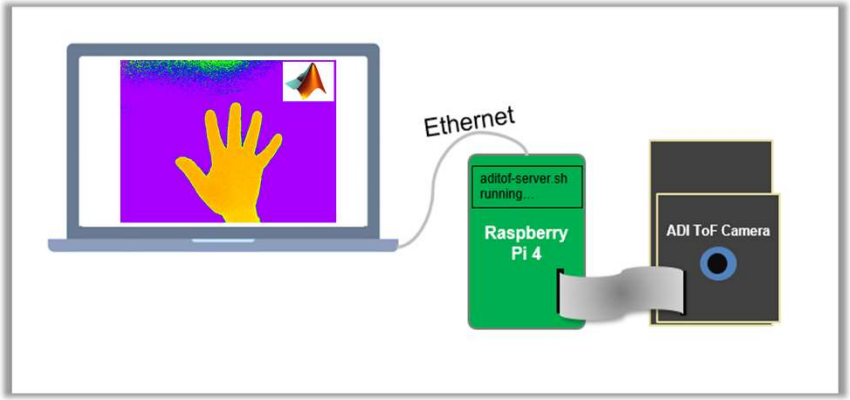
Installation

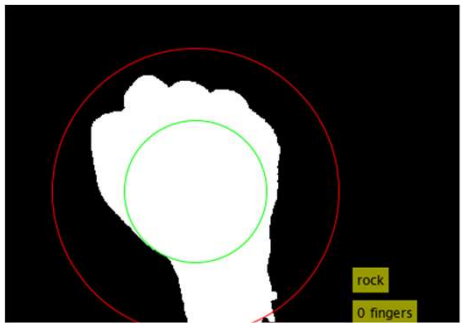
After you install third-party support files, you can use the data with the Computer Vision Toolbox™ product. Use one of two ways to install the Add-on support files.

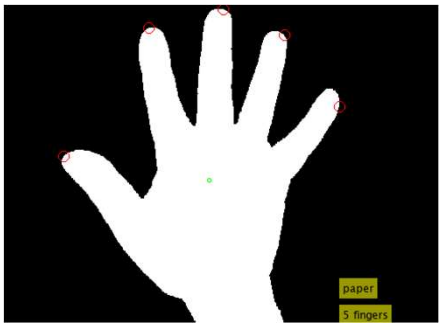
- Select **Get Add-ons** from the **Add-ons** drop-down menu from the MATLAB desktop. The Add-on files are in the "MathWorks Features" section.
- Type `visionSupportPackages` in a MATLAB Command Window and follow the prompts.

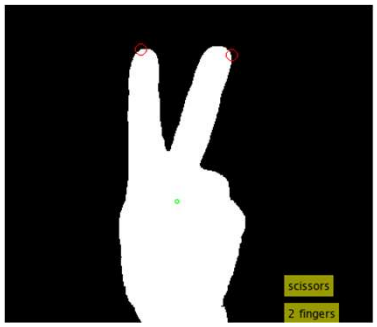
MATLAB with ADI ToF Camera

- ToF Camera makes it easy to find the hand
- MATLAB is used to figure out hand signal
- **Demo**: Rock, Paper, Scissors



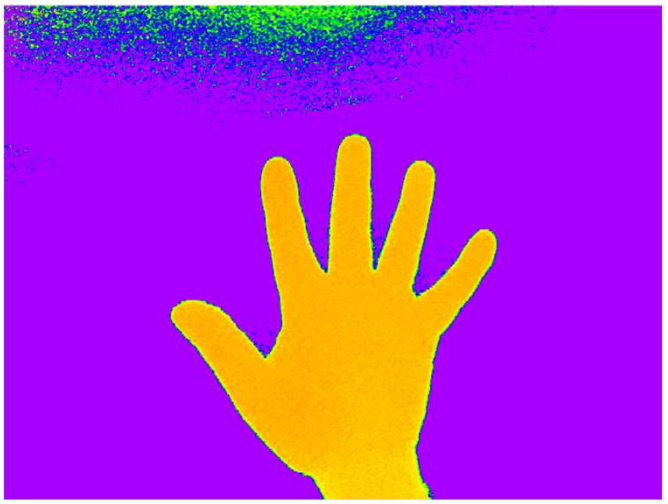






NOTE: Additional toolboxes required are Image Processing, Computer Vision, and Image Acquisition

