

# Multi Agent Control and Computer Vision



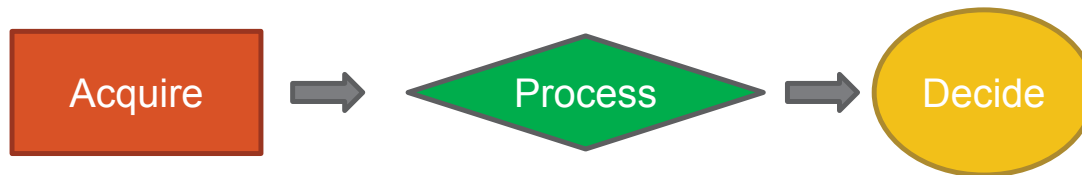
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# INTRODUCTION/BACKGROUND

- **Computer Vision**

- The ability to acquire and process images in order to form a decision



- **Utilizes Supervised Machine Learning**

- An annotated training set is provided to distinguish different objects
- The “process images” component

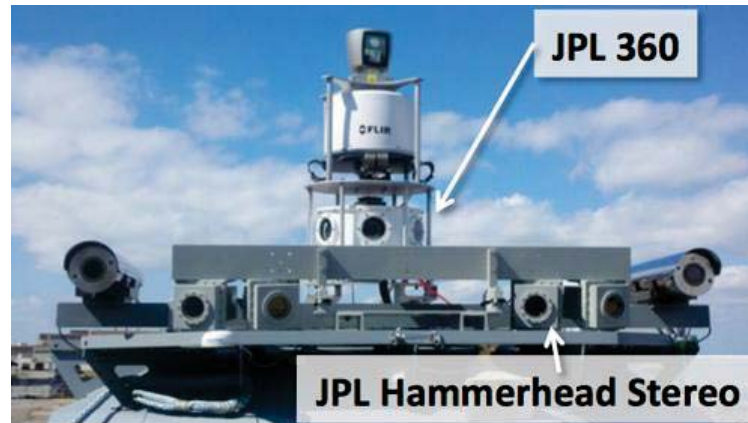
# MOTIVATION

- **Maritime Asset Protection**
  - **24/7 Patrols**
- **Autonomous Shipping Industry**
  - **No Crew = No Piracy**
- **Navigate Hostile Environments**
  - **Search and Rescue**



# USV: ACHIEVING COMPUTER VISION

- **Acquire the Image**
  - Hammerhead Stereo Cameras
  - Comprised of Four Cameras
- **Process the Image**
  - SAVAnT Structure
  - Surface Autonomous Visual Analysis and Tracking (SAVAnT)
- **Form a Decision**
  - CARACaS Structure
  - Control Architecture for Robotic Agent Command and Sensing (CARACaS)

