

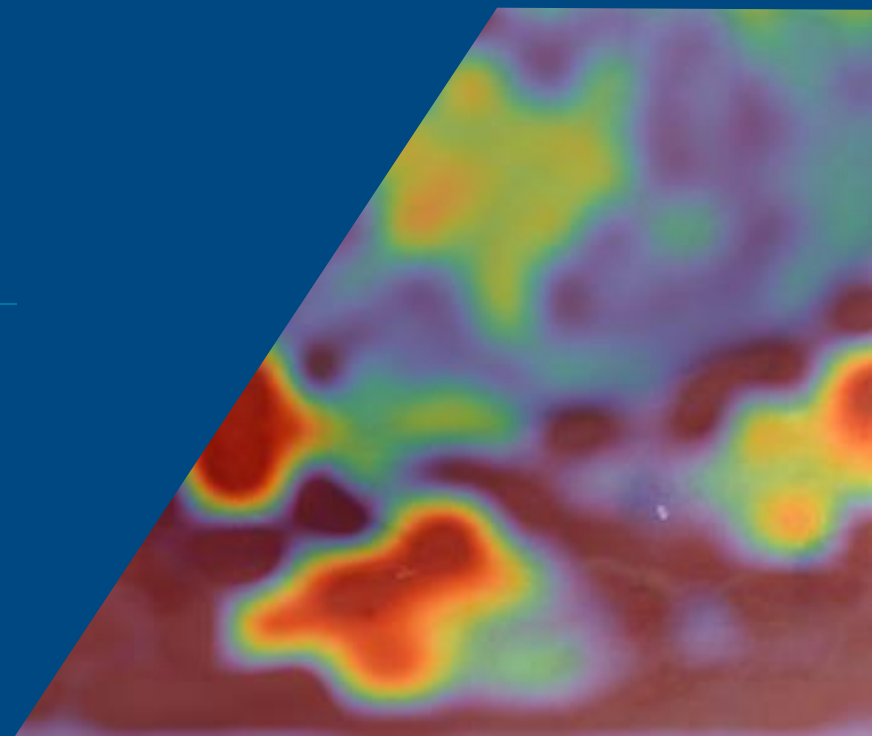


Extracting Features and Classifying Anomalies

Using Computer Vision and Machine Learning

Paul Huxel, PhD

Senior Application Engineer
MathWorks



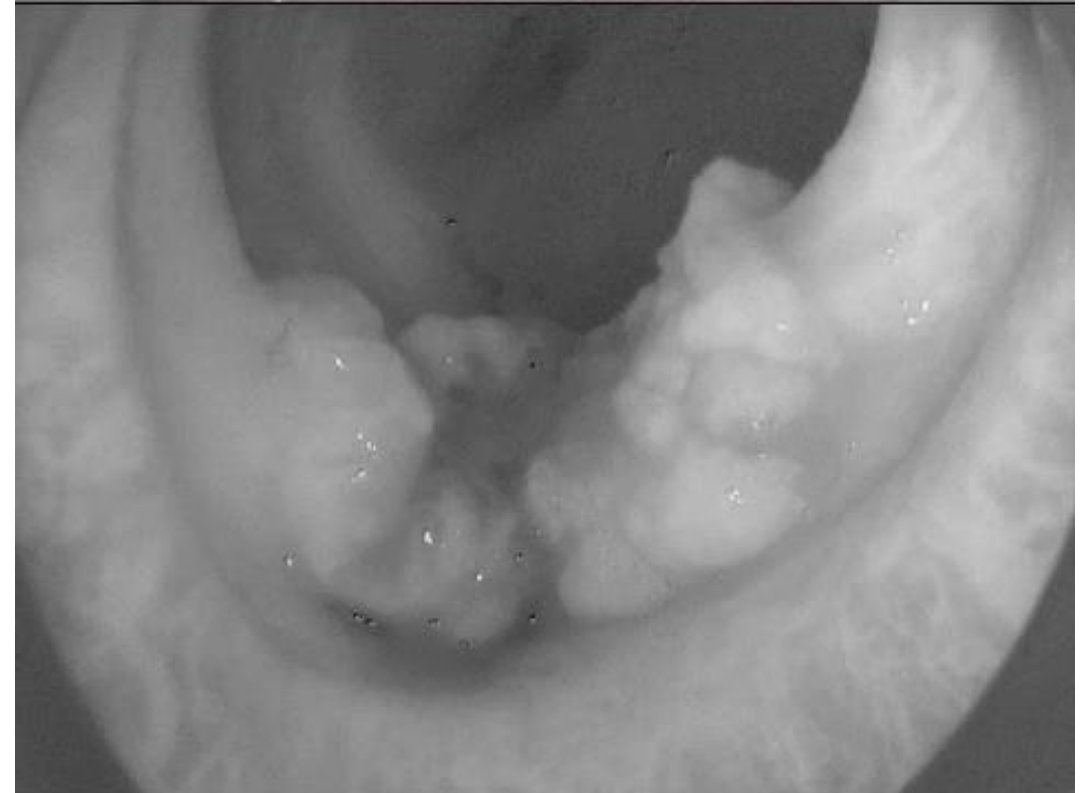
Fluorescence Guided Surgery

