Towards the Development of an Autonomous Iceberg Draft Measurement Probe (AIDMP)

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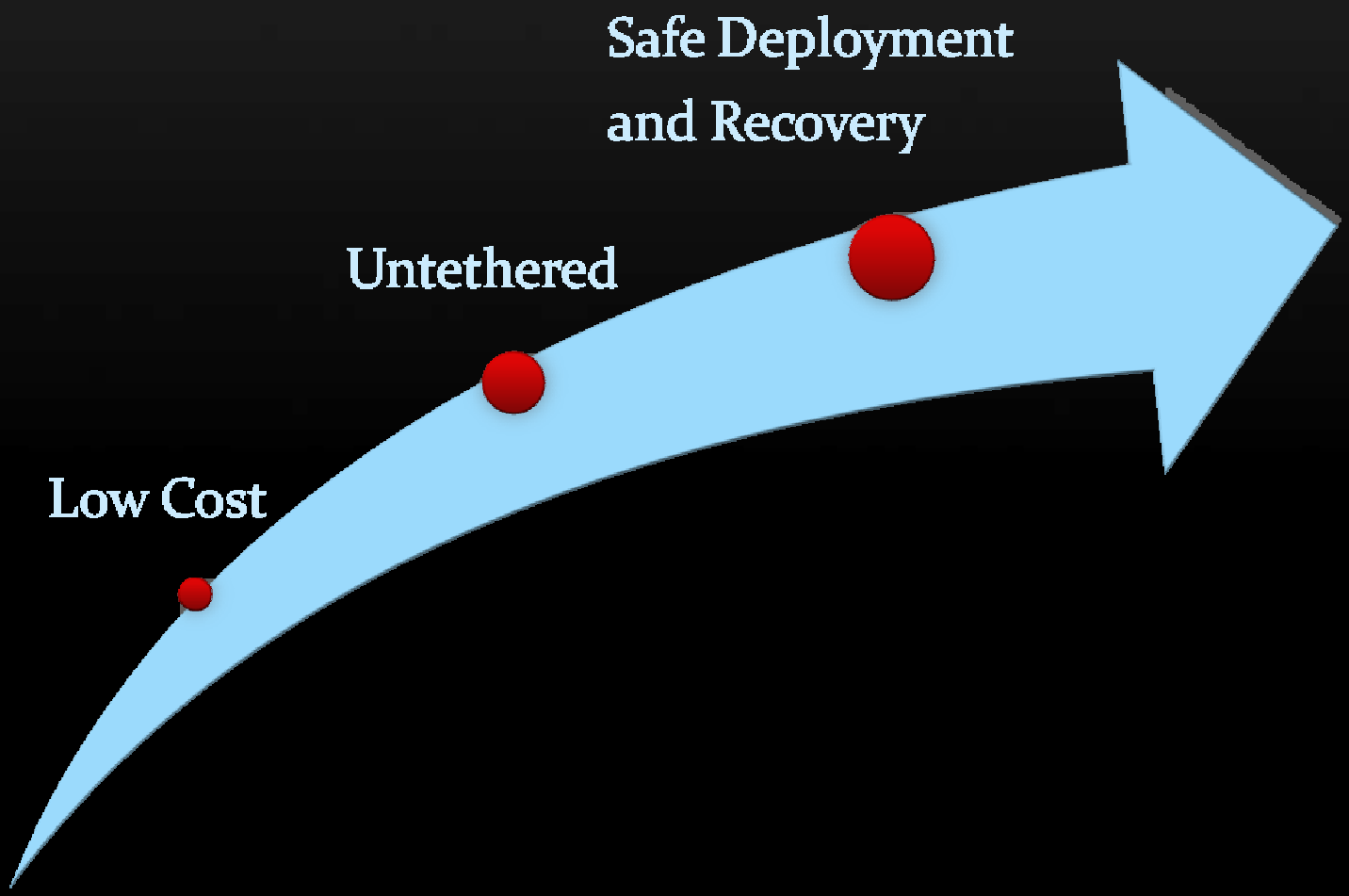
Outline

