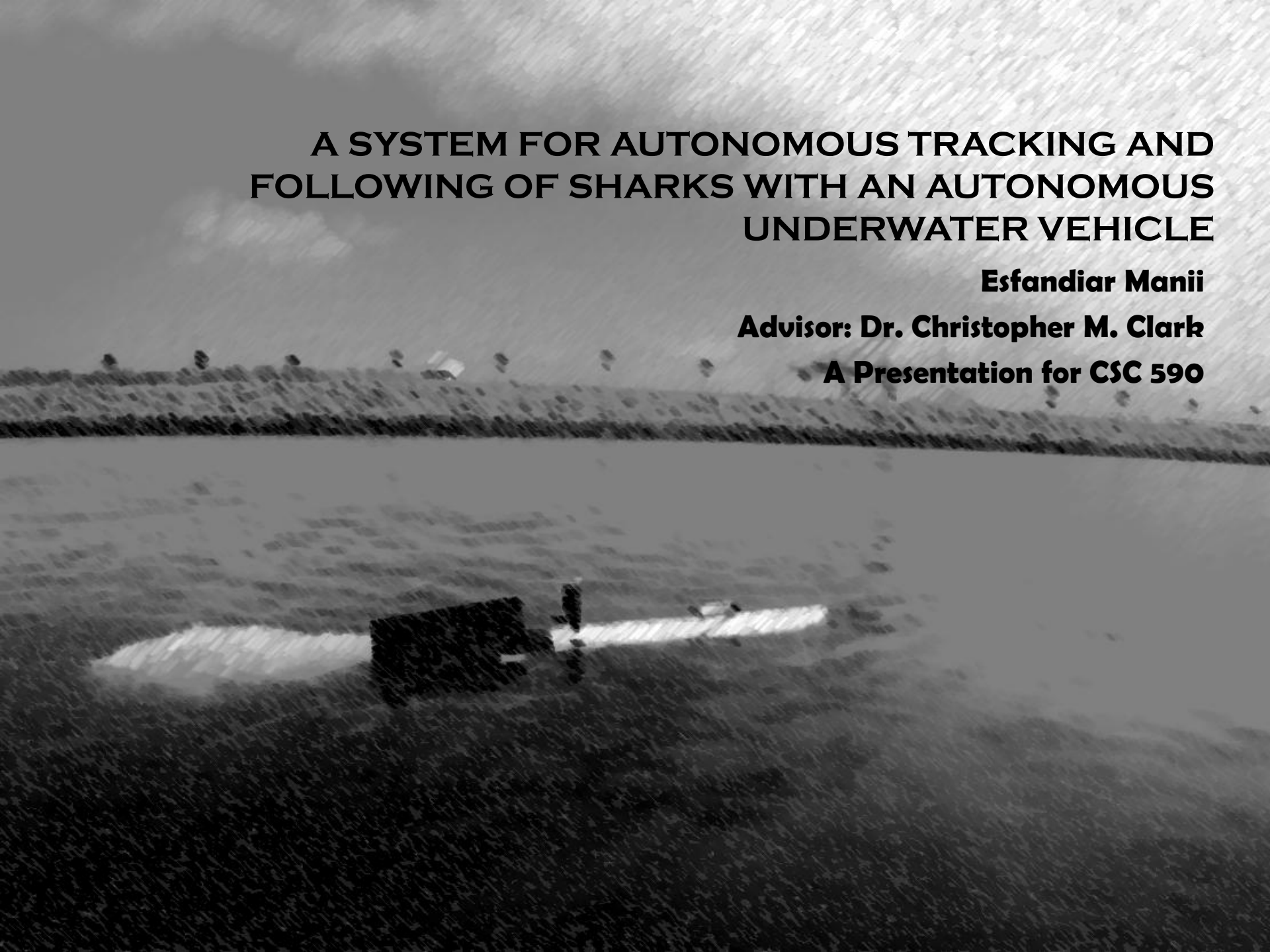


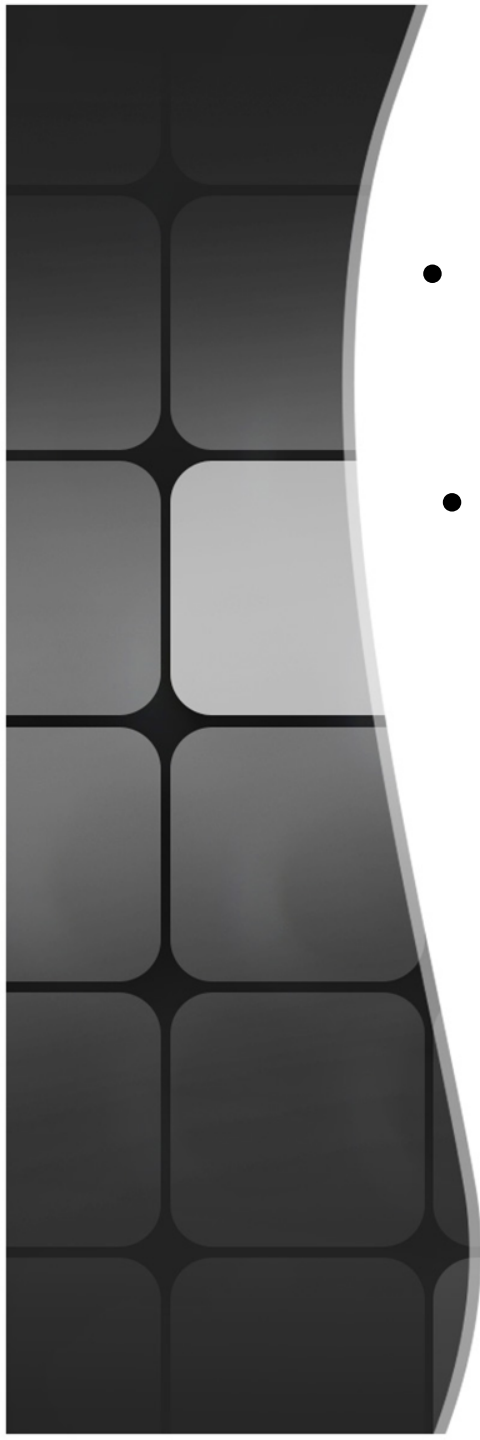
# **A SYSTEM FOR AUTONOMOUS TRACKING AND FOLLOWING OF SHARKS WITH AN AUTONOMOUS UNDERWATER VEHICLE**

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**Advisor: Dr. Christopher M. Clark**

**A Presentation for CSC 590**



- 
- **Tracking Objects underwater?**
  - **Why do we want to track those objects?**
  - **What to track?**
  - **Why Sharks?**

- **What type of Shark has been chosen?**



*Sharks*

# What do we need to track a shark?

- An autonomous underwater vehicle (AUV)
- At least a tracking device (Acoustic Systems e.g. Sonars, Hydrophones; GPS Systems, visual tracking Systems)
  - A Shark

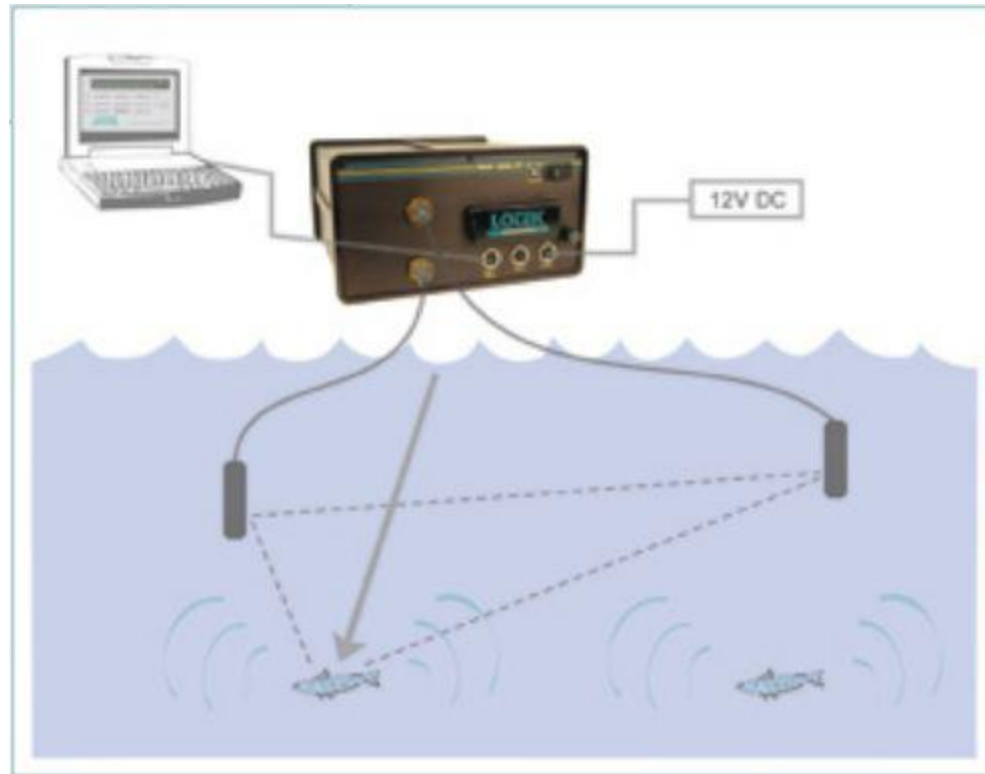
# The Tracking device

- Acoustic System tracking device.