Endoscopic Imaging System

White-Light



Near-Infrared



University College Dublin Centre for Precision Surgery

Goal: Use fluorescence time histories to assess tissue health

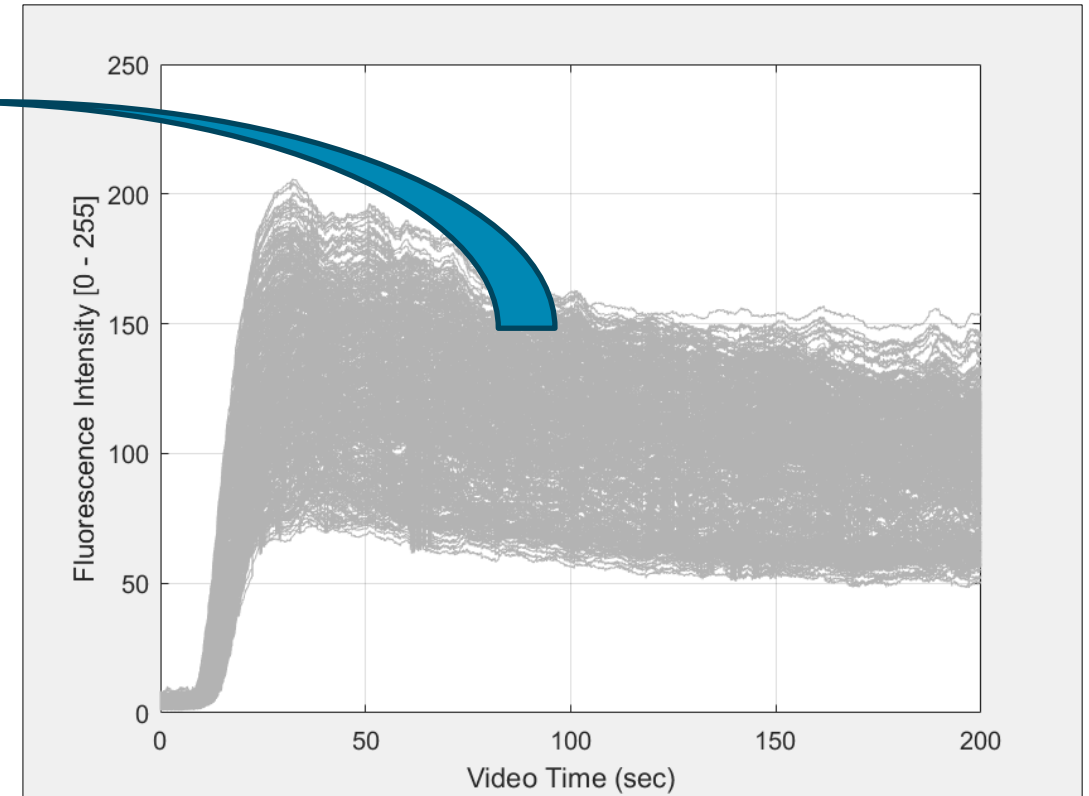
Prediction Heatmap



Cancer

Negative