1. Basic Design Concept
2. Customized Logging System
3. Experiment Design
4. Conclusion and Future Work

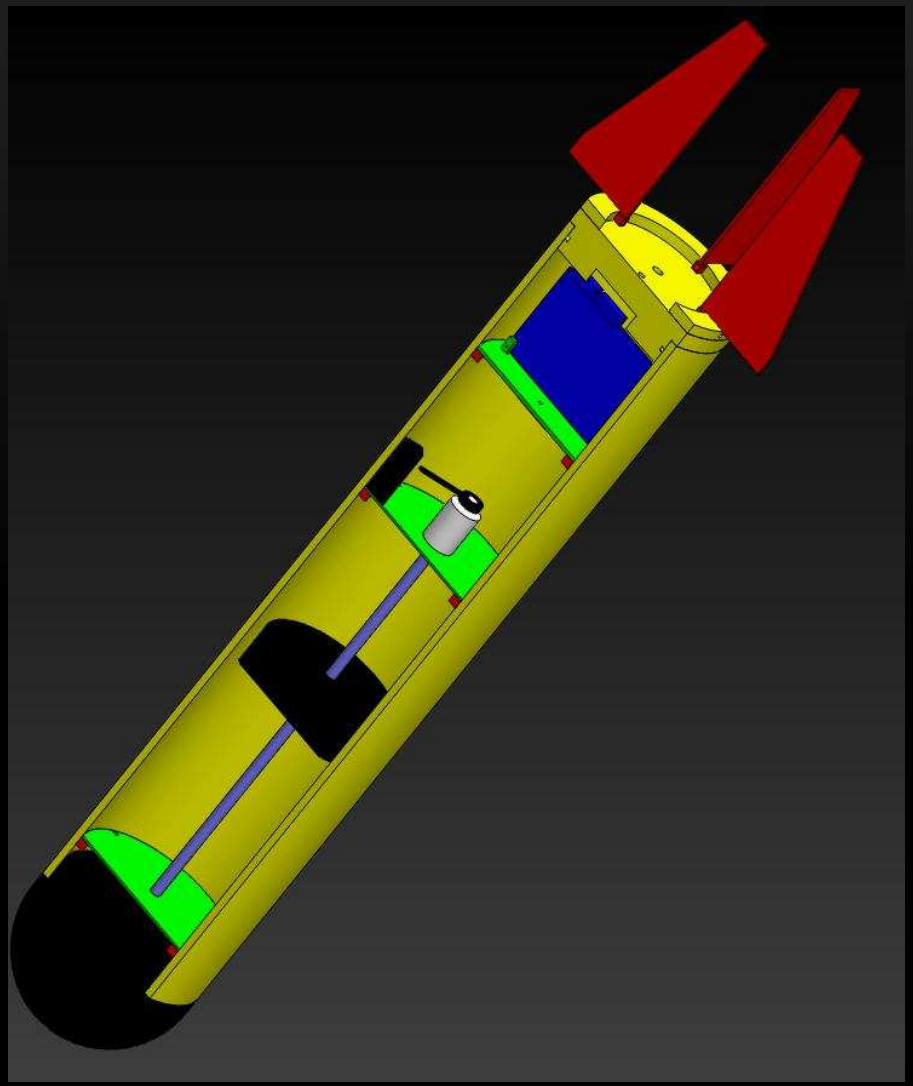
Iceberg and Offshore Industry

AIDMP

Design Principles