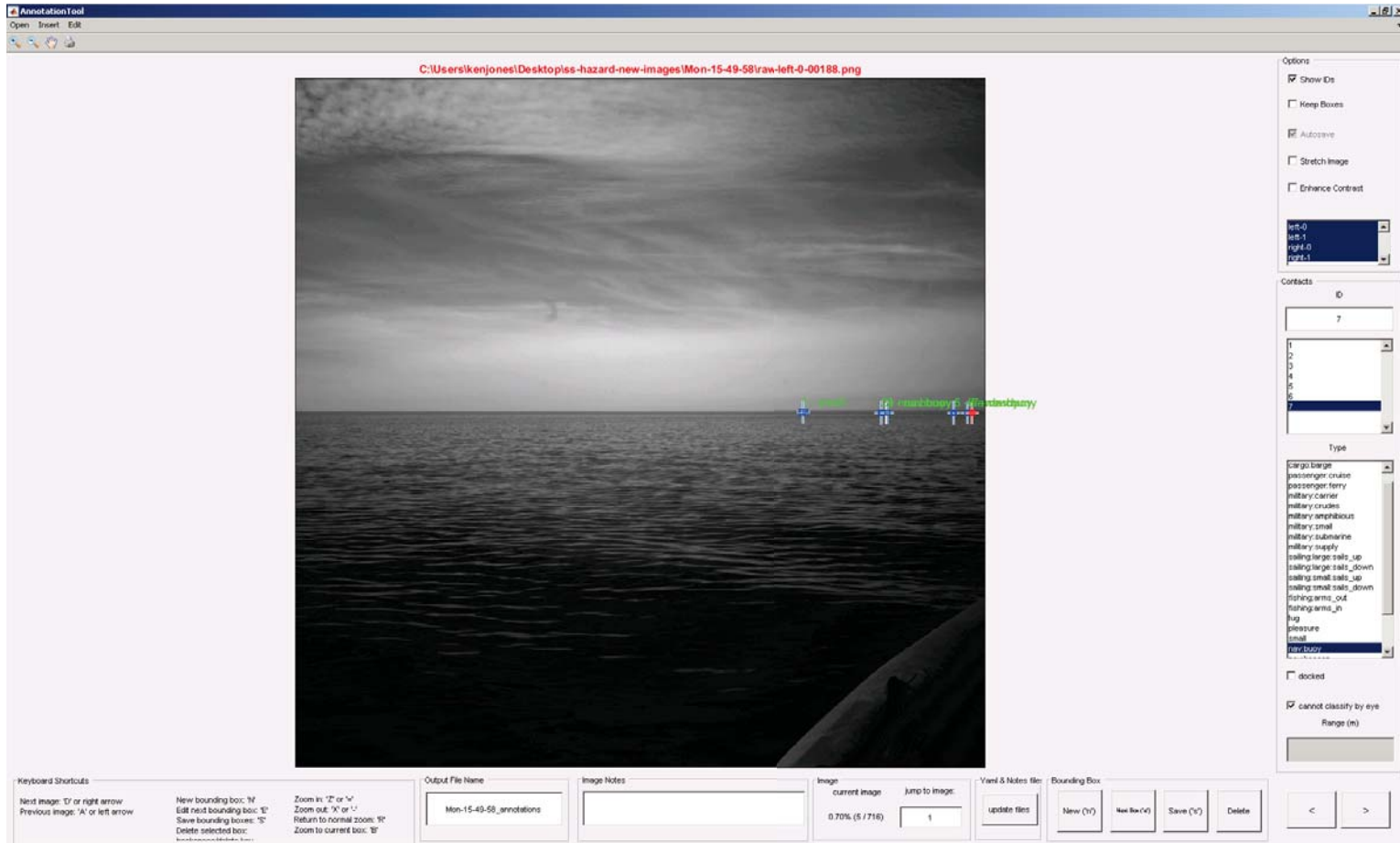


# CREATING A TRAINING SET

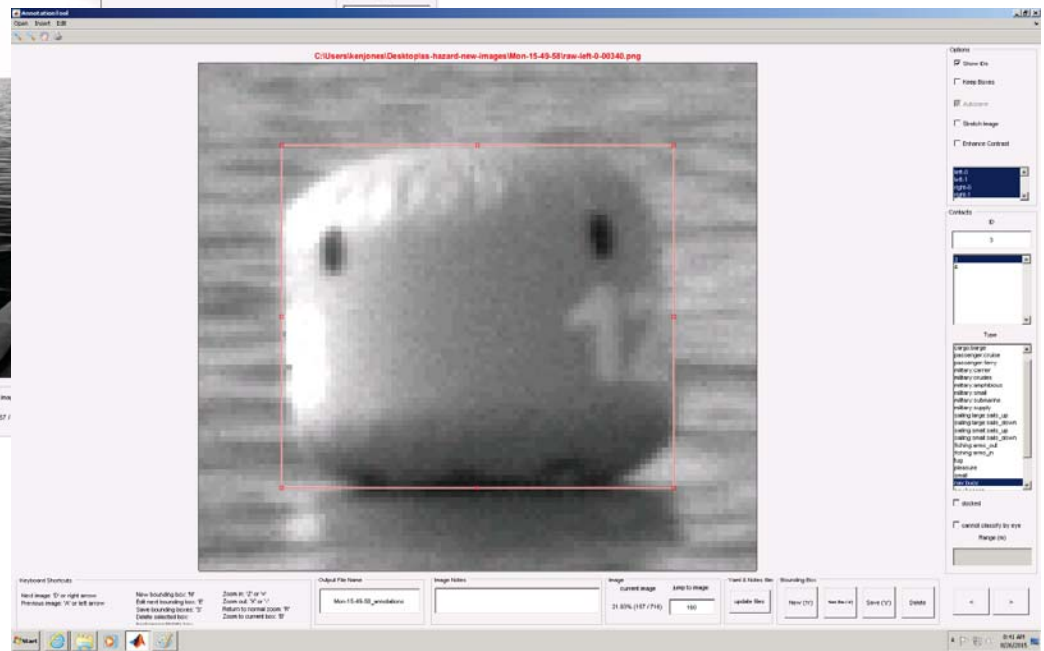
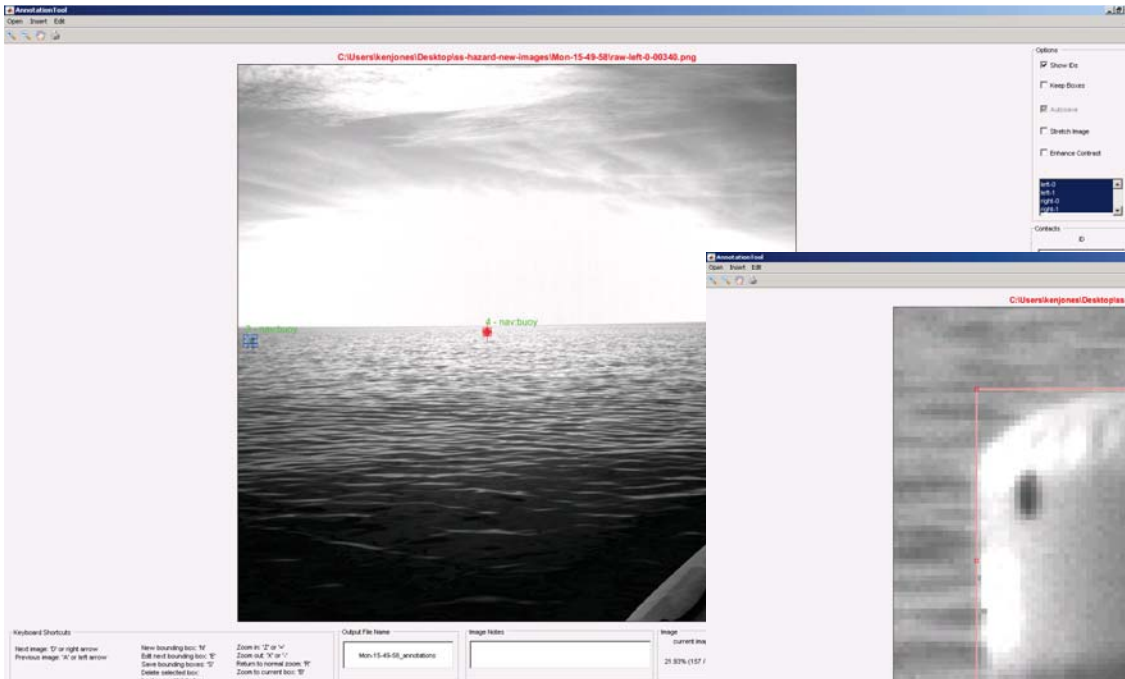
- Images Gathered During an On-the-Water Test
- Annotate Images
  - MATLAB GUI used for Annotation Tool
  - Objects on the water are classified and ID'd
  - Classification provides what the object is
  - IDs keeps track of which object is which