*Tracking Device*

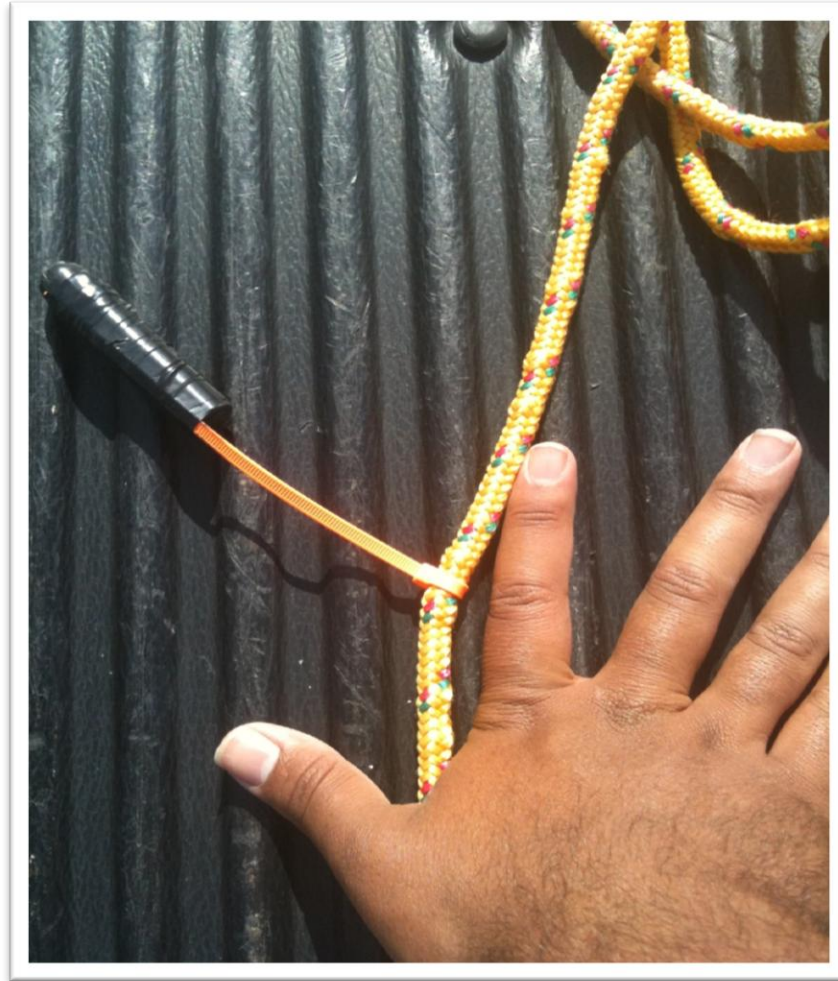
- **Consists of two hydrophones.**
- **One or more acoustic transmitter.**