Fluorescence Time Histories

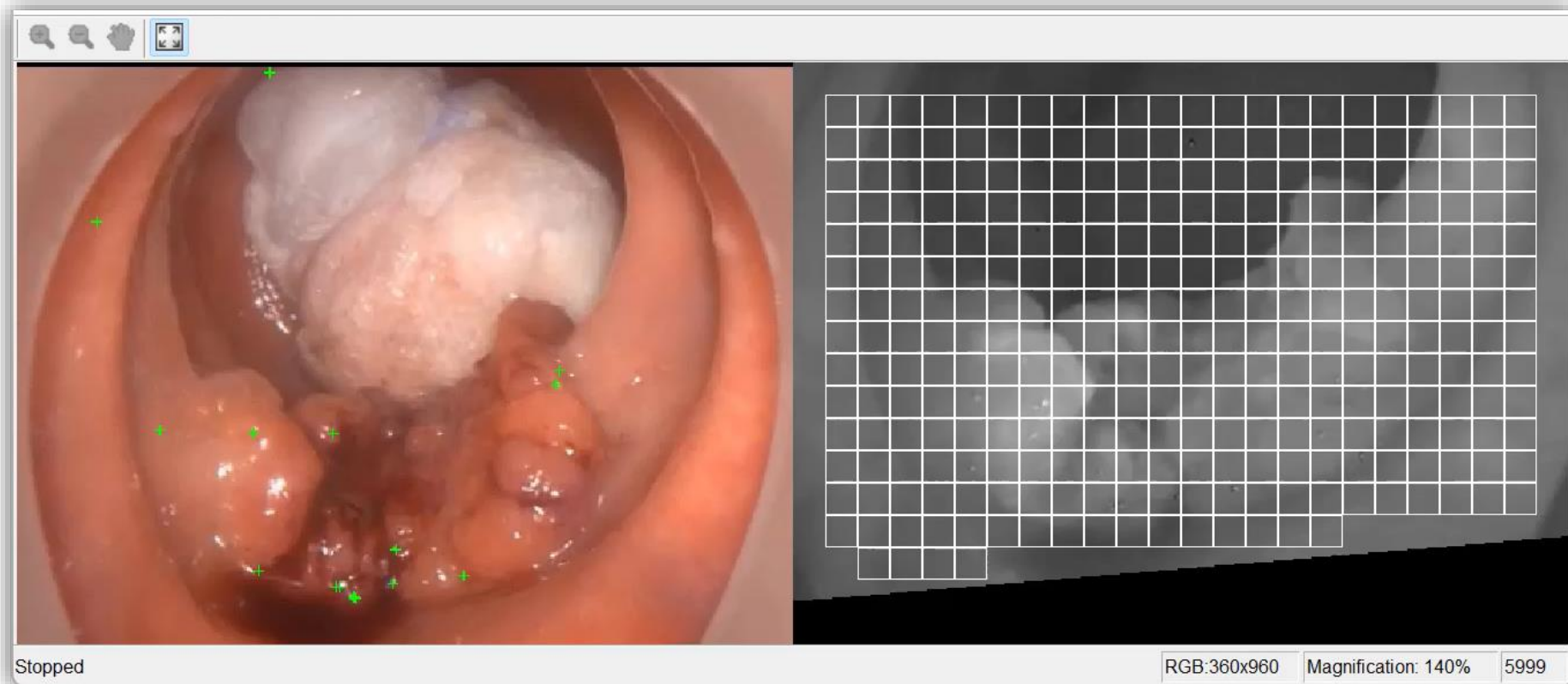


Extracting Features using Computer Vision

Agenda and Workflow (Part 1)

White-Light (tracking)

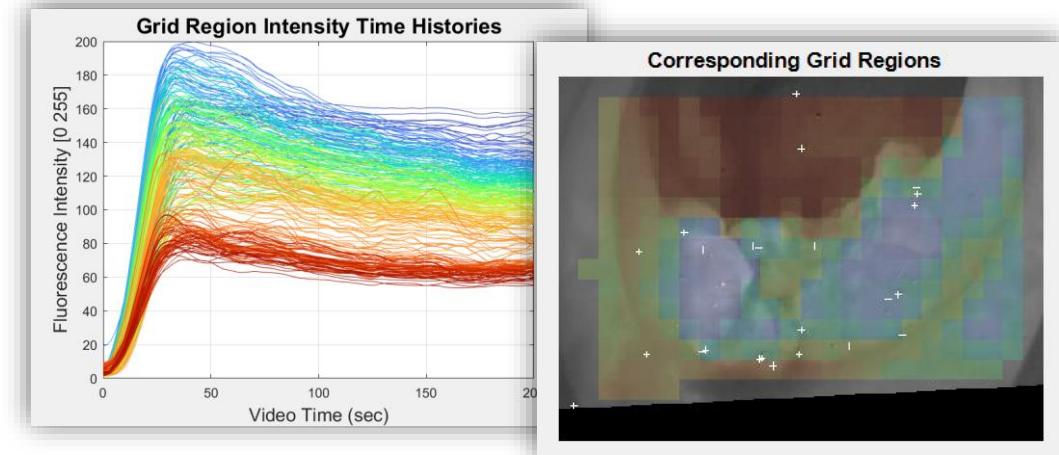
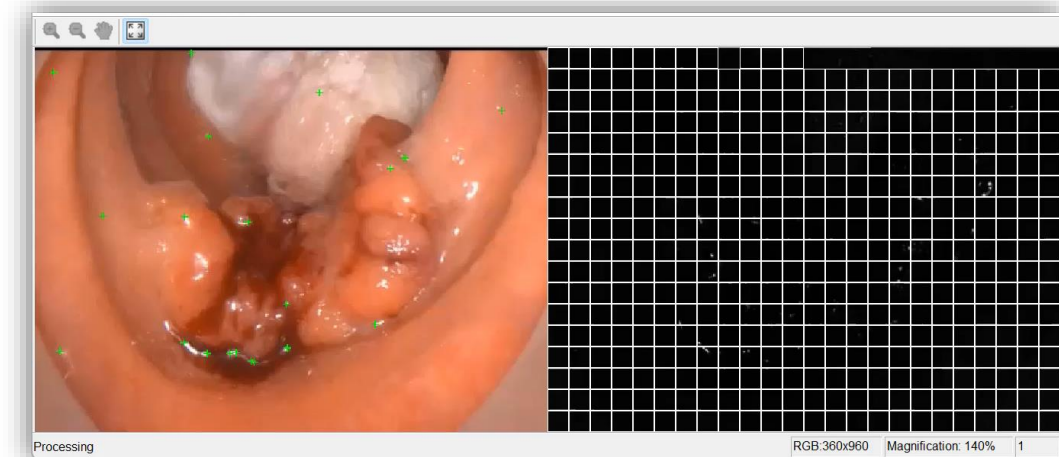
Near-Infrared (registered)