Step 1 – Detect the hand



- Grab image from camera

```
depthMap = getsnapshot(depthVid);
```

- Convert to HSV color space, threshold, and clean up edges

```
hsv = rgb2hsv(depthMap);
BW = hsv(:,:,1) <= 0.25;
BW = imopen(BW,strel('disk',3));
BW = imfill(BW,'holes');
```

Step 2 – Measure hand, determine if fingers are extended

- Determine hand area, centroid, and convex hull
  - Convex hull allows us to find the fingers

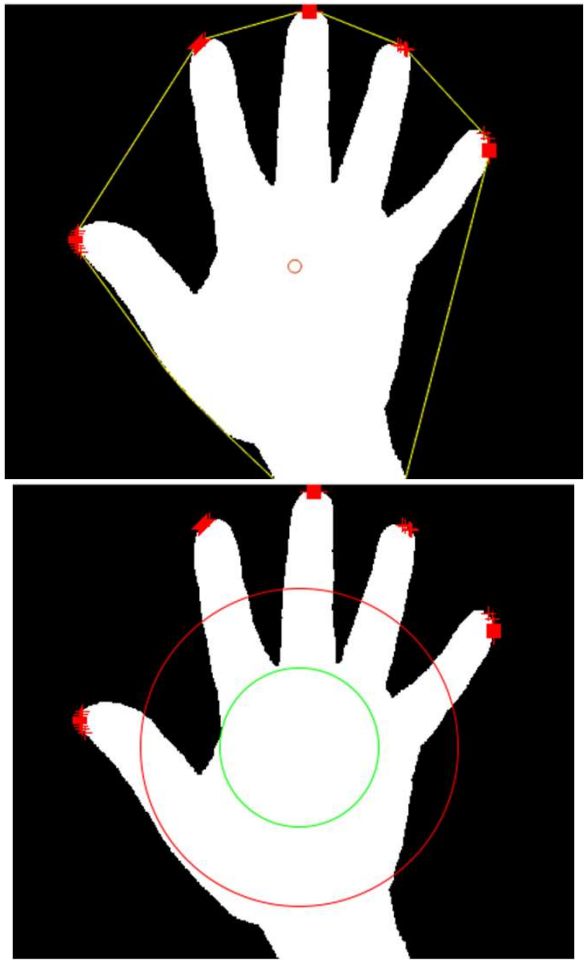
```
blobs = regionprops(BW,'Area','Centroid','ConvexHull');
```

- Determine if fingers are extended
  - Distance transform helps us estimate radius (green line)

```
bwd = bwdist(~BW);
radius = bwd(round(c(2)), round(c(1)));
```

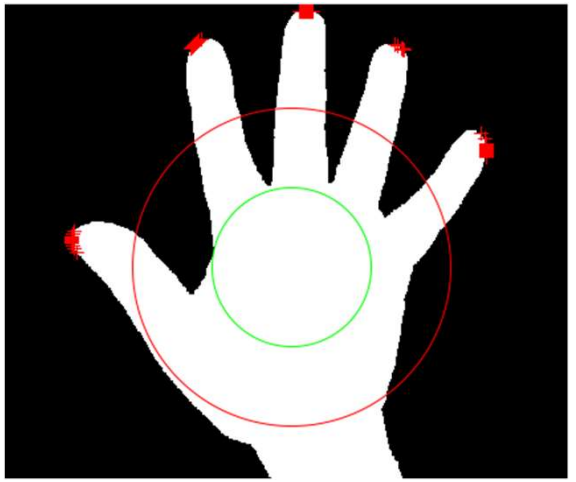
  - Sub-select for the points outside 2*radius estimate (red line)