*Tracking Device*



# Acoustic transmitter



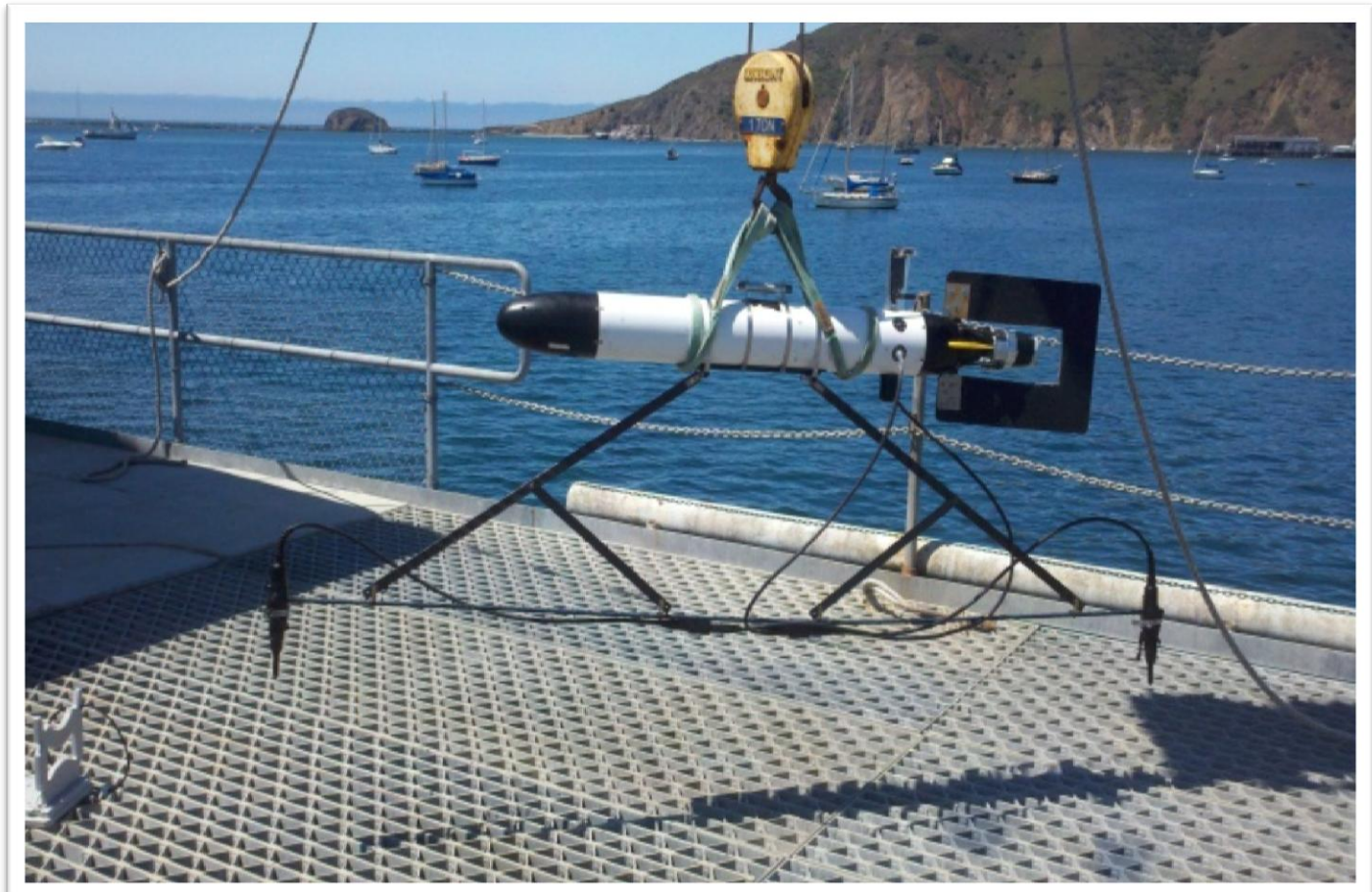
*Transmitter*

# The AUV



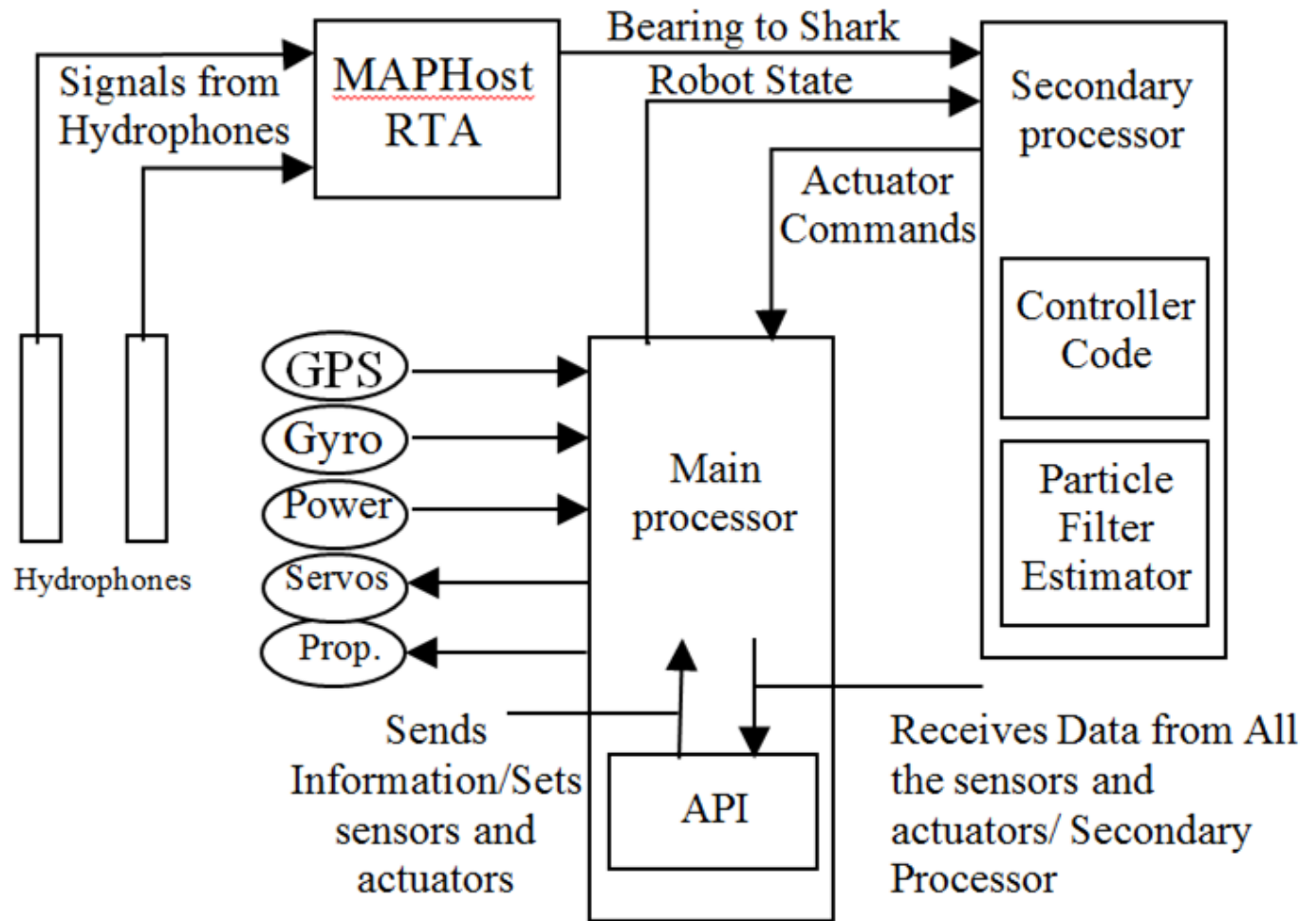
*AUV*



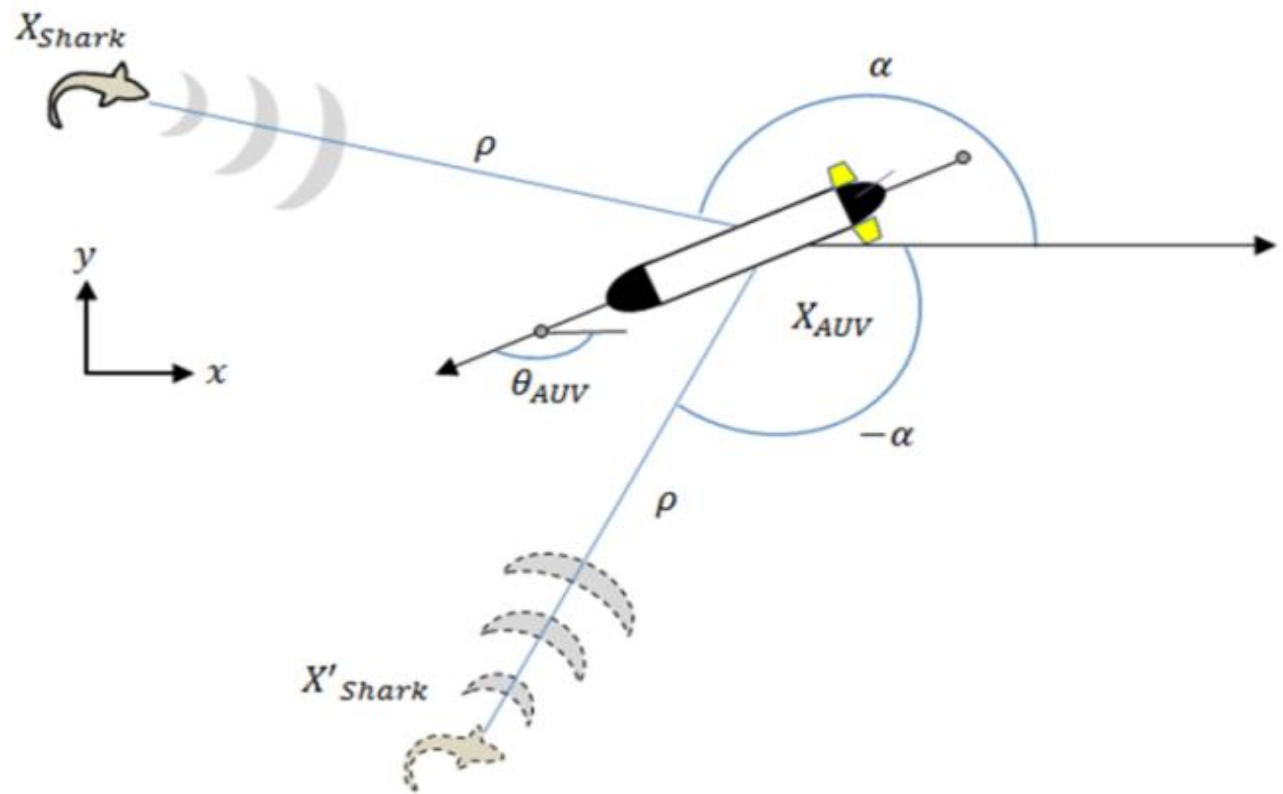


*AUV*

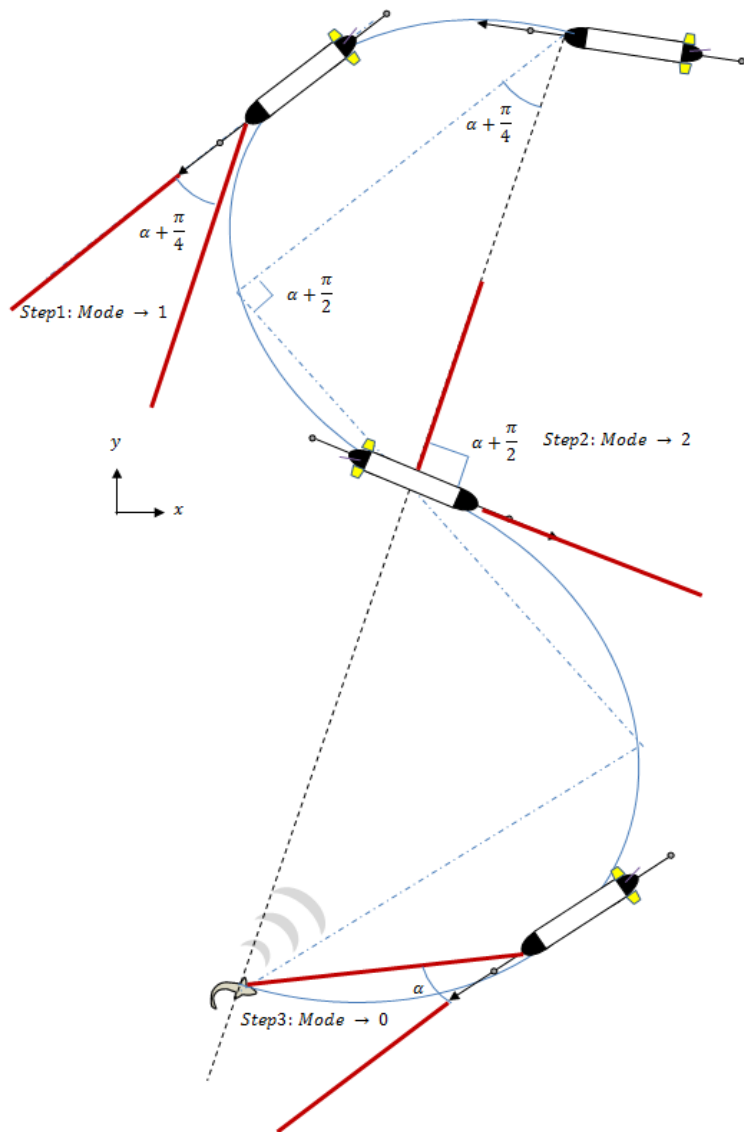
# System Diagram



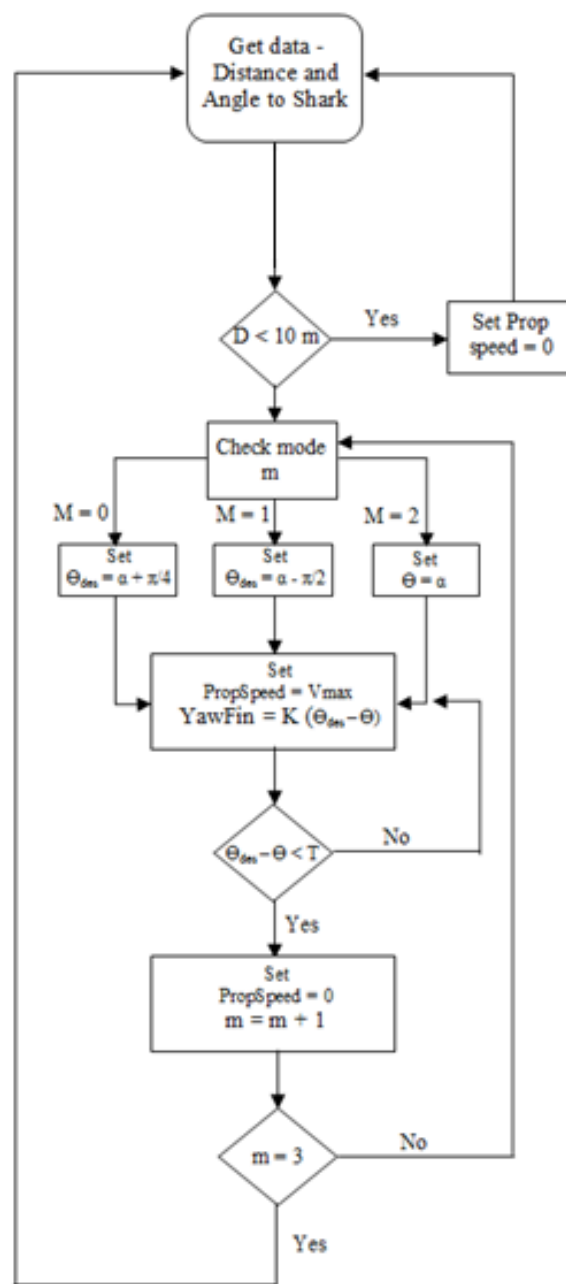
*System Diagram*



*AUV and Shark*



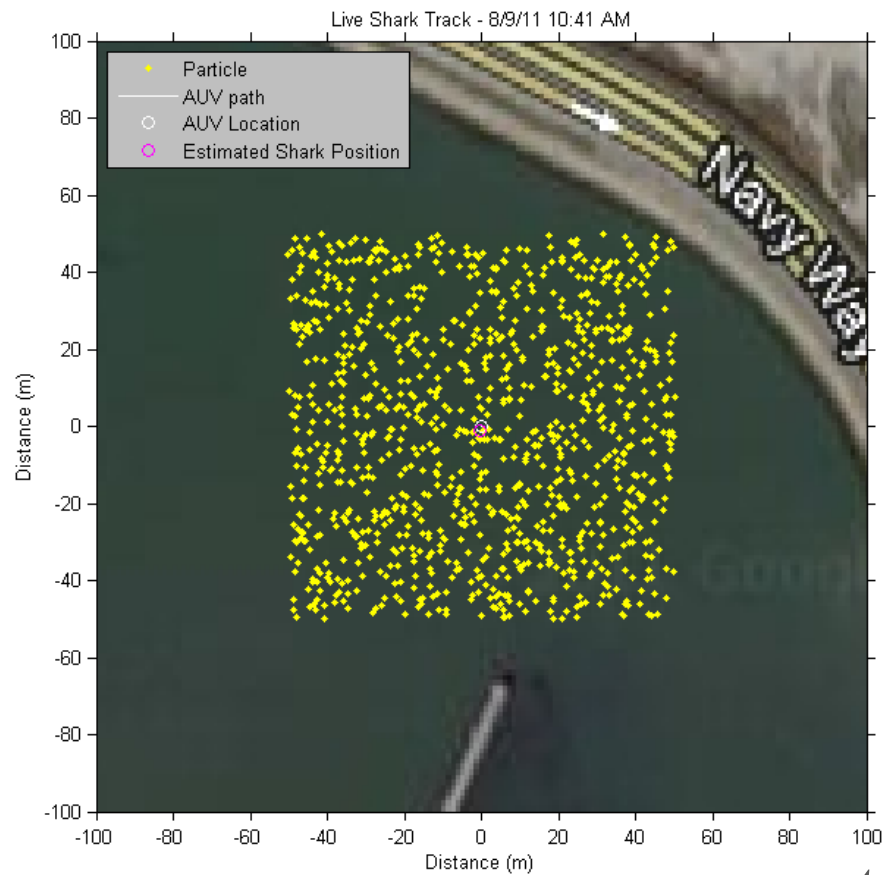
*AUV and Shark*



*Control System*