Extracting Features using Computer Vision

Agenda and Workflow (Part 1)

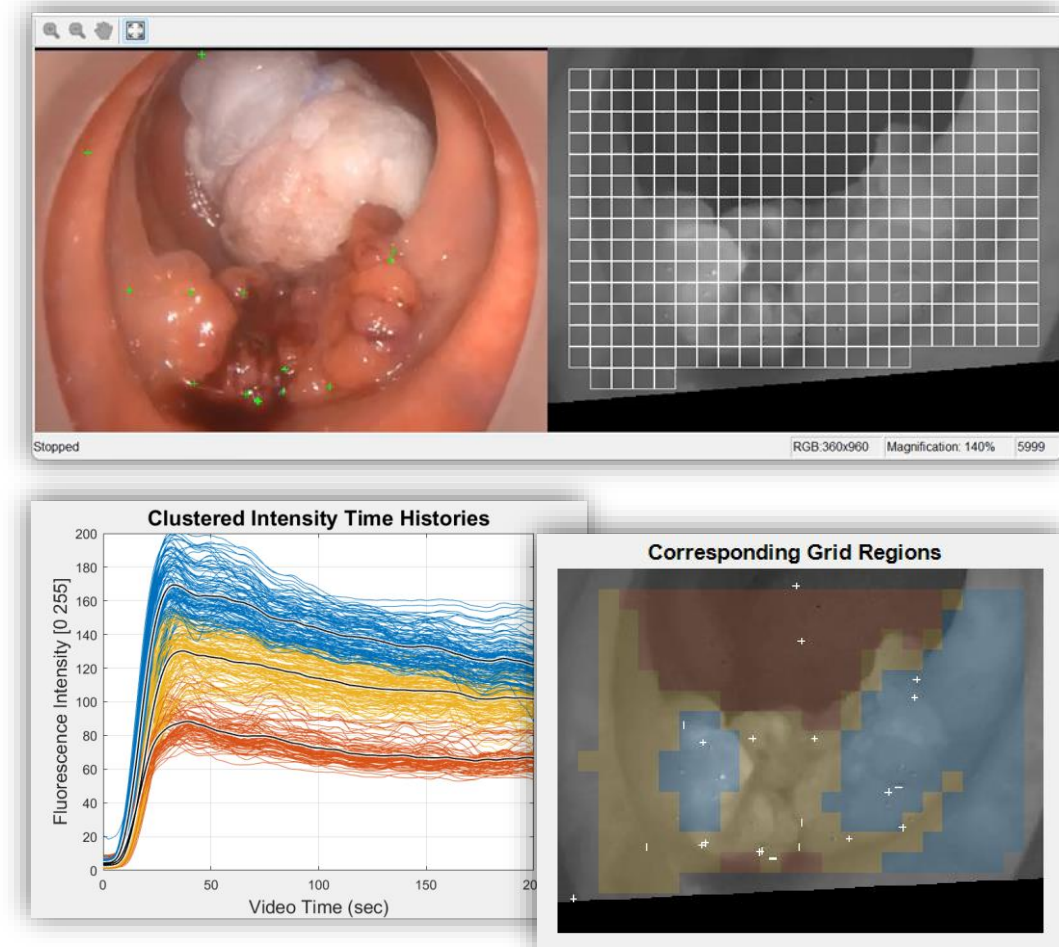
- 1) Detect and track feature points in a video
- 2) Compute transformation using tracked points
- 3) Warp video frame to align with initial frame
- 4) Compute mean grid region intensity using 2-D convolution and leveraging GPU Computing



Extracting Features using Computer Vision

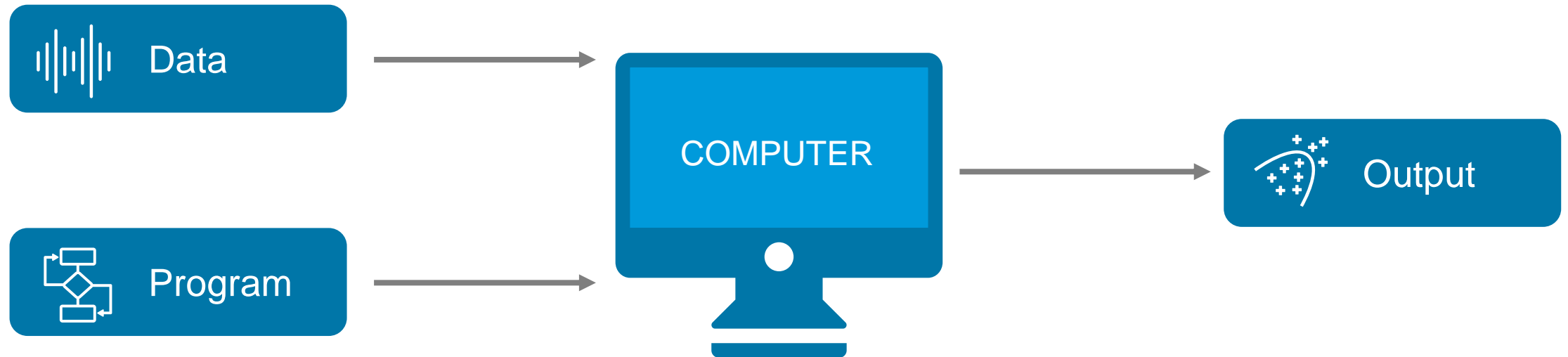
Agenda and Workflow (Part 1)