Mechanical Design



Variable Weight Distribution → Change the CM in longitudinal direction

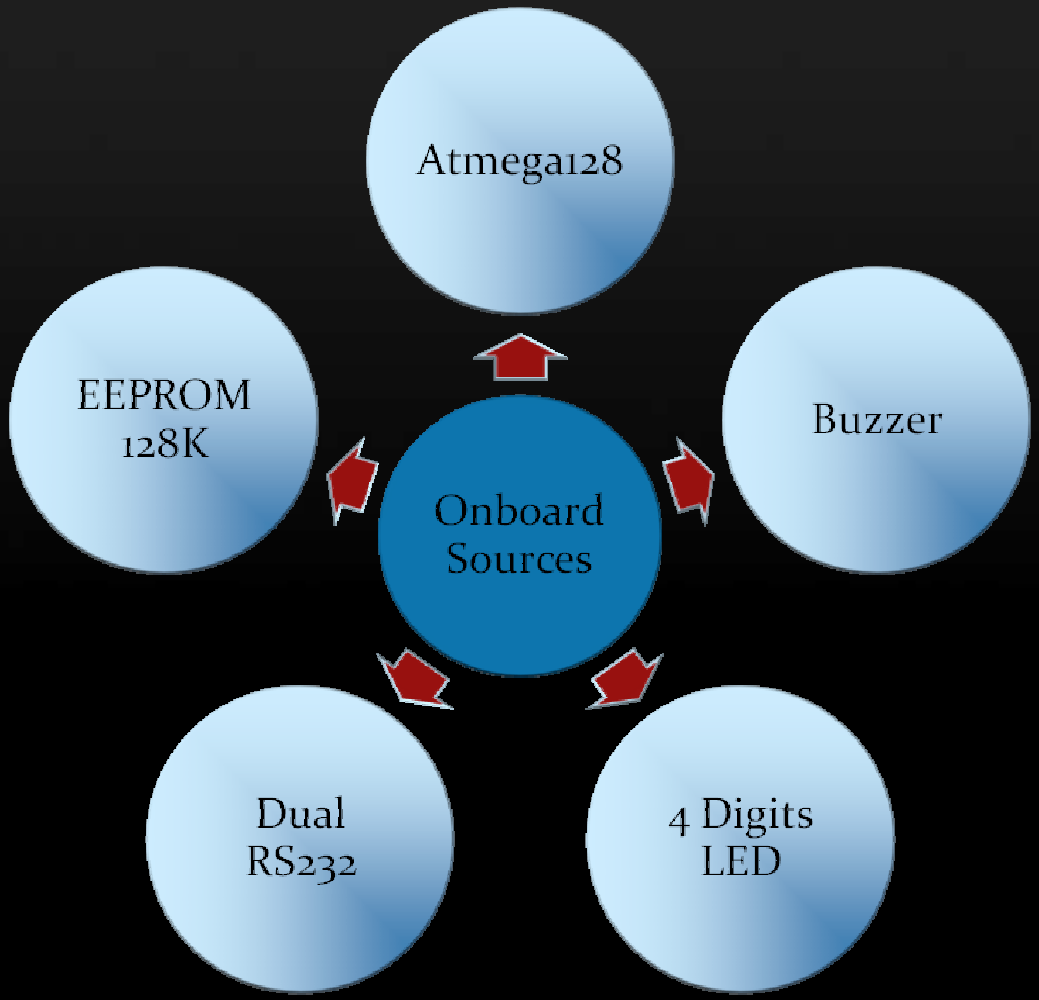
Roll Control → Maintain CM coincide with cylinder axis