# Localization

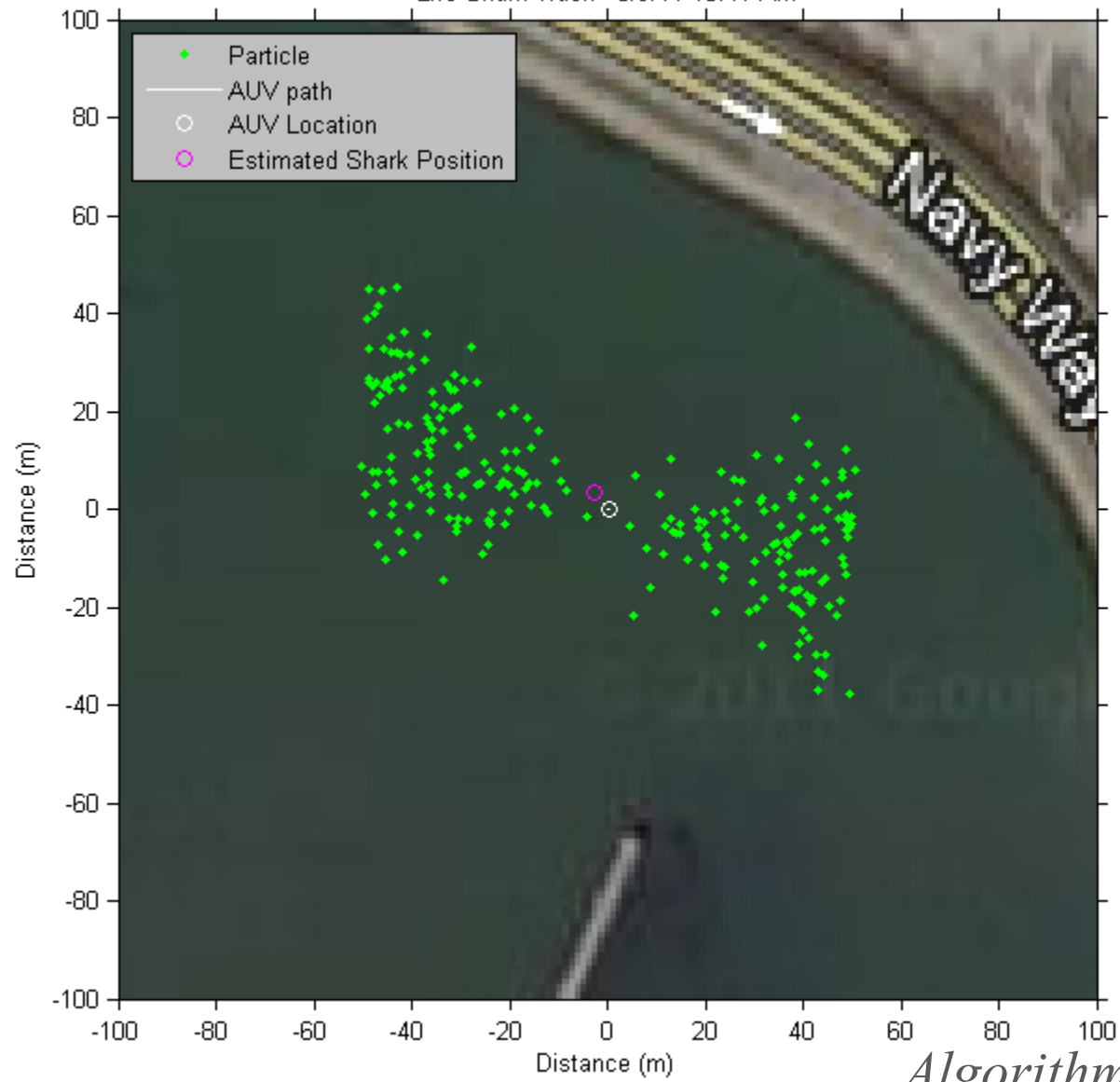
- **Particle Filter.**



*Algorithm*

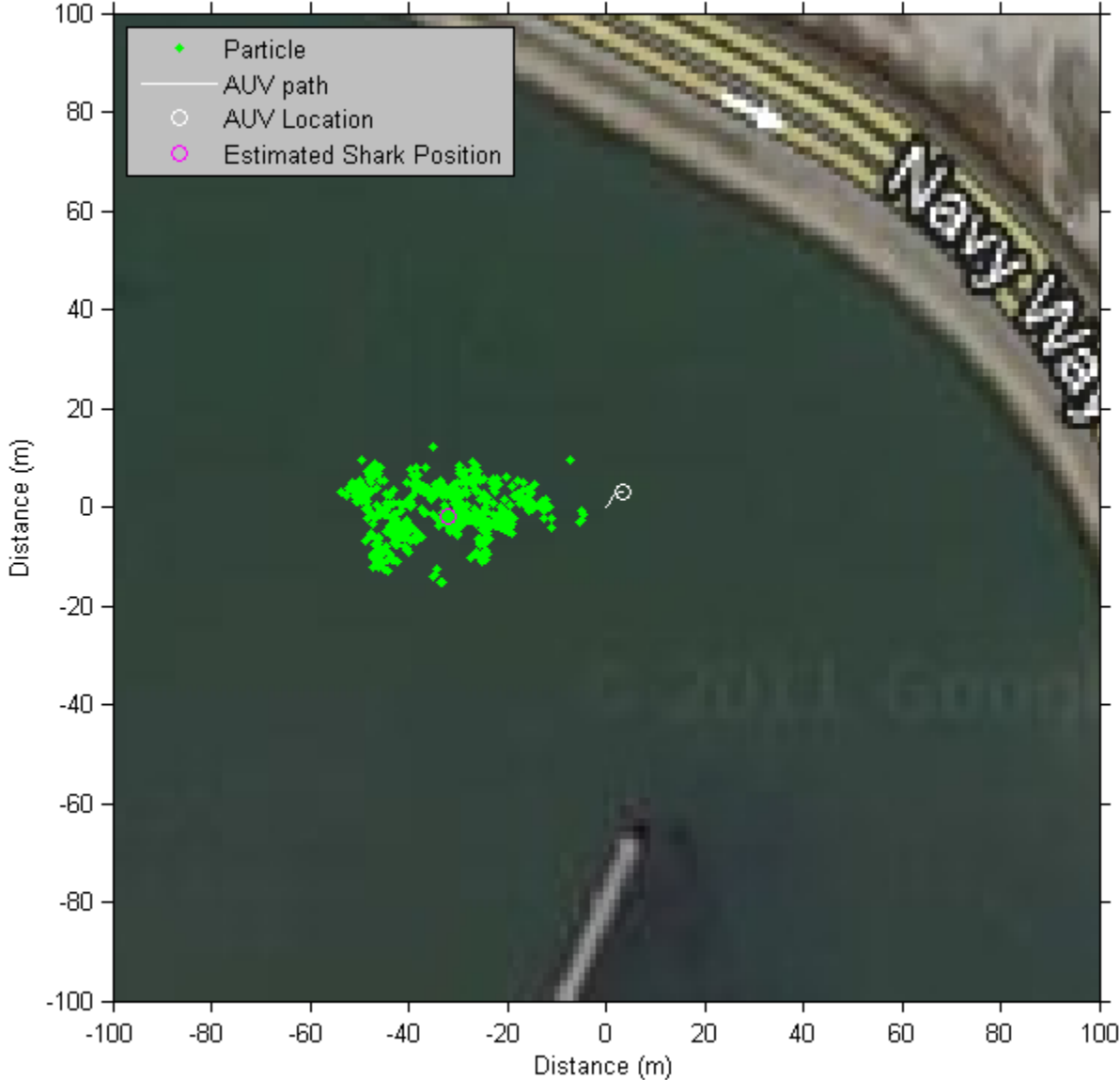


Live Shark Track - 8/9/11 10:41 AM



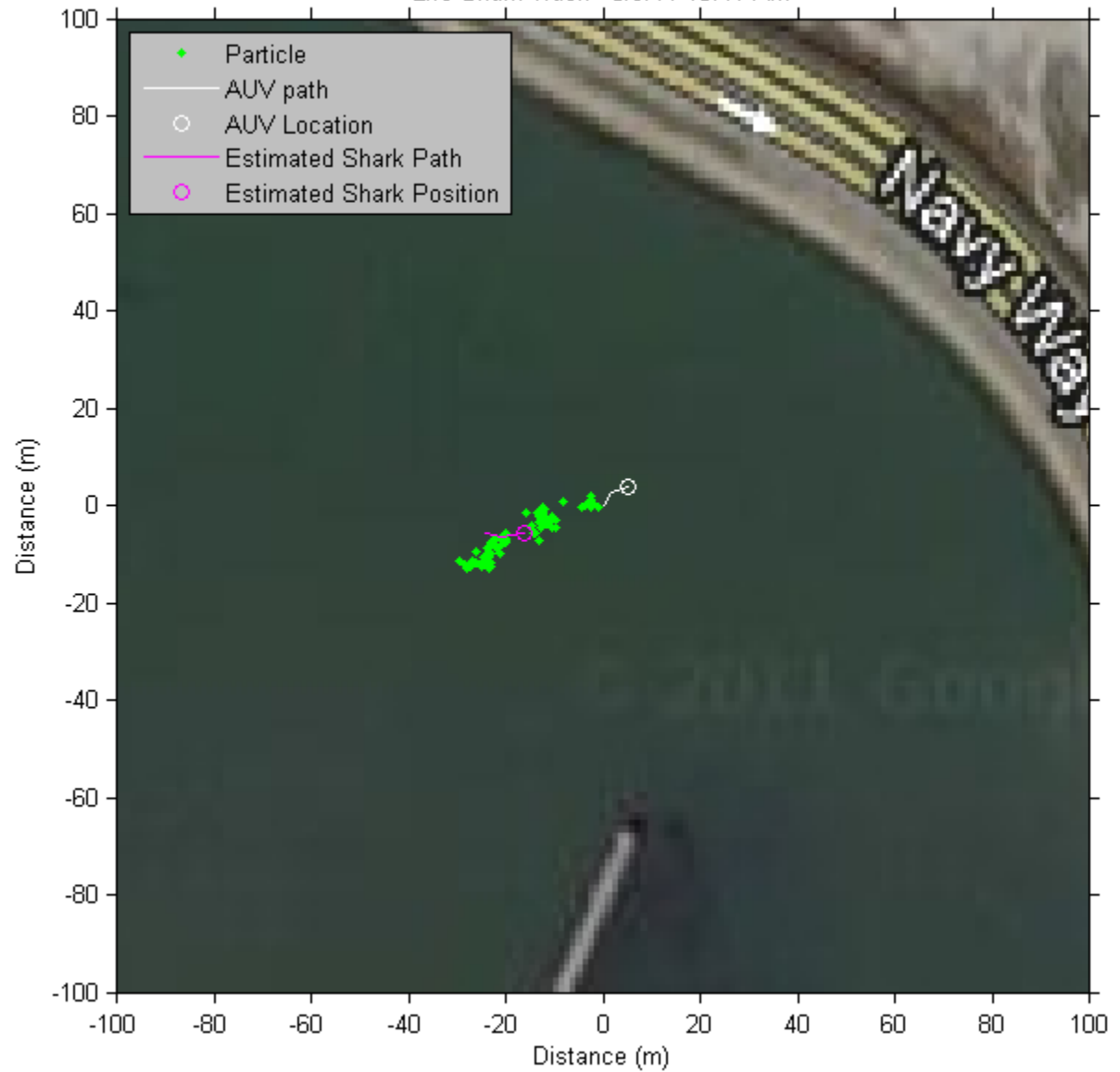
*Algorithm*

Live Shark Track - 8/9/11 10:41 AM

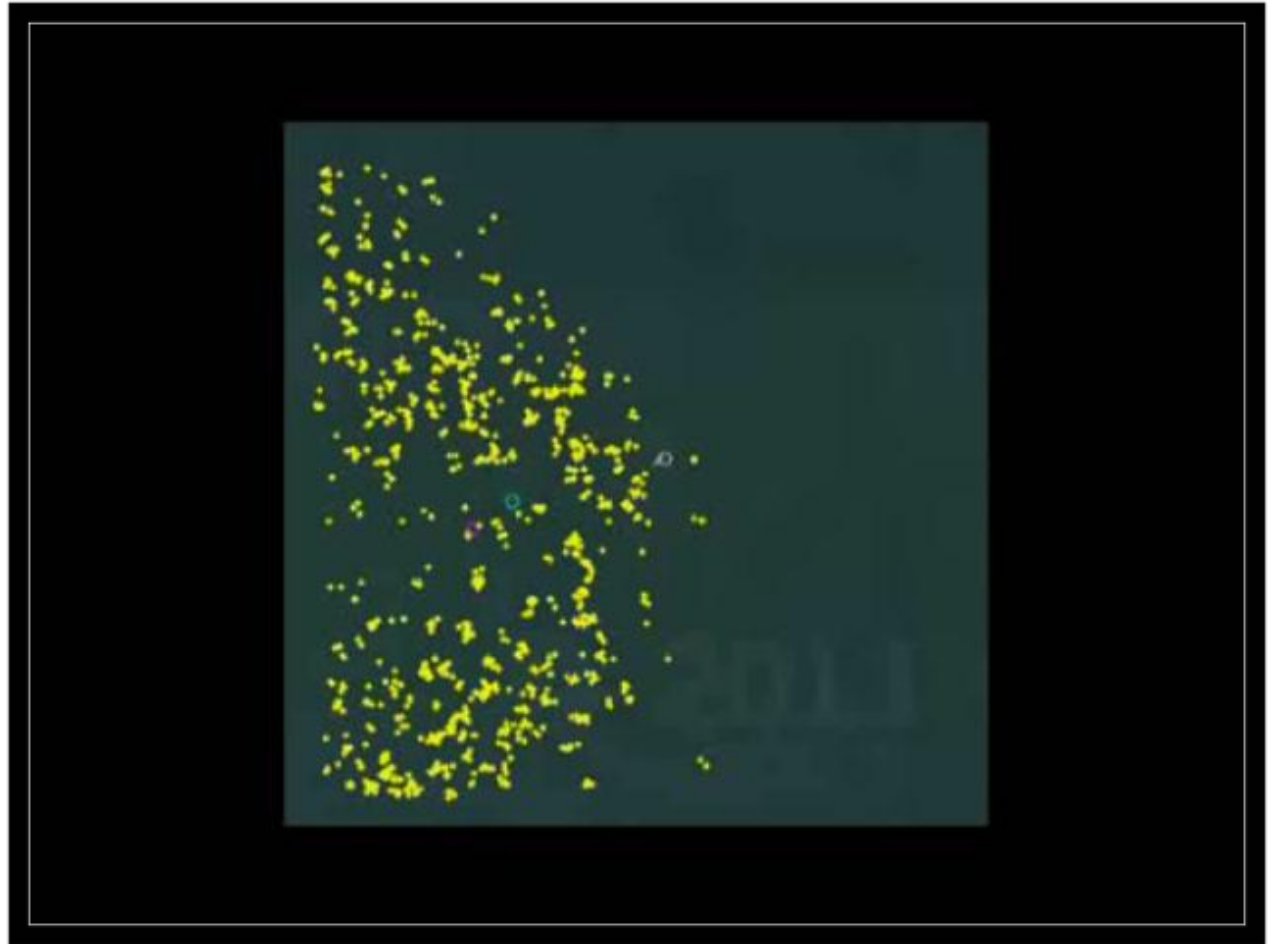


*Algorithm*

Live Shark Track - 8/9/11 10:41 AM



*Algorithm*

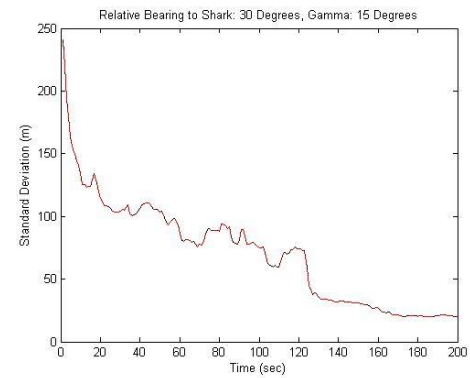
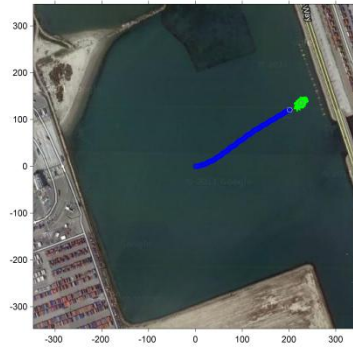
