



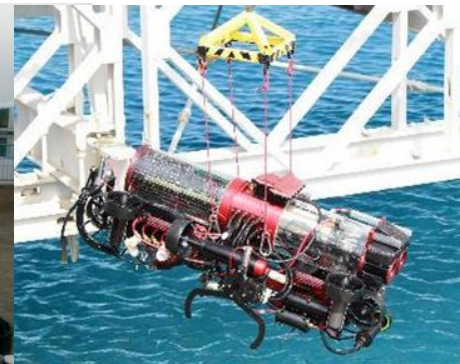
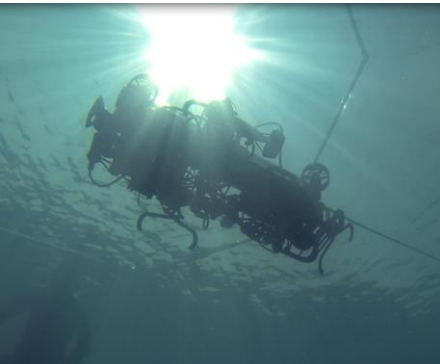
# CORNELL UNIVERSITY AUTONOMOUS UNDERWATER VEHICLE

## Electrical System Design

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# Overview

- How to breakdown the competition
- Choosing the right parts
- Custom vs off-the-shelf solutions
- Closing



# How to Breakdown the Competition

- Types of tasks
  - Vision
    - Pipe tracking, Buoy
  - Fine manipulation and actuation
    - Forward Manipulator, Recovery
    - Bins, Torpedoes
  - Vehicle control
    - Circumnavigation
  - Hydrophones



# Choosing the Tasks to Attempt

- How do I decide which tasks to attempt?
- What components do I need to fulfill the task?



# What type of motor is right for me?

There are many motors out there

- Brushless DC
- Brushed DC
- Stepper Motor
- Servo Motor



# CCD vs CMOS

- Global Shutter vs Rolling Shutter
  - Skew, wobble, smear



## To DVL or not to DVL

Pro: Accurate position information, less susceptible to drift

Con: Cost

Seek sponsorship

Discounts provided on used components or rentals



# Interfacing with Other Subteams

## Cabling and Wire Interconnects

How many external connections do I need?

Where will my parts be located?

Where should I route connections?

## Communication with Software





# Custom vs Off-the-Shelf Controllers

Custom	Off-the-Shelf
Tunability	Reliability
More complex design	Less complex design
	More complex integration
Note: either solution may be difficult to integrate into an already functional system	
Meets all (designed for) requirements	May have to make compromises
Cost!	



# Our Team

## Subsystem breakdown

- Power
- Mechatronics
- Sensors
- Acoustics

Check out our upcoming webinars for more information

PCB Board Design and Layout -- 11/22/14 @ 11AM

Hydrophones (How To) -- 11/29/14 @ 1PM



# Power System

## Batteries

- LiPo
  - Sponsors: Advance Energy Inc. (Custom battery solutions), Maxamps (High quality and capacity for reduced cost)

## Battery Management Board

- Monitor individual cell voltage and charge capacity over time
- Off-the-shelf solutions: Fuel gauge IC, Battery Management Chip

## Power Distribution Board

- DCDC converters for voltage rails
- Ability to power cycle each channel to reset sensors, protect from overcurrent



# Mechatronics

## **Thruster Controller (Brushed vs Brushless) Board**

- Custom H-bridges, isolation, current monitoring
- Off-the-shelf solution: Motor controllers or packages H-bridges

## **Stepper Motor Controller Board**

- Control and timing logic implemented on board
- Absolute position encoder
- Alternative: servomotor

## **Actuator Board**

- Solenoid and DC motor driver
- Relays killswitch information to other mechatronics boards



# Sensors

## Sensor Suite

- IMU (6 axis)
- Magnetometer and Compass
- DVL
- Cameras

Note: interfacing will be challenging as each sensor may have its own protocol/method of communication

## **Serial Board**

- Sensor interfacing

## **HIM Board (Heading and Inertial Measurement)**

- Accelerometer, magnetometer

## **GPIO Board**

- Pressure and depth sensing

**SPONSORSHIP is your best friend!**



# Acoustics

## **Hydrophones System**

- On board signal processing solutions (DSP vs FPGA vs MCU)

## **Custom Pinger**

- Allow for transmitting pings as well as receiving commands to adjust frequency output

Hydrophones (How To) -- 11/29/14 @ 1PM



# My team is brand new, where do I start?

1. Determine which tasks to attempt
  - a. Sensor limitations and requirements
  - b. Manpower
  - c. Integration time and debugging
2. Breakdown each task into specific implementation goals (How To)
  - a. Keep in mind that a lot of time must be saved for software and testing
3. Are custom solutions right for me?

Again, catch our other electrical webinars for more information!

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**Questions?**