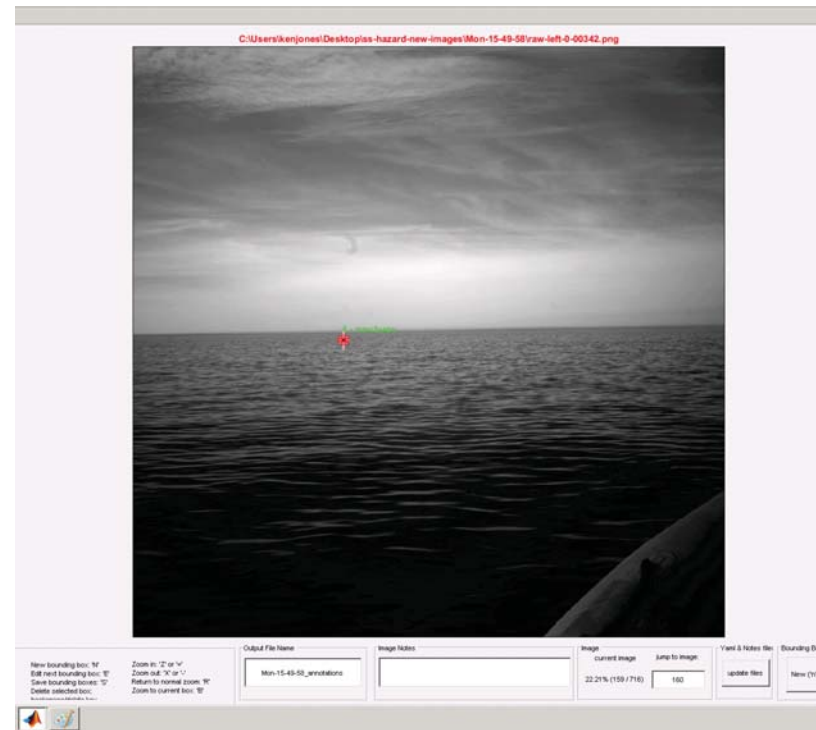
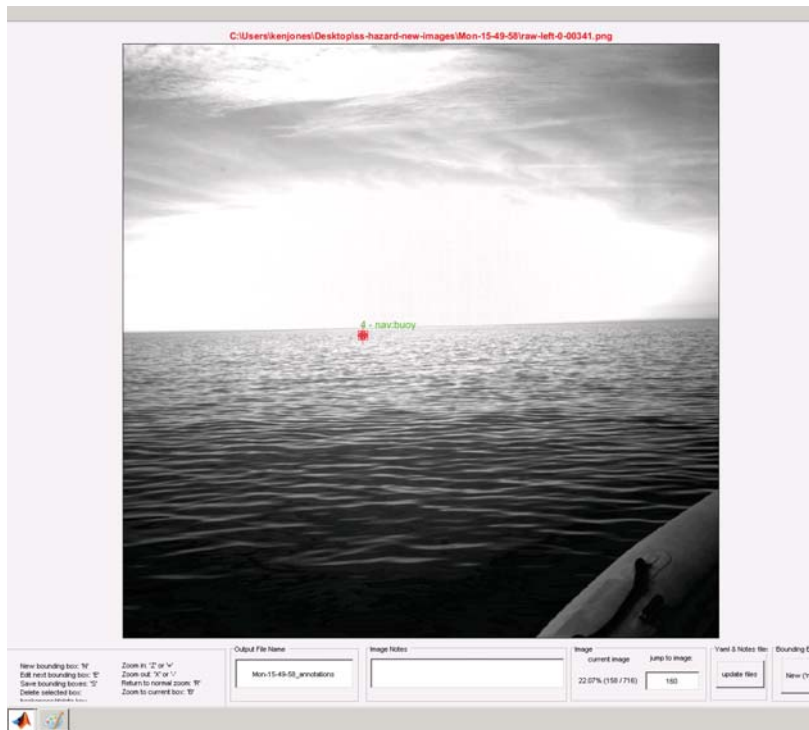
# MATLAB ANNOTATION TOOL



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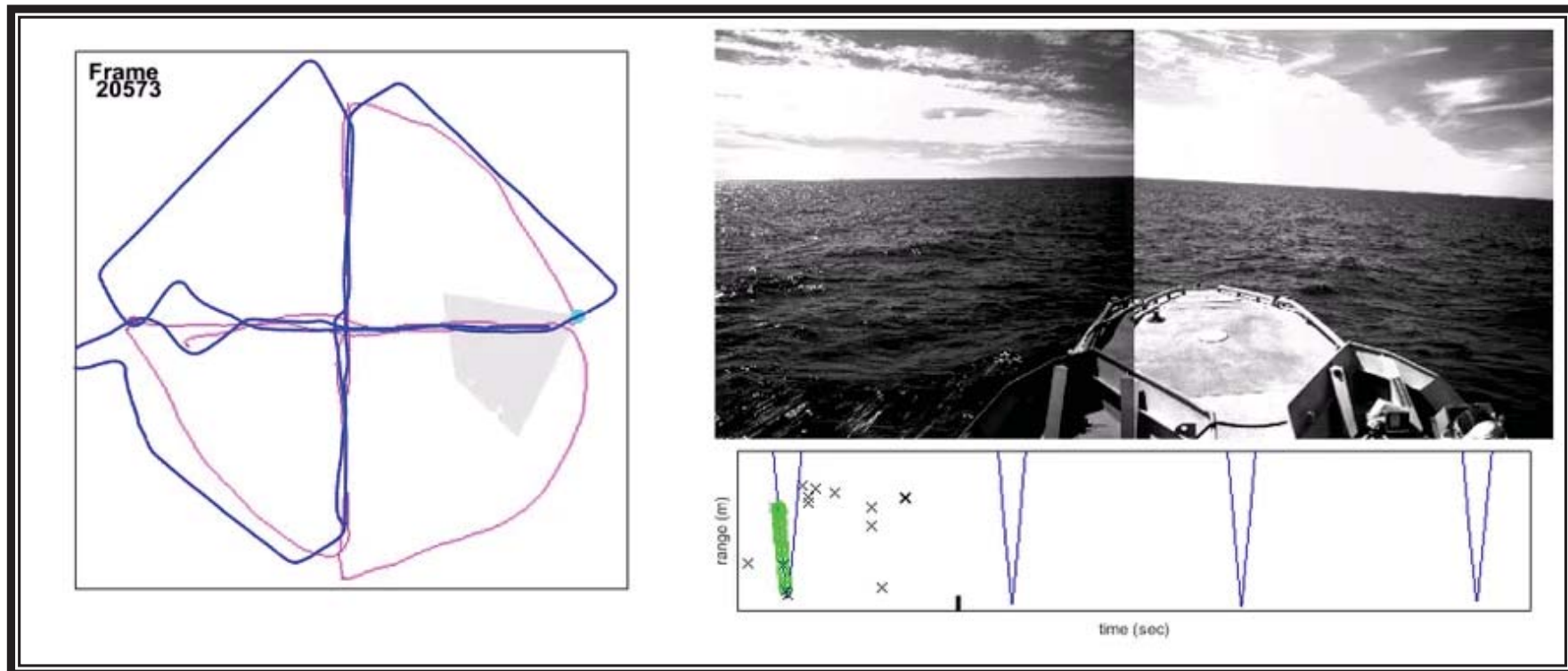
# MATLAB ANNOTATION TOOL