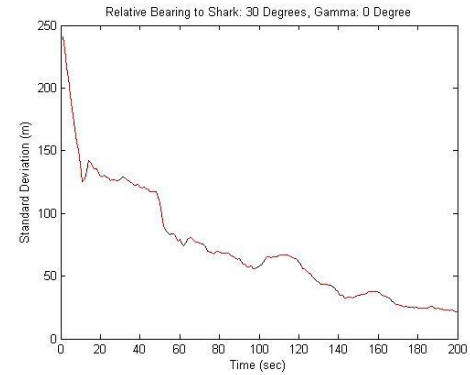
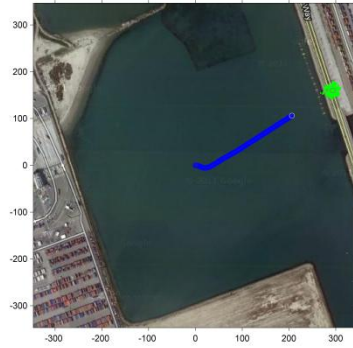


*Algorithm*

# Is it really intelligent?

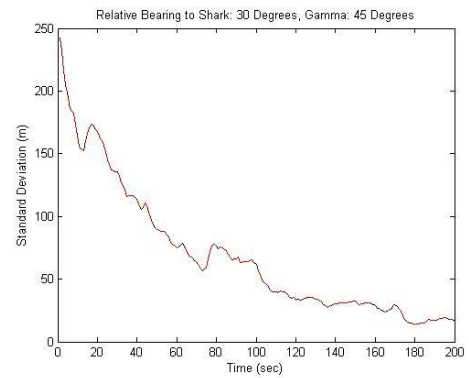
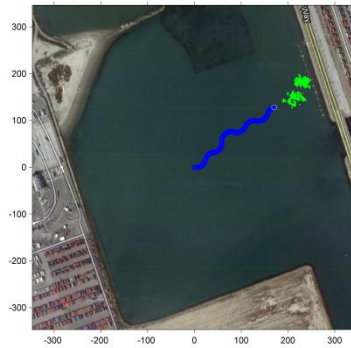
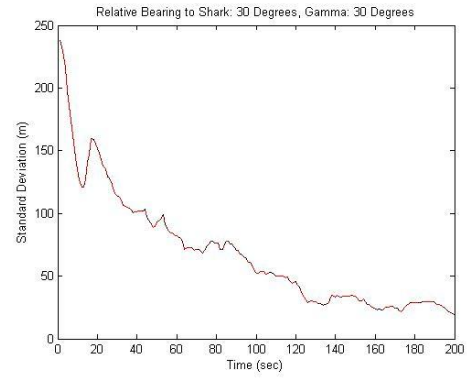
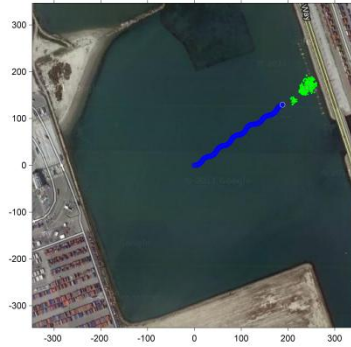
- **By getting more signals from the tracking device, robot learns more.**
  - **Motion planner tries to find an optimal path to the shark, to decrease the travelled distance.**