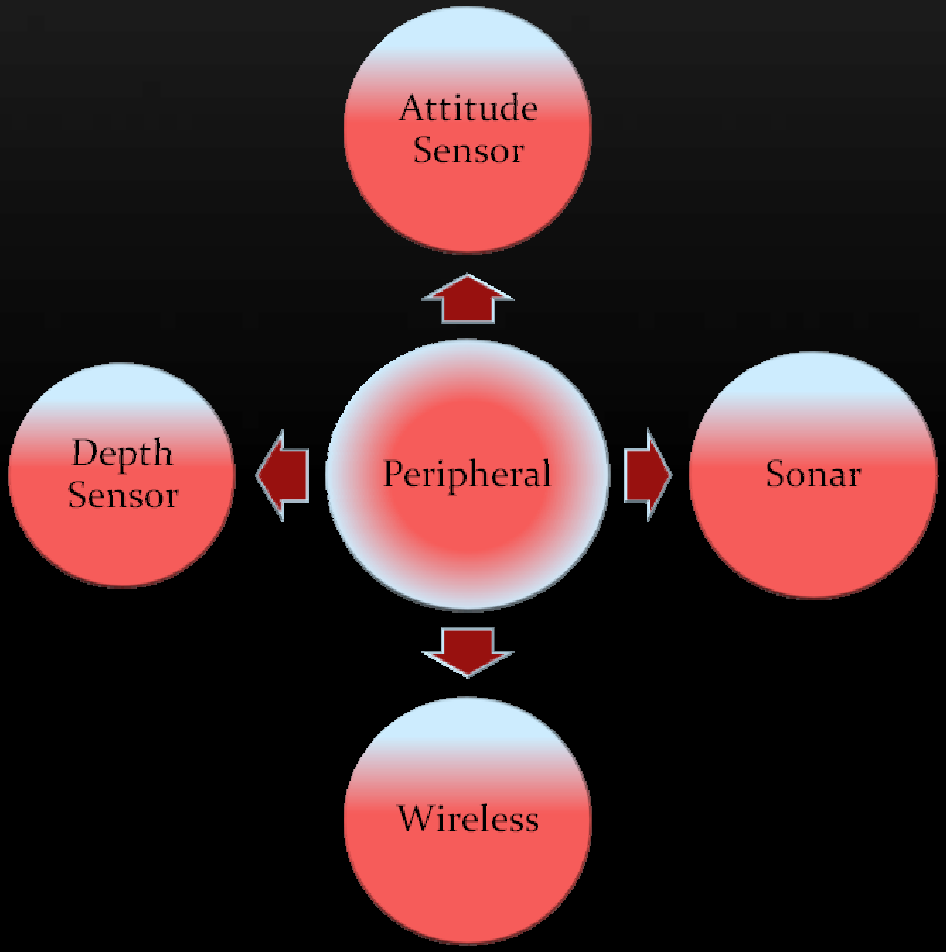
Fins → Change Hydrodynamic Force

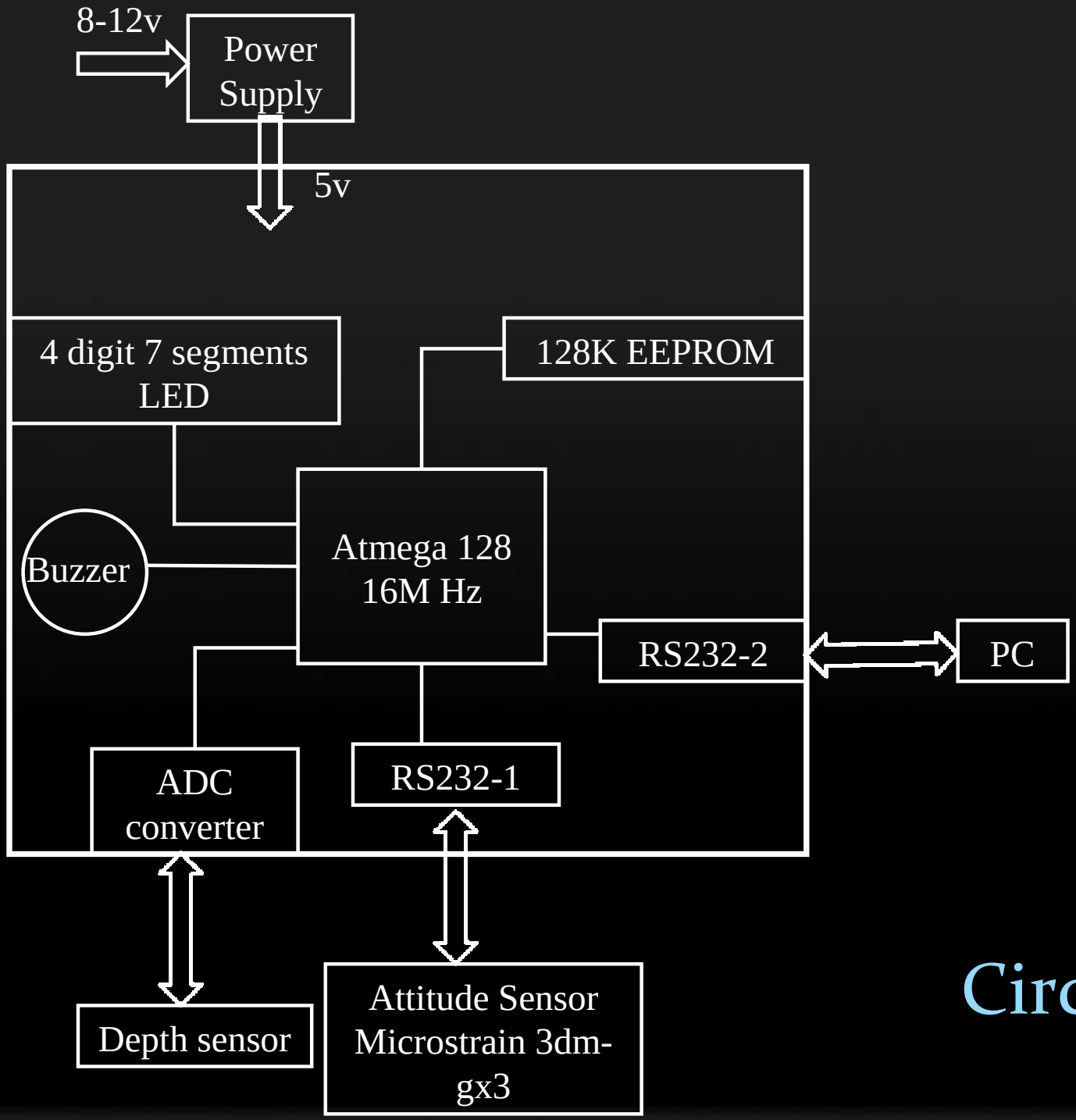
→ Improve Stability

Customized Logging System

Hardware

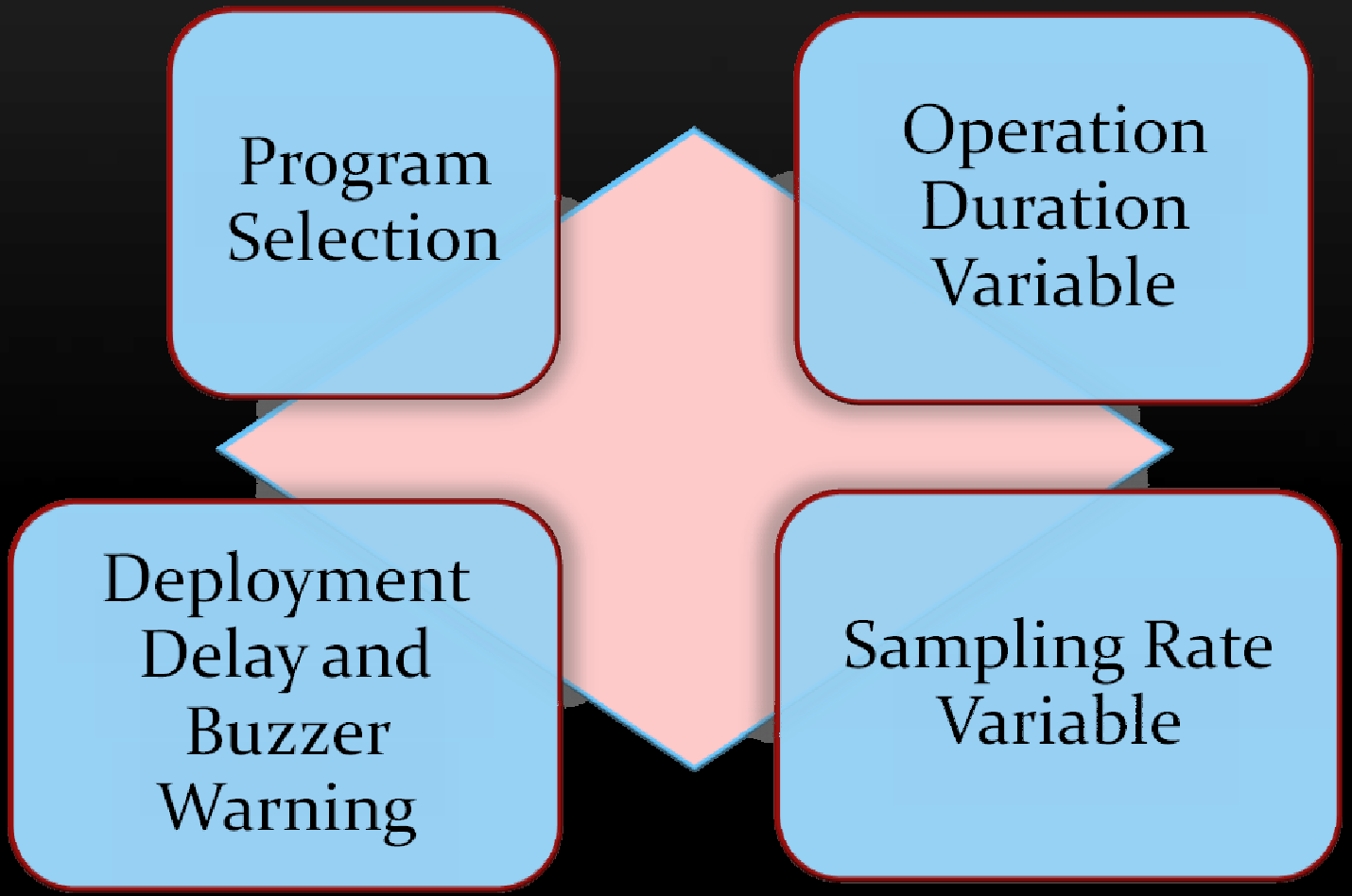

Atmega128
EEPROM
128K
Buzzer
Onboard
Sources
Dual
RS232
4 Digits
LED

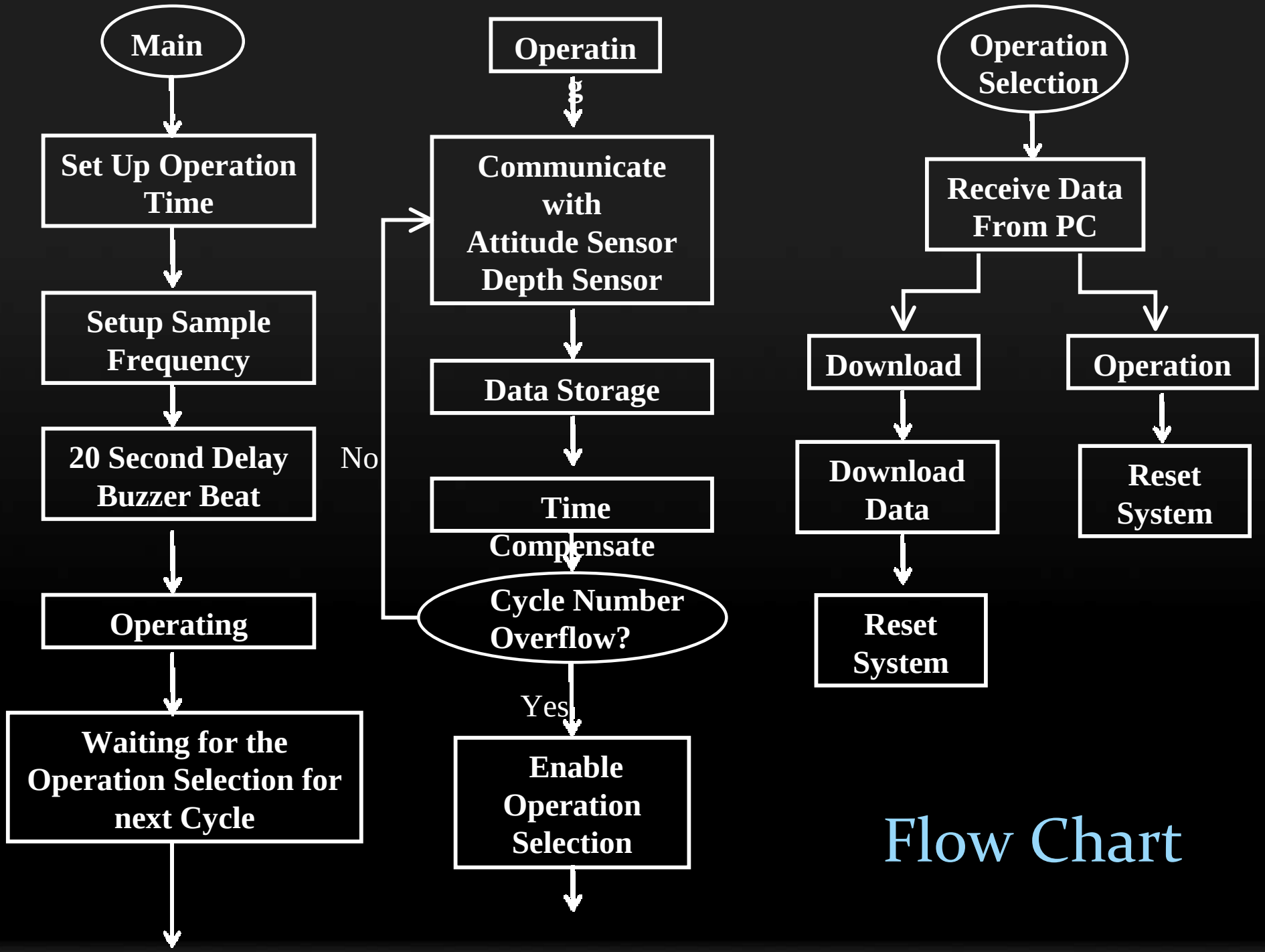

Attitude
Sensor
Depth