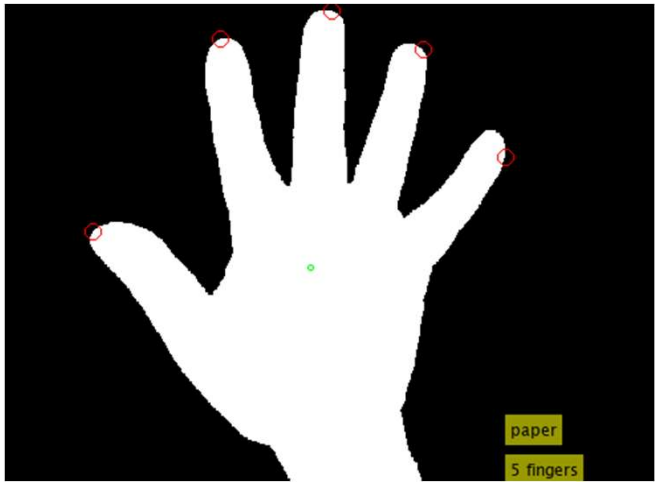
```
d = sqrt((x-c(1)).^2+(y-c(2)).^2);
x((d - 2*radius)<0) = 0;
y((d - 2*radius)<0) = 0;
```



Step 3 – Count the number of fingers

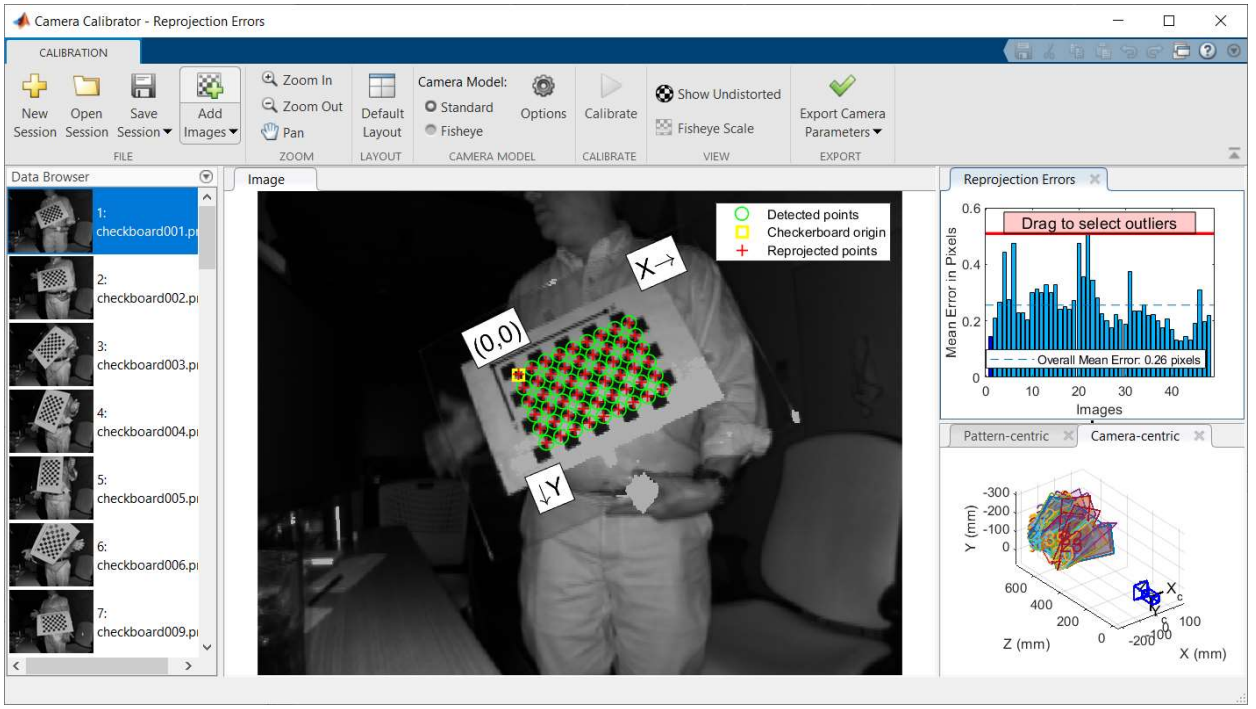
- Eliminate points within 10 pixels of each other
- If no fingers, then it's "rock"
- If 1 finger, then it's "unclassified"
- If 2 fingers, then it's "scissors"
- If 3-5 fingers, then it's "paper"





Accelerate Calibration Workflow with cameraCalibrator

- Steps
  - Use checkboard printout with squares of a known size (29mm in this case)
  - Load into Camera Calibrator app
  - Press the calibration button
  - Inspect results



Next Steps

- Use executable provided to try it yourself
- Download the code
- Evaluate MATLAB, Image Processing Toolbox, Computer Vision Toolbox, and Image Acquisition Toolbox