- 1) Detect and track feature points in a video
- 2) Compute transformation using tracked points
- 3) Warp video frame to align with initial frame
- 4) Compute mean grid region intensity using 2-D convolution and leveraging GPU Computing
- 5) Cluster intensity time histories into groups (*unsupervised* machine learning)



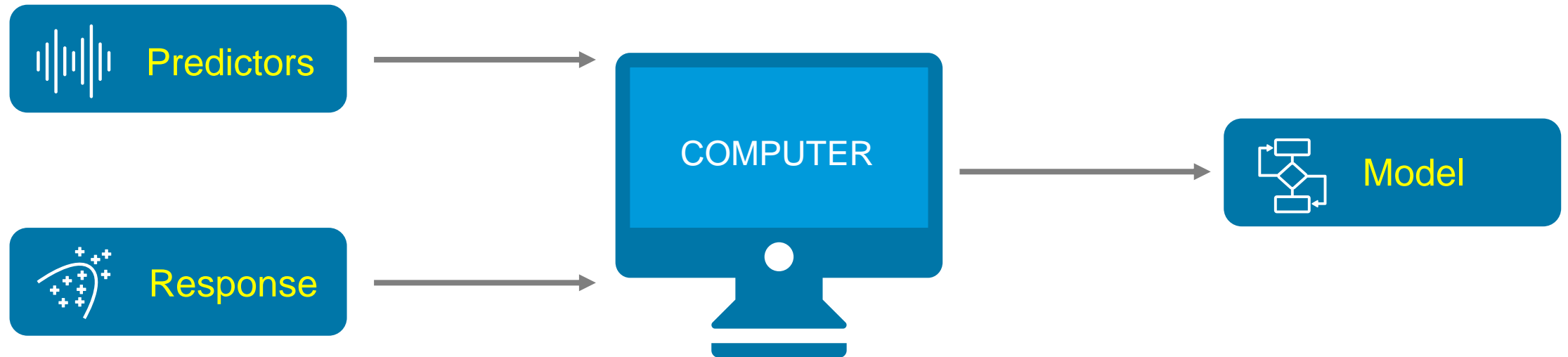
Traditional Programming vs. Machine Learning