Sensor
Peripheral
Sonar
Wireless



Circuit Scheme

Software


Program Selection
Operation Duration Variable
Deployment Delay and Buzzer Warning
Sampling Rate Variable


Main
Set Up Operation Time
Setup Sample Frequency
20 Second Delay Buzzer Beat
Operating
Waiting for the Operation Selection for next Cycle
Operatin
Communicate with Attitude Sensor Depth Sensor
Data Storage
Time Compensate
Cycle Number Overflow?
No
Yes
Enable Operation Selection
Operation Selection
Receive Data From PC
Download
Download Data
Reset System
Operation
Reset System

Flow Chart

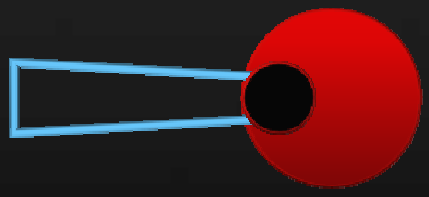
Experiment Design

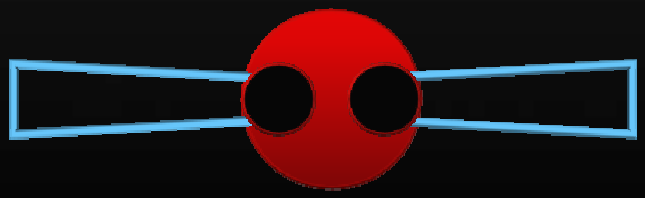
Beam Width: 15 degree / Bin Size: 1 m / Iceberg depth 200m

Frequency	Properties	1-sonar	2-sonar	3 -sonar
1 Hz	Rotational Speed	0.26 rad/s	0.52 rad/s	0.79rad/s
	Translation Speed	0.042 m/s	0.083 m/s	0.125 m/s
	Operation Time	80 min	40 min	26.6 min
2 Hz	Rotational Speed	0.52 rad/s	1.05 rad/s	1.57 rad/s
	Translation Speed	0.083 m/s	0.167 m/s	0.25 m/s
	Operation Time	40 min	20 min	13.3 min