# **DATA ANALYSIS**

- **Processed and Analyzed Data Collected**
  - **Processed data to collect information on range of first contact, bearing, velocity, sun location, etc.**
  - **Process generated a movie that was used to confirm the reaction time of the USV when adhering to COLREGS**
- **COLREGS**
  - **International Regulations for Preventing Collisions at Sea**

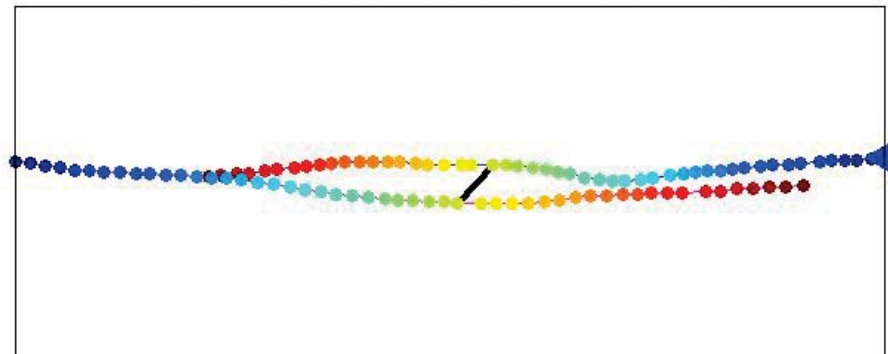
# DATA ANALYSIS MOVIE



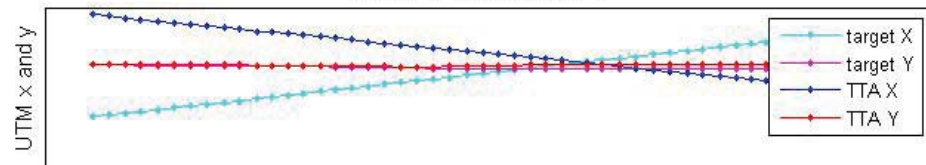
# CLOSER LOOK

- Needs to Deviate more
- Reaction too slow

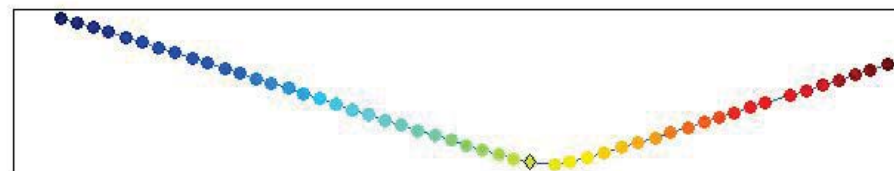
stereo-2015-03-12-Thu-09-19-44 start time 0 frame 13693



TTA GPS vs. Target GPS



CPA = 43



time (sec)

# **FUTURE AND ONWARDS**

- Automate More Algorithms
- Make Codes more client friendly
- Get to work on more intensive code

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