    - **Depend on the situation, robot stop when the shark is so close and it sets its speed in comparison with the distance.**
  - **If the AUV loses the shark, depend on the situation, it stops or seek for the shark.**

# Improved Controller

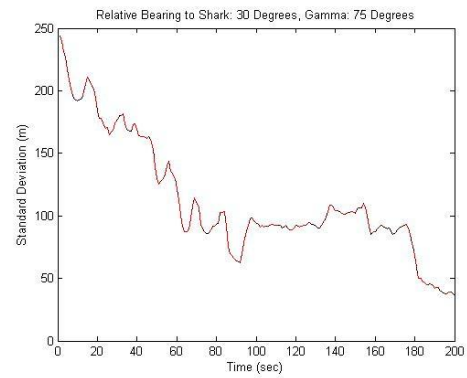
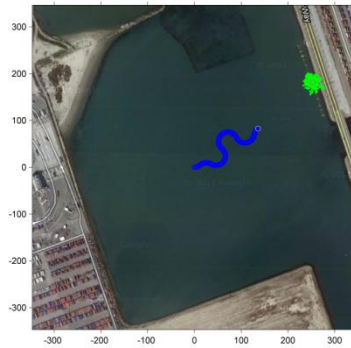
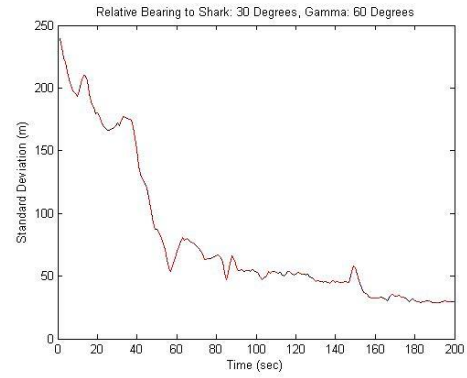
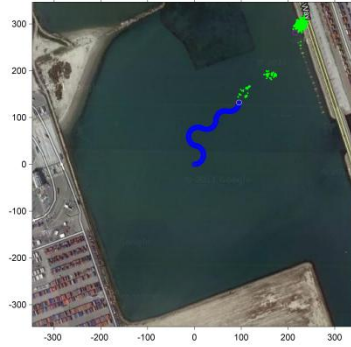