Traditional Programming



Traditional Programming vs. Machine Learning

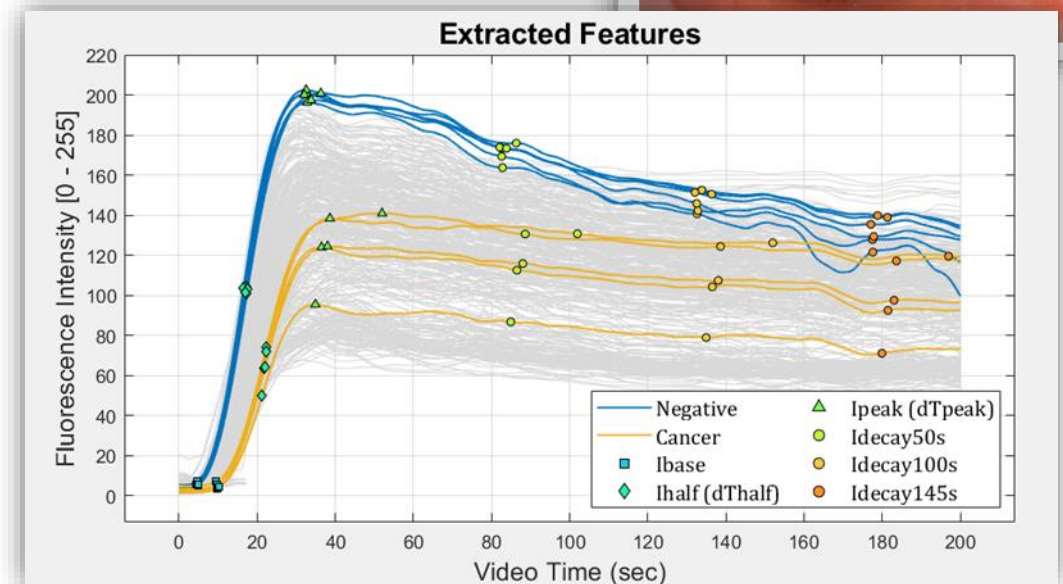
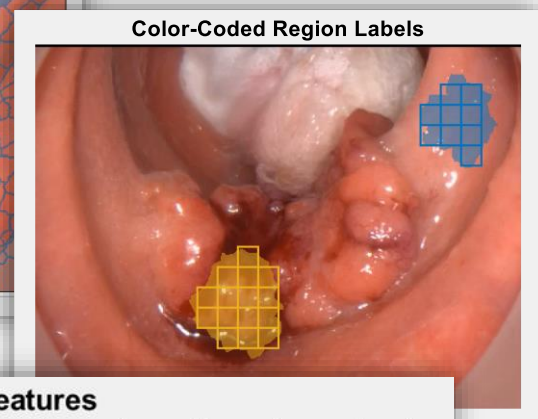
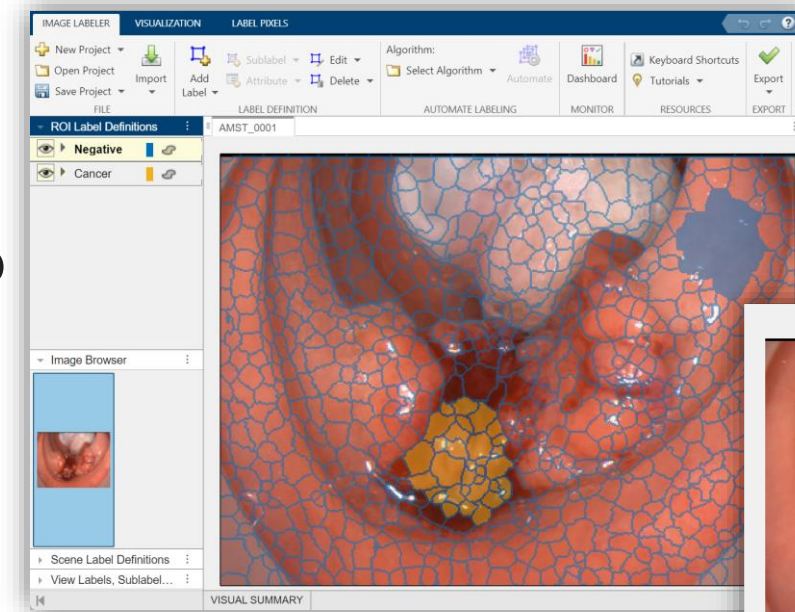
Supervised Learning



Classifying Anomalies using Machine Learning

Agenda and Workflow (Part 2)

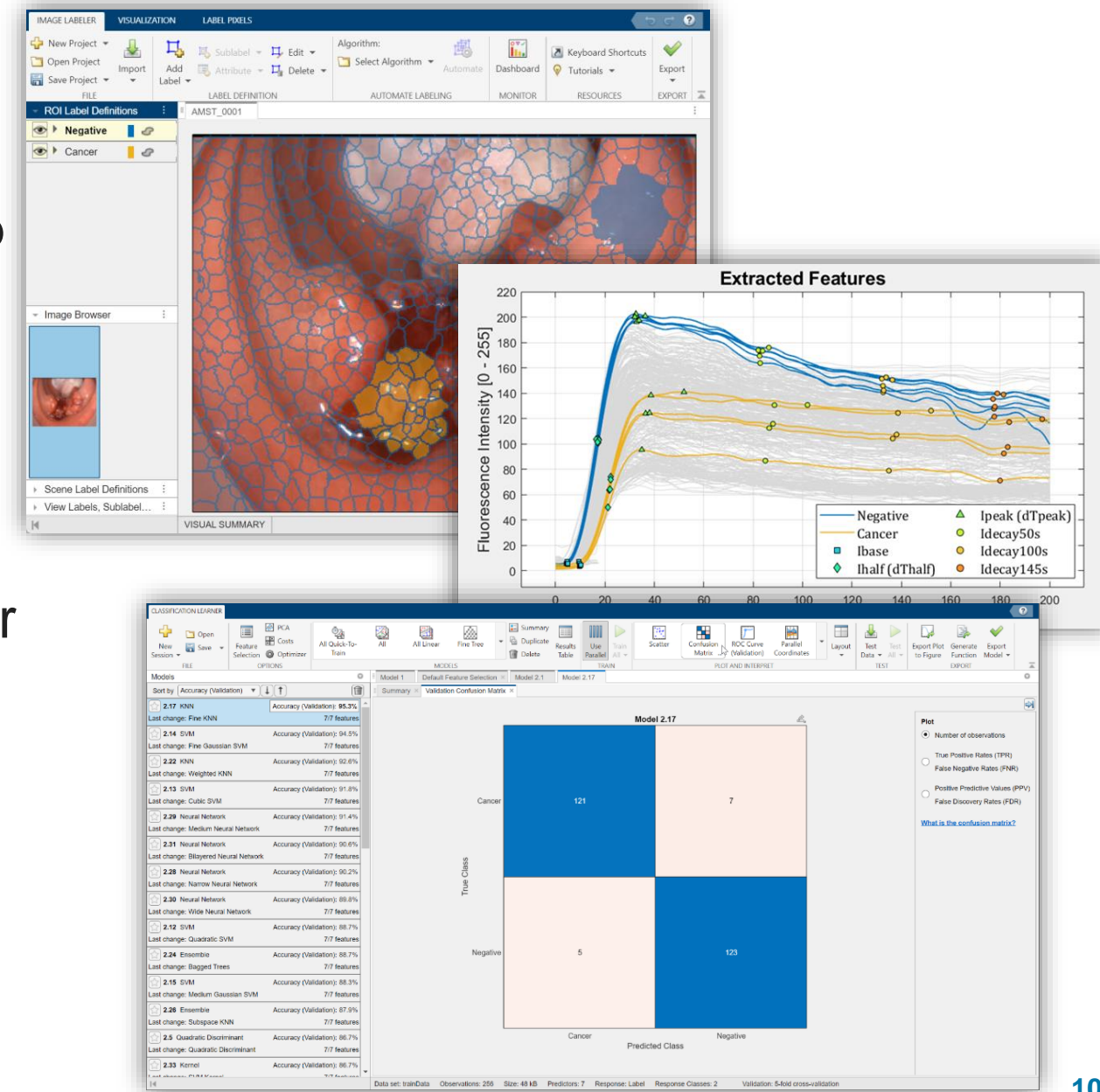
- 6) Label regions using Image Labeler app
- 7) Extract features from time histories, such as time to peak & decay values