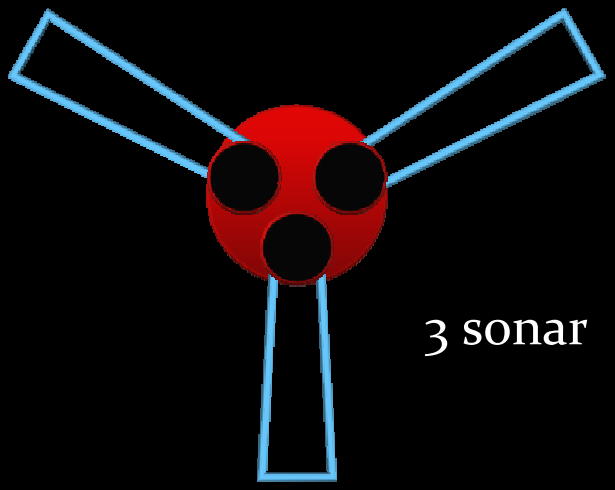
Top View

1 sonar





2 sonar

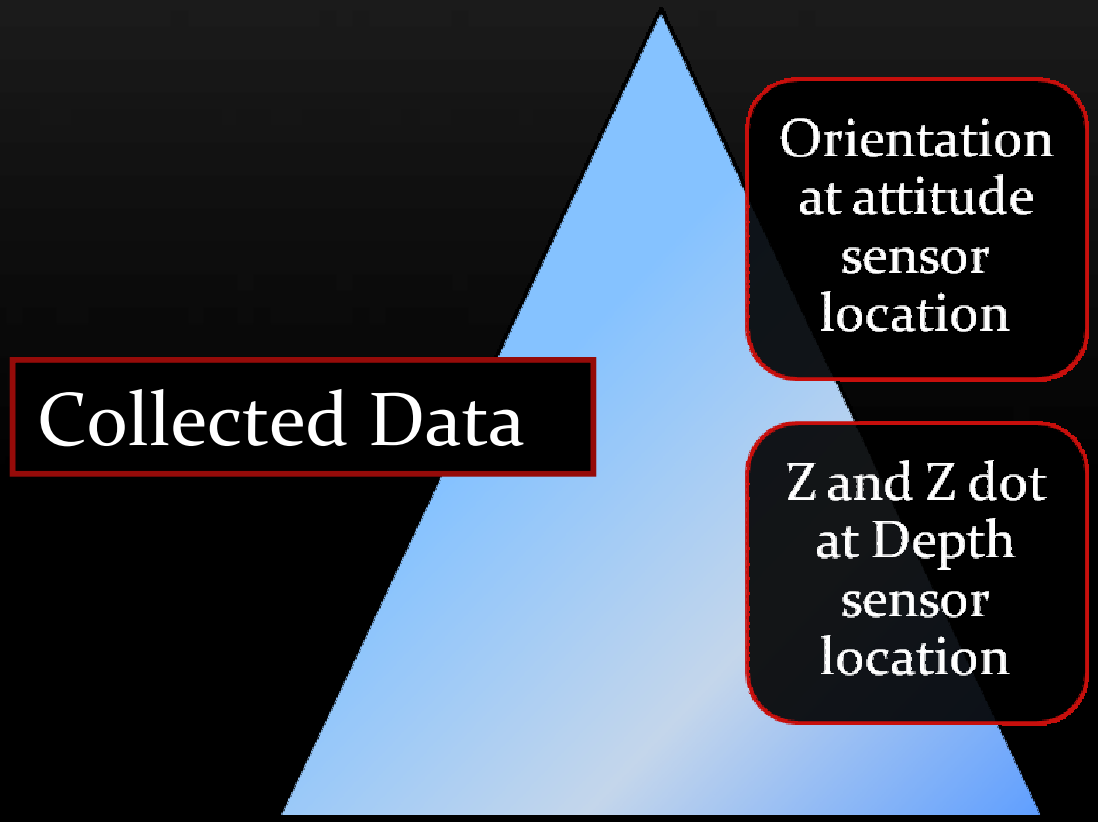


3 sonar

Factors and Responses

	Name	Levels
Factors	Distance Between Center of Buoyancy and Center of Mass	0 mm
		50 mm
		100 mm
	Angle of Attack of Wings	0 degree
		90 degree
	Number of Fins	2
		4
Responses	Ultimate Vertical Velocity	N/A
	Ultimate Rotational Velocity	N/A
	Pitch & Roll Angle	N/A
	Settling Time	N/A

Data Analysis



Orientation and Angular rate

directly obtain from attitude sensor, the orientation and angular rate is the same for whole body

Settling Time

Observing Plot of Vertical Speed vs. Time
Plot of Angular Rate vs. Time

Responses

Speed of cylinder

$$\dot{v}_c = \dot{v}_0 + \omega \times v_0 + \dot{\omega} \times r_G + \omega \times (\omega \times r_G)$$

Where v_c is the speed at C location,
ω is the angular rate at collected by attitude sensor
v_0 is the velocity of attitude sensor
$\dot{\omega}$ the sign above the letter means take the derivative in the body frame
r_G is the vector between body frame origin and c

Future Work

I. Conduct Experiment

II. Modify Operation

III. Revise Mechanical Design

Conclusion

I. Introduced basic concept AIDMP

II. Customized Logging System

III. Experiment Design