*Improved Controller*



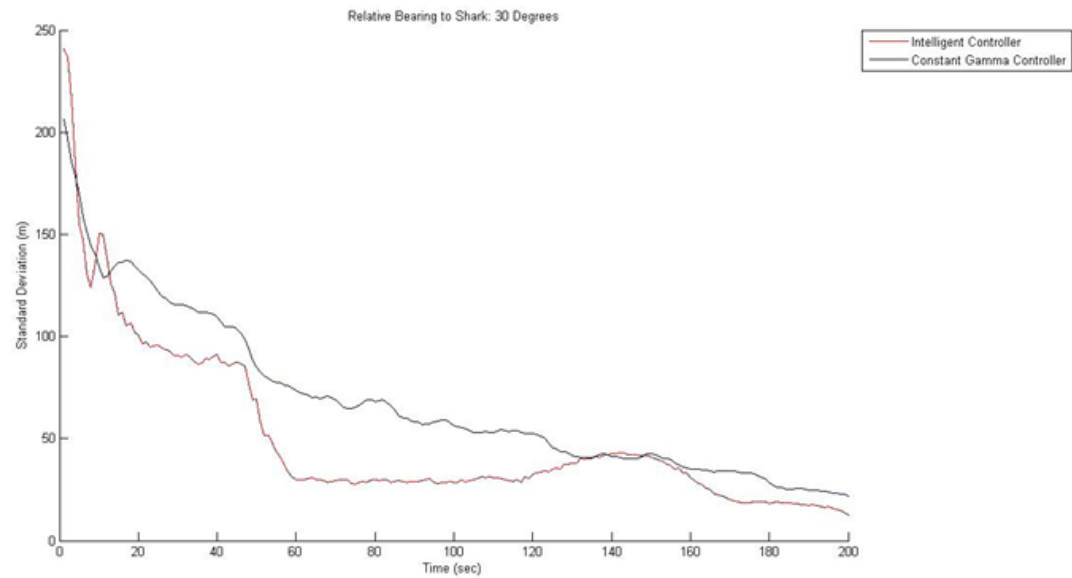


*Improved Controller*



*Improved Controller*

# Comparison



*Improved Controller*

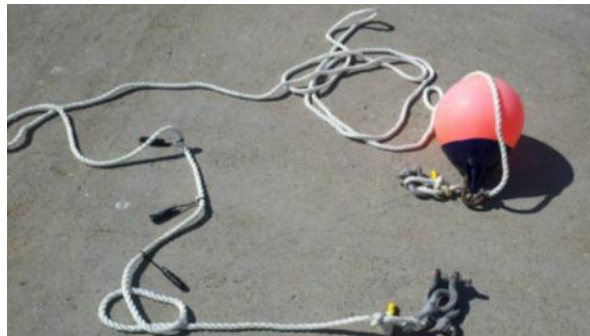


# How can we trust the algorithm?

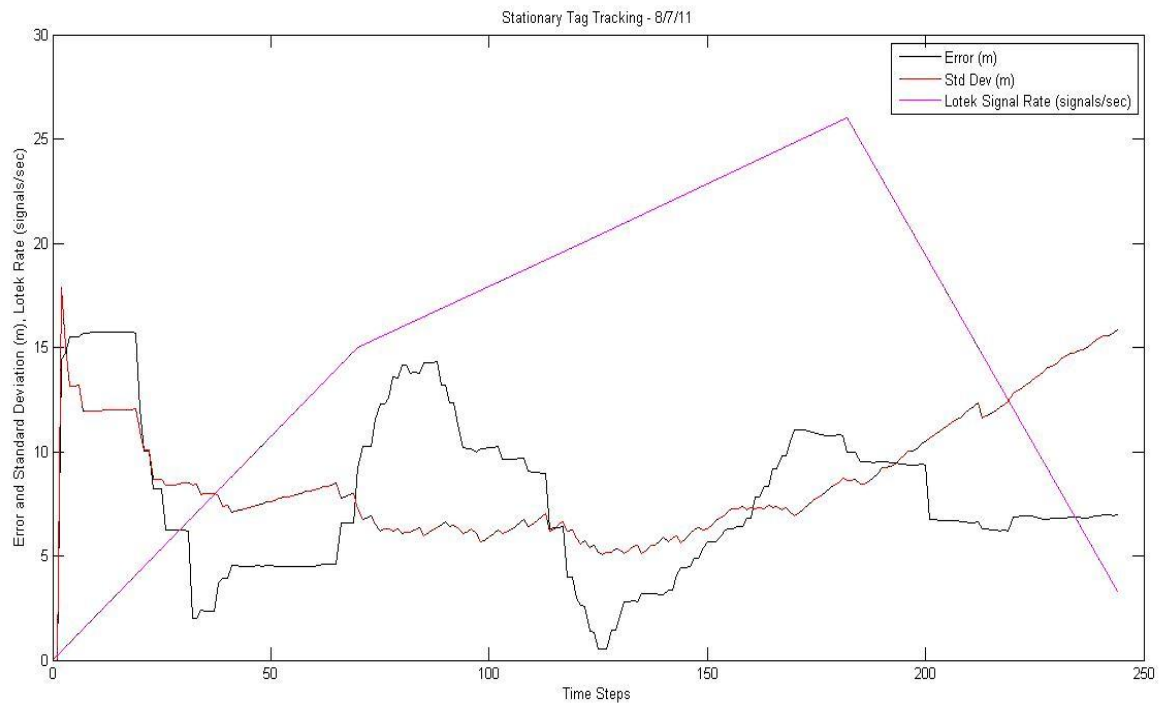
- **Experiments at Cal Poly pier, Avila Beach.**
- **Stationary transmitter.**
- **Non-Stationary transmitter.**

# Stationary Tag Tracking

Cal Poly pier, Avila Beach.