Classifying Anomalies using Machine Learning

Agenda and Workflow (Part 2)

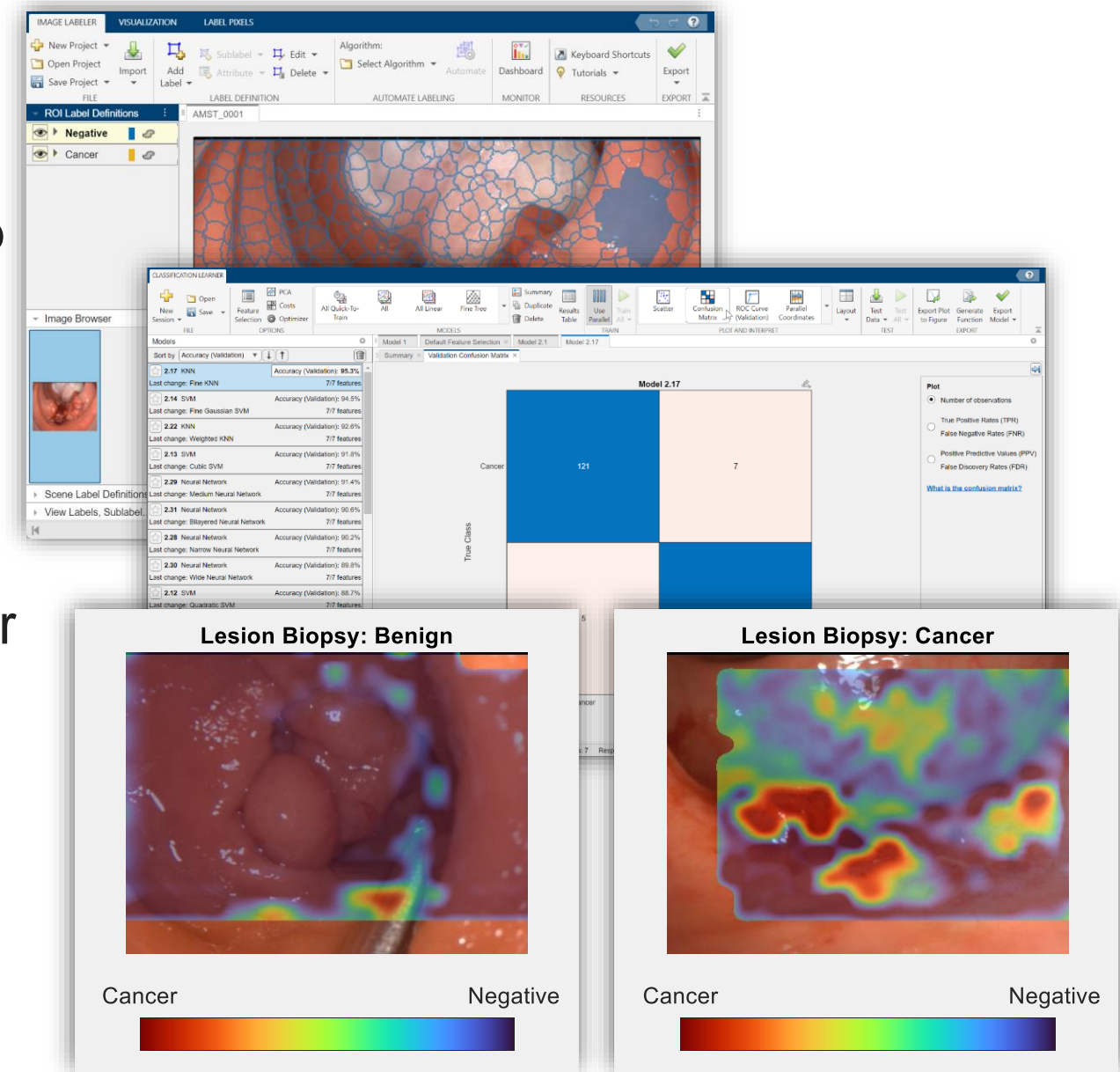
- 6) Label regions using **Image Labeler** app
- 7) Extract features from time histories, such as time to peak & decay values
- 8) Use labeled features to train a classifier using **Classification Learner** app



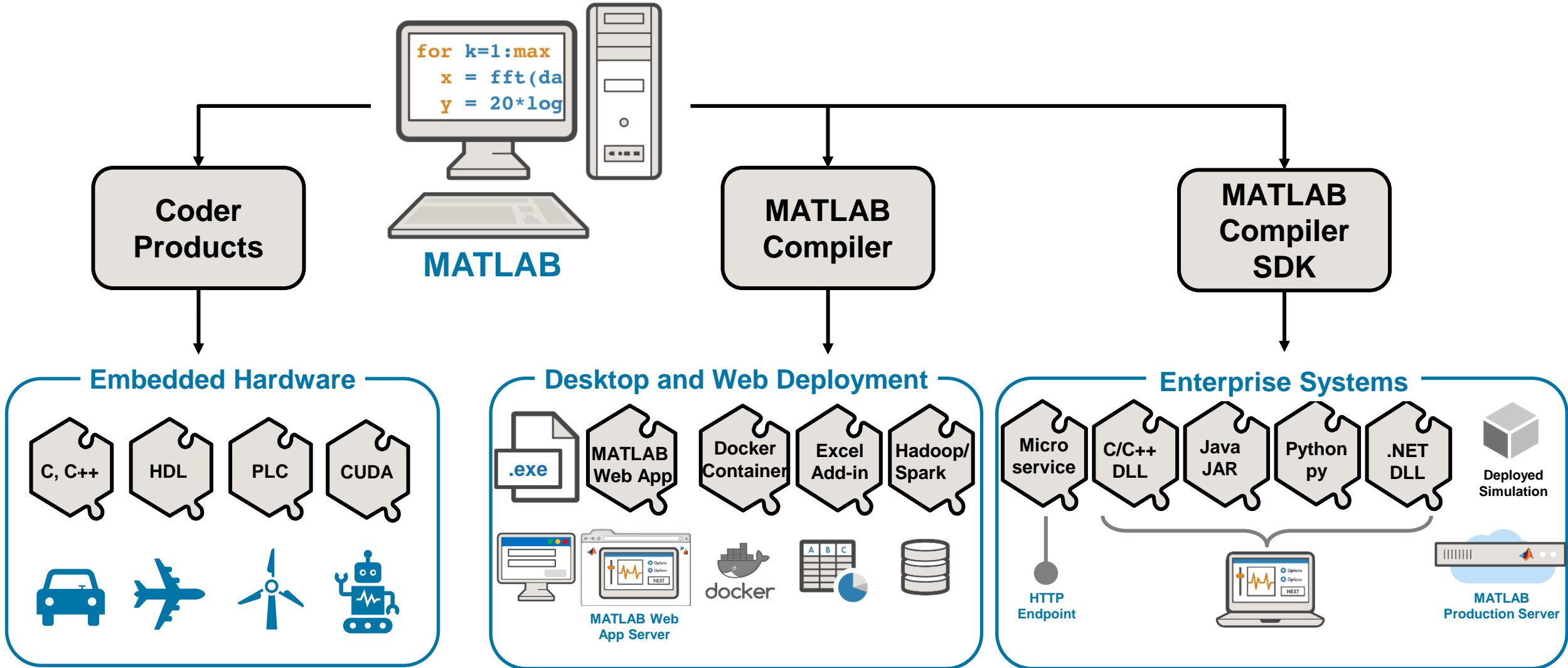
Classifying Anomalies using Machine Learning

Agenda and Workflow (Part 2)

- 6) Label regions using **Image Labeler** app
- 7) Extract features from time histories, such as time to peak & decay values
- 8) Use labeled features to train a classifier using **Classification Learner** app
- 9) Test the classifier using new patient videos to assess its robustness



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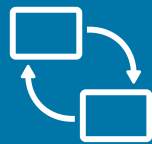
Programming and
App Development



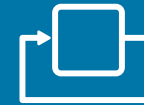
Image Processing
and Computer Vision



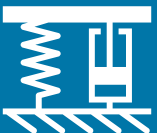
Signal Processing
and Communications



Modeling and
Simulation



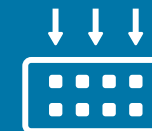
Control and
Algorithm Design



Physical Modeling



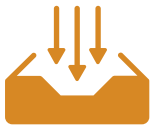
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C Code Generation



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