*Validation*



*Validation*



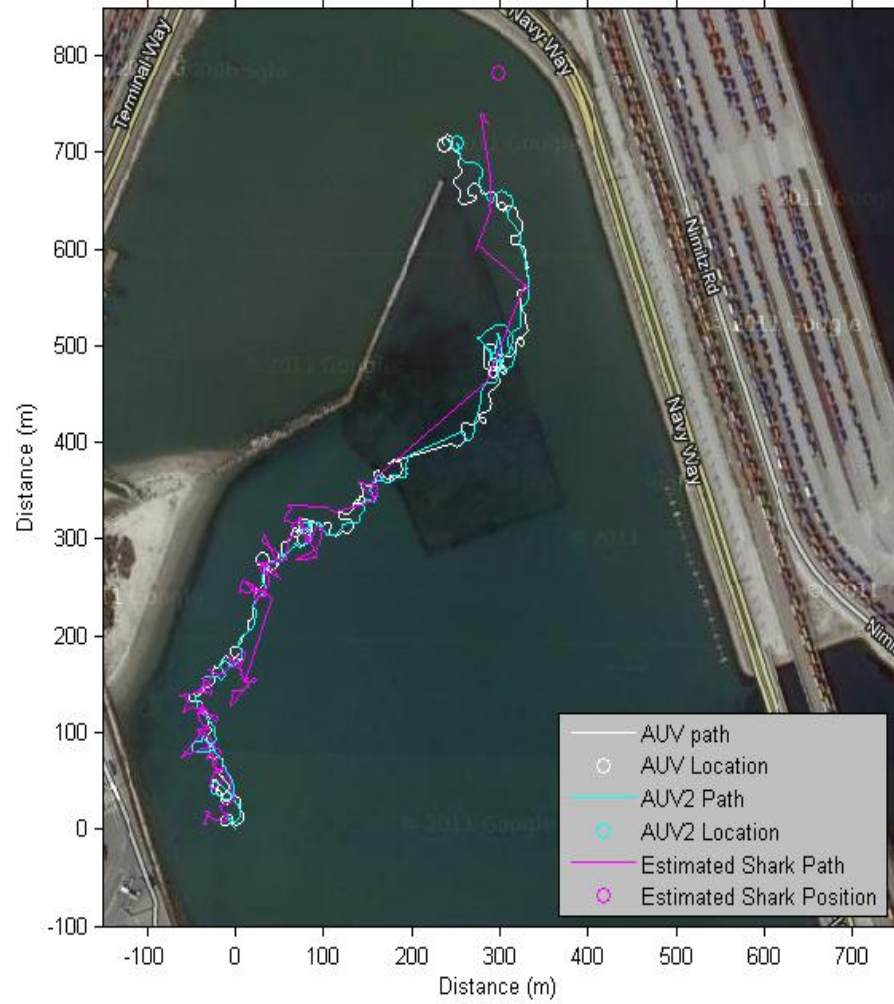
# Tagged AUV Tracking



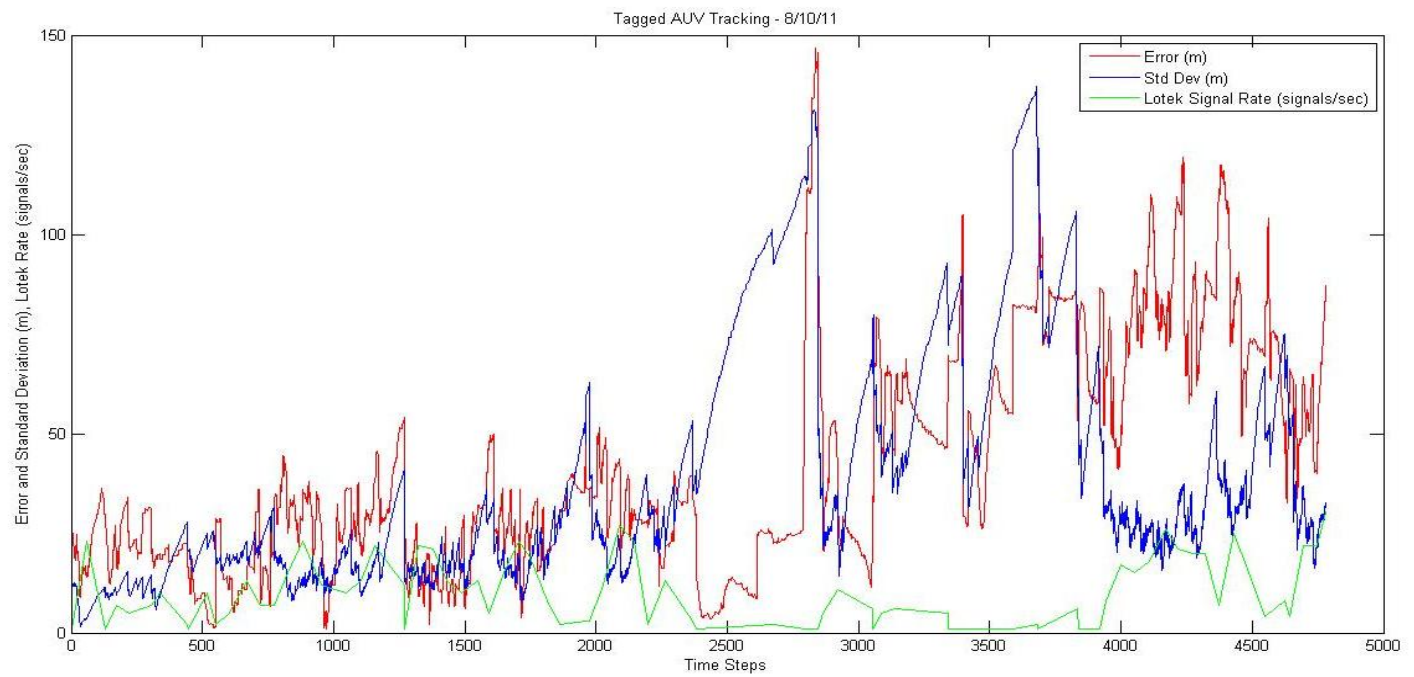
**SeaPlane Lagoon, LA**

*Validation*

Tagged AUV Tracking - 8/10/11

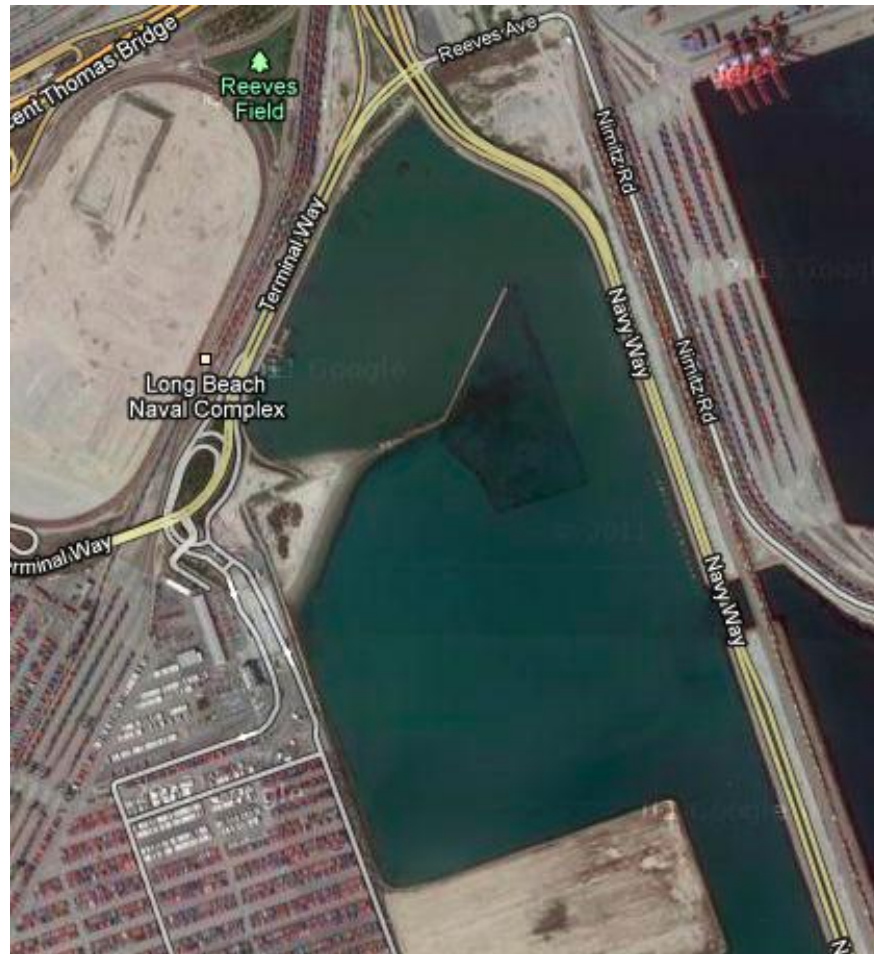


*Validation*

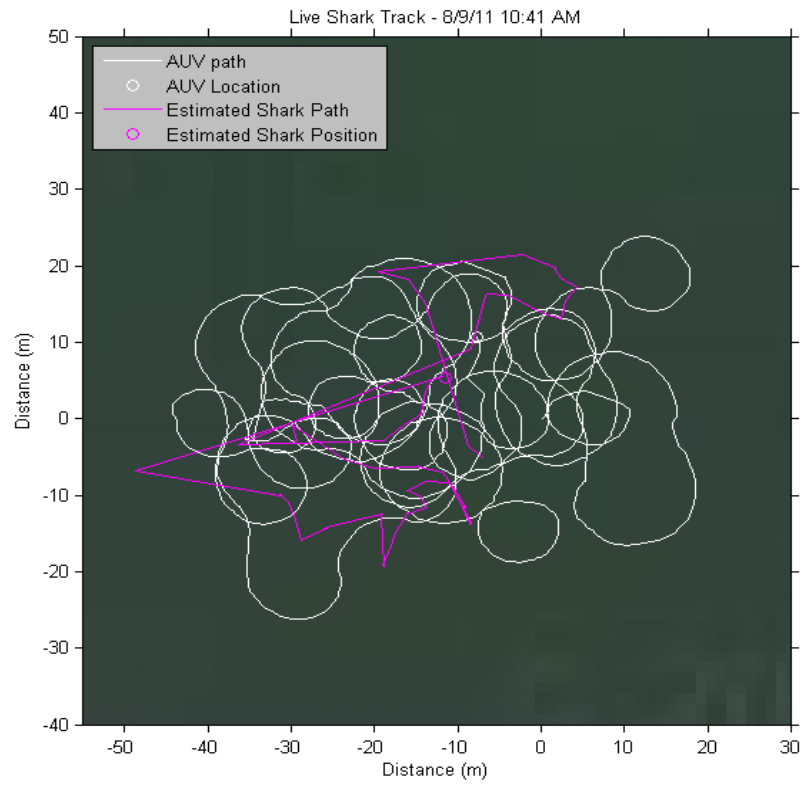


*Validation*

# Shark Tracking

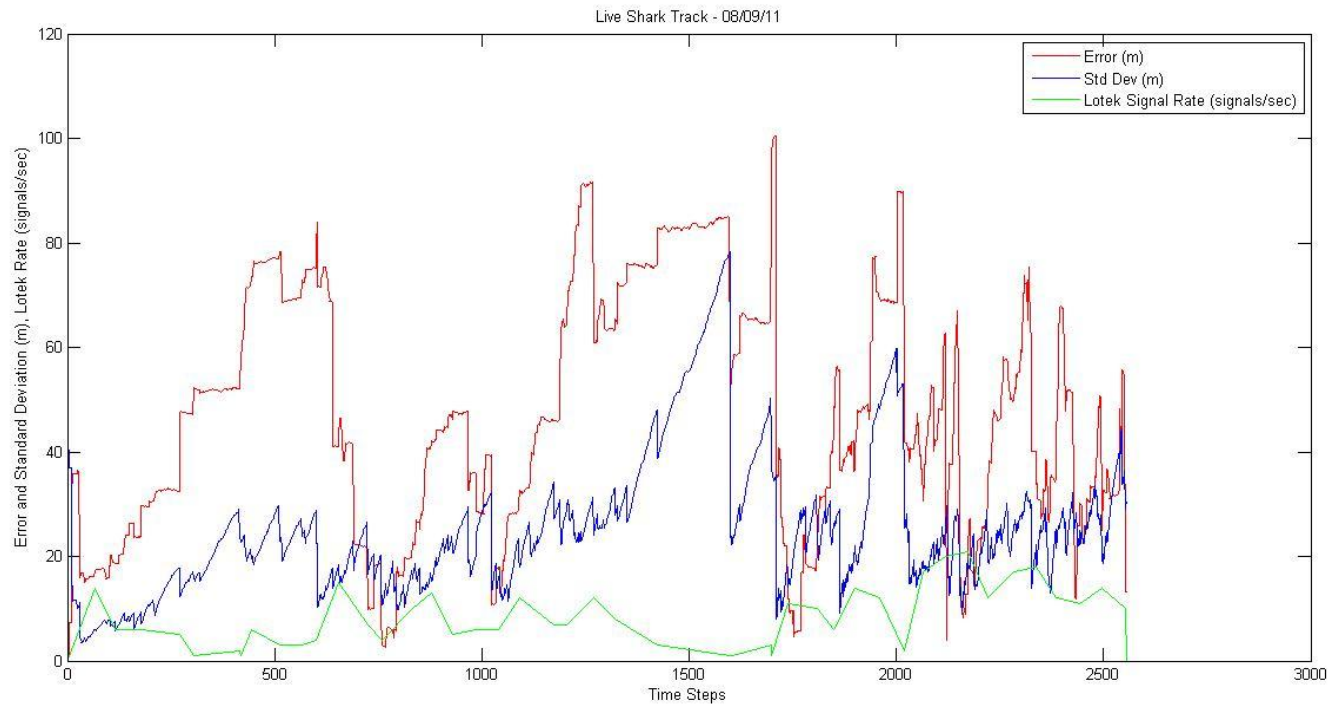


*Validation*



*Validation*





*Validation*





*Luring a Shark*



*Field Experiment*

- 
- ***Thank you all for